STATE MODEL SYLLABUS FOR UNDER GRADUATE COURSE IN ABILITY ENHANCEMENT COURSE (I)

(Bachelor of Arts/Sc/Com Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

ENVIRONMENTAL STUDIES

SEMESTER – I

FOR UNDER GRADUATE ARTS, SCIENCE & COMMERCE – 2019-20

FULL MARKS: 100

TIME: 3 HOURS **END SEMESTER: 80**
TIME: 1 HOUR **MID SEMESTER: 20**

Unit – I

The Environment: The Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecology, Ecosystem, Biogeochemical Cycle (Carbon Cycle, Nitrogen Cycle), Environment Pollution: Air Pollution, Water Pollution, Soil Pollution, Radiation Pollution.

Unit – II

Population Ecology: Individuals, Species, Pollution, Community, Control Methods of Population, Urbanization and its effects on Society, Communicable Diseases and its Transmission, Non-Communicable Diseases.

Unit- III

Environmental Movements in India: Grassroot Environmental movements in India, Role of women, Environmental Movements in Odisha, State Pollution Control Board, Central Pollution Control Board.

Unit –IV

Natural Resources: Conservation of Natural Resources, Management and Conservation of Wildlife, Soil Erosion and Conservation, Environmental Laws: Water Act, 1974, Air Act, 1981, The Wildlife (Protection) Act, 1972, Environment Protection, 1986, Natural Disasters and their Management.

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STATE MODEL SYLLABUS FOR UNDERGRADUATE COURSE IN BOTANY

(Bachelor of Science Examination)

UNDER
CHOICE BASED CREDIT SYSTEM

Course Structure of U.G. Botany Honours

Semester	Course	Course Name	Credit	Total marks
Semester-I	AECC-I		4	100
	C-1 (Theory)	Microbiology and Phycology	4	75
	C-1 (Practical)	Microbiology and Phycology	2	25
	C-2 (Theory)	Biomolecules and Cell Biology	4	75
	C-2 (Practical)	Biomolecules and Cell Biology	2	25
	GE -1A (Theory)	Biodiversity (Microbes, Algae, Fungi & Archegoniate)	4	75
	GE -1A(Practical)	Biodiversity (Microbes, Algae, Fungi & Archegoniate)	2	25
Semester-II	AECC-II		4	100
	C-3 (Theory)	Mycology and Phytopathology	4	75
	C-3 (Practical)	Mycology and Phytopathology	2	25
	C-4 (Theory)	Archegoniate	4	75
	C-4 (Practical)	Archegoniate	2	25
	GE -2A (Theory)	Plant Physiology & Metabolism	4	75
	GE -2A(Practical)	Plant Physiology & Metabolism	2	25
Semester-III	C-5 (Theory)	Anatomy of Angiosperms	4	75
	C-5 (Practical)	Anatomy of Angiosperms	2	25
	C-6 (Theory)	Economic Botany	4	75
	C-6 (Practical)	Economic Botany	2	25
	C-7 (Theory)	Genetics	4	75
	C-7 (Practical)	Genetics	2	25
	SEC-1		4	100
	GE -1B (Theory)	Plant Ecology & Taxonomy	4	75
	GE -1B (Practical)	Plant Ecology & Taxonomy	2	25
Semester-IV	C-8 (Theory)	Molecular Biology	4	75
	C-8 (Practical)	Molecular Biology	2	25
	C-9 (Theory)	Plant Ecology & Phytogeography	4	75
	C-9 (Practical)	Plant Ecology & Phytogeography	2	25

	C-10 (Theory)	Plant Systematics	4	75
	C-10 (Practical)	Plant Systematics	2	25
	SEC II		4	100
	GE-2B (Theory)	Plant Anatomy , Embryology & Biotechnology	4	75
	GE-2B(Practical)	Plant Anatomy , Embryology & Biotechnology	2	25
Semester-V	C-11 (Theory)	Reproductive Biology of Angiosperms	4	75
	C-11 (Practical)	Reproductive Biology of Angiosperms	2	25
	C-12 (Theory)	Plant Physiology	4	75
	C-12 (Practical)	Plant Physiology	2	25
	DSE - 1 (Theory)	Analytical Techniques in Plants Sciences	4	75
	DSE - 1 (Practical)	Analytical Techniques in Plants Sciences	2	25
	DSE - 2 (Theory)	Natural Resource Management	4	75
	DSE - 2 (Practical)	Natural Resource Management	2	25
Semester-VI	C-13 (Theory)	Plant Metabolism	4	75
	C-13 (Practical)	Plant Metabolism	2	25
	C-14 (Theory)	Plant Biotechnology	4	75
	C-14 (Practical)	Plant Biotechnology	2	25
	DSE - 3 (Theory)	Horticulture Practices & Post Harvest Technology	4	75
	DSE-3 (Practical)	Horticulture Practices & Post Harvest Technology	2	25
	DSE – 4 Project work	Project Work	6	100
		Total	**148**	**2600**

BOTANY

HONOURS PAPERS:

Core course – 14 papers
Discipline Specific Elective – 4 papers
Generic Elective for non-Botany students – 4 papers. In case University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper. The students has the option of taking any two.

Marks per paper – Mid term: 15 marks, End term: 60 marks (Theory) + 25 marks (Practical), Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 40 hours (theory) + 10 hours (practical)

Core Paper I

MICROBIOLOGY AND PHYCOLOGY

Unit-I

Introduction to microbial world, microbial nutrition, growth and metabolism. **Viruses:-** Discovery, physicochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases.

Unit–II

(i) **Bacteria: -** Discovery, general characteristics, types- archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

(ii) **Cyanobacteria:-**Ecology and occurrence, cell structure, heterocyst, reproduction, economic importance; role in biotechnology. Morphology and life-cycle of *Nostoc*. General characteristics of prochlorophyceae, Evolutionary significance of Prochloron.

Unit–III

(i) Algae:- General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella and methods of reproduction, classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Role of algae in the environment, agriculture, biotechnology and industry.

(ii) Chlorophyta:- General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of *Chlamydomonas*, *Volvox*, *Oedogonium* and *Coleochaete*.

Unit-IV

(i) Charophyta:- General characteristics; occurrence, morphology, cell structure and

life-cycle of *Chara*; evolutionary significance.

(ii) Xanthophyta:- General characteristics; Occurrence, morphology and life- cycle of *Vaucheria*.

(iii) Phaeophyta:-Characteristics, occurrence, cell structure and reproduction. Morphology and life-cycles of *Ectocarpus* and *Fucus*.

(iv)Rhodophyta:-General characteristics, occurrence, cell structure and reproduction. Morphology and life-cycle of *Polysiphonia*.

PRACTICAL

Microbiology

(i) Electron micrographs/Models of viruses –T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.

(ii) Types of Bacteria to be observed from temporary/permanent slides/photographs.

(iii) Examination of bacteria from bacterial culture by Gram's staining method.

(iv) Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule (live materials and photographs).

Phycology

Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium,Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia, Procholoron, Diatoms through, temporary preparations and permanent slides.

Text Books:

1. Singh, V., Pandey, P.C., and Jain, D.K. (2017). Microbiology and Phycology, Rastogi Publication, Meerut.

Reference Books:

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Prescott, L.M., Harley J.P., Klein D. A. (2010). Microbiology, McGraw-Hill, India. 8th edition.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
5. Pelczar, M.J., Chan, E.C.S., Krieg, N.R. (2011) Microbiology, 8th edition, Tata McGraw-Hill Co, New Delhi.
6. Willey, Sherwood and Christopher. Laboratory exercises in Microbiology. McGraw-Hill, India. 9th edition.
7. Vasistha B.R. (2017) Botany for Degree student, Algae, S. Chand Publication, New Delhi.
8. Mishra B. K. (2018) Microbiology and Phycology, Kalyani Publishers, New Delhi.

Core Paper II

BIOMOLECULES AND CELL BIOLOGY

Unit-I

(i) Biomolecules and Bioenergenetics: Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions.

(ii) Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, properties of enzymes, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

(iii) Carbohydrates: Nomenclature, classification, structure and function of Monosaccharides, Disaccharides, Oligosaccharides and polysaccharides

Unit –II

(i) Lipids: Definition and major classes of storage and structural lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties.

(ii) Proteins: Structure and classification of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quarternary; Isoelectric point; Protein denaturation and biological roles of proteins.

(iii) Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit –III

(i) The Cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

(ii) Cell wall and plasma membrane: Chemistry, structure and function of Plant Cell Wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

(i) Cell organelles: Nucleus; Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

Unit-IV

(i) Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.

(ii) Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Endoplasmic Reticulum, Golgi Apparatus, Lysosomes.

(iii) Cell division: Eukaryotic cell cycle, different stages of mitosis and meiosis. Cell cycle, Regulation of cell cycle.

PRACTICAL

(i) Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids

and proteins.

(ii) Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*

(iii) Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.

(iv) Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).

(v) Study the phenomenon of plasmolysis and deplasmolysis.

(vi) Study of different stages of mitosis and meiosis using aceto carmine and aceto orcine method from Onion root tip and bud respectively.

Text Books:

1. Rastogi, V. B. (2016). Introductory Cytology, Kedar Nath & Ram Nath, Meerut
2. Gupta, P. K. (2017). Biomolecules and Cell Biology, Rastogi Publication, Meerut.

Reference Books:

1. Sahoo, K. (2017) Biomolecules and Cell Biology, Kalyani Publishers, New Delhi.
2. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012) Biochemistry: A short course, 2nd ed., W.H. Freeman
3. Nelson, D.L. and Cox, M.M. (2008) Lehninger Principles of Biochemistry, 5th Edition, W.H. Freeman and Company.
4. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

Core Paper III

MYCOLOGY AND PHYTOPATHOLOGY

Unit-I

(i) Introduction to true fungi: Definition, General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

(ii) Zygomycota: General characteristics; Ecology; Thallus organisation; Life cycle with reference to *Rhizopus*.

(iii) Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to *Saccharomyces, Aspergillus*, *Penicillium,* and *Neurospora.*

(iv) Basidiomycota: General characteristics; Ecology and Classification; Life cycle of *Puccinia* and *Agaricus*.

Unit-II

(i) Allied Fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

(ii) Oomycota: General characteristic; Ecology; Life cycle and classification with reference to *Phytophthora,* and *Albugo.*

(iii) Symbiotic associations: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction. Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance. Economic importance of Lichens.

Unit-III

Applied Mycology: Role of fungi in biotechnology, Mushroom cultivation, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit-IV

Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; etiology; symptomology; Host- Pathogen relationships; disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot disease of Cotton. Viral diseases – Tobacco Mosaic, Vein Clearing. Fungal diseases – Early blight of potato, Loose and covered smut.

PRACTICAL

(i) Introduction to the world of fungi (Unicellular, coenocytic/ septate mycelium, ascocarps & basidiocarps).

(ii) *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.

(iii) *Aspergillus, Penicillium* and *Saccharomyces* : study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.

(iv) *Puccnia :* Study of different stages from temporary mounts and permanent slides.

(v) *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, and fairy rings are to be shown.

(vi) *Albugo:* Study of symptoms of plants infected with *Albugo*; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.

(vii) *Phytopathology*: Herbarium specimens of bacterial diseases; Citrus Canker; Viral diseases: Mosaic disease of ladies finger, papaya, cucurbits, moong, black gram, Fungal diseases: Blast of rice, Tikka disease of ground nut, powdery mildew of locally available plants and White rust of crucifers.

Text Books:

1. Mishra, B. K. (2017), Mycology and Phytopathology, Kalynai Publishers, New Delhi.

Reference Books:

1. Sharma, P. D. (2017). Mycology and Phytopathology Rastogi Publication, Meerut.
2. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
3. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley &Sons (Asia) Singapore. 4th edition.
4. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
5. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
6. Mehrotra, R. S.(2011). Plant Pathology. Tata Mc Graw-Hill Publishing Company Limited, New Delhi

Core Paper IV

ARCHEGONIATAE

Unit-I

(i) Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations. General characteristics; Origin of land plants and Adaptations to land habit;

(ii) Bryophytes : Origin and Classification; Range of thallus organization. Classification (up to family). Structure, Reproduction and evolutionary trends in *Riccia*, *Marchantia*, *Anthoceros* and *Funaria* (developmental stages not included). Ecological and economic importance of bryophytes.

Unit-II

Pteridophytes: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Psilotum*, *Selaginella*, *Equisetum, Pteris* and *Marsilea*. Apogamy, and apospory, heterospory and seed habit, telome theory, stellar evolution and economic importance.

Unit-III

Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus, Ginkgo* and *Gnetum*. (Developmental details not to be included).Ecological and economic importance.

Unit-IV

Palaeobotany: Geological time scale, fossils and fossilization process. Morphology, anatomy and affinities of Rhynia, Calamites, Lepidodendron, Lyginopteris, Cycadeoidea and Williamsonnia.

PRACTICAL

(i) Morphology, anatomy and reproductive structures of *Riccia, Marchantia*, *Anthoceros, Funaria*.

(ii) *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).

(iii) *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).

(iv) *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).

(v) Study of temporary preparations and permanent slides of *Marsilea*.

(vi) *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).

(vii) *Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll and megaspore, T.S root, leaflet, rachis

(viii) *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), T.S. Needle, stem, L.S. male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), L.S.of female cone.

(ix) *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide).

(x) Study of some fossil slides / photographs as per theory.

Text Books:

1. Vasistha, B. R. (2017) Botany for Degree student, Bryophyta, S. Chand Publication, New Delhi.
2. Singh, V., Pandey, P.C. and Jain, D.K. (2017). Archegoniate, Rastogi Publication, Meerut.

Reference Books:

1. Acharya, B. S. (2017), Archegoniate, Kalyani Publishers, New Delhi.
2. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. New Delhi, India.
3. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.

Core Paper V

ANATOMY OF ANGIOSPERMS

Unit-I

(i) Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy.

(ii) Tissues: Classification of tissues; Simple and complex tissues (no phylogeny); cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Cell wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances.

Unit-II

(i) Stem: Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Types of vascular bundles; Anatomy of dicot and monocot stem. Vascular Cambium: Structure, function and seasonal activity of cambium; secondary growth in stem (normal and anomalous). Root Stem transition.

(ii) Leaf: Anatomy of dicot and monocot leaf, Kranz anatomy.

Unit-III

(i) Root: Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Anatomy of dicot and monocot root; Endodermis, exodermis and origin of lateral root. Secondary growth in roots.

(ii) Wood: Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology.

(iii) Periderm: Development and composition of periderm, rhytidome and lenticels.

Unit –IV

(i) Adaptive and Protective Systems Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and nonglandular: two examples of each), stomata (classification); Anatomical adaptations of xerophytes and hydrophytes.

(ii) Secretory System: Hydathodes, cavities, lithocysts and laticifers.

(iii) Mechanical tissue system.

PRACTICAL

1. Study of distribution and types of parenchyma, collenchyma and sclerenchyma, Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres, Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
2. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
3. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
4. Root: monocot, dicot, secondary growth.
5. Stem: monocot, dicot - primary and secondary growth (normal and anomalous); periderm; lenticels.

6. Leaf: isobilateral, dorsiventral, C_4 leaves (Kranz anatomy).
7. Ecological anatomy.

Text Books:

1. Singh, V., Pandey, P.C. and Jain, D.K. (2017). Anatomy of Angiosperms, Rastogi Publication, Meerut.

Reference Books:

1. Eames, A.J. and Mc Daniels, L.H., (1953). An introduction to plant anatomy, Tata Mc Grow Hills, New Delhi
2. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi.
3. Tayal, M. S. (2012) Plant Anatomy Rajpal and Sons, New Delhi
4. Mishra, B. K. (2017). Anatomy of Angiosperms, Kalyani Publishers, New Delhi.
5. Pandey, B. P. (2017) Plant Anatomy, S. Chand Publication, New Delhi.

Core Paper VI

ECONOMIC BOTANY

Unit-I

(i) Origin of Cultivated Plants: Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

(ii) Cereals: Cultivation and brief account of Wheat, Rice and millets.

(iii) Legumes: General account, importance to man and ecosystem.

(iv) Sugars & Starches: Morphology, cultivation and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, cultivation, propagation & uses.

Unit-II

(i) Spices: Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper Beverages: Tea, Coffee (morphology, processing & uses)

(ii) Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis.

(iii) Tobacco: Tobacco (Morphology, processing, uses and health hazards)

Unit-III

(i) Oils & Fats: General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and *Brassica* (Botanical name, family & uses)

(ii) Essential Oils: General account, extraction methods, comparison with fatty oils &

their uses.

Unit-IV

(i) Natural Rubber: Para-rubber: tapping, processing and uses.

(ii) Timber plants: General account with special reference to teak and pine. Fibers: Classification based on the origin of fibers, Cotton and Jute (morphology, extraction and uses).

PRACTICAL

(i) Cereals: Rice (habit sketch, study of paddy and grain, starch grains).

(ii) Legumes: Soya bean/moong bean/black gram, Groundnut, (habit, fruit, seed structure, micro-chemical tests).

(iii) Sugars & Starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, starch grains, micro-chemical tests).

(iv) Spice and Beverages: clove, black pepper ,Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).

(v) Oils & Fats: Groundnut, Mustard–plant specimen, seeds; tests for fats in crushedseeds.

(vi) Drug-yielding plants: Specimens of *Digitalis, Papaver* and *Cannabis.*

(vii) Woods: *Tectona*, *Pinus/*Sal: Specimen, Section of young stem.

(viii) Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

Text Books:

1. B. P. Pandey, (2017) Economic Botany. S. Chand Publication, New Delhi.

Reference Books:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Samba Murty, A.V.S.S. and Subrahmanyam, N.S. (2011). Text Book of Modern Economic Botany, CBS Publishers and Distributors, New Delhi.
3. Hill, Albert F. Economic Botany, Tata Mc Grow Hill Publishing Company, Ltd. New Delhi.
4. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
5. Singh, V., Pandey, P.C. and Jain, D.K. (2017). Economic Botany, Rastogi Publication, Meerut.
6. Baruah, B. (2017). Economic Botany, Kalyani Publishers, New Delhi.

Core Paper VII

GENETICS

Unit-I

(i) Mendelian genetics and its extension Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Interaction of genes, Pleiotropy, Recessive and Dominant traits, Polygenic inheritance.

(ii) Extrachromosomal Inheritance: Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; cytoplasmic male sterility; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium.

Unit-II

Linkage, crossing over and chromosome mapping: Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.

Unit-III

(i) Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

(ii) Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms.

Unit-IV

(i) Fine structure of gene: Classical vs. molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.

(ii) Population and Evolutionary Genetics: Gene pool, Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

PRACTICAL

1. Analysis of allelic and genotypic frequencies.
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
3. Chromosome mapping using test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Blood Typing: ABO groups & Rh factor.

7. Chromosome anomaly : Translocation Ring, Laggards and Inversion Bridge, break etc (through photographs).

Text Books:

1. Singh B. D. (2017). Fundamental of Genetics, Kalyani Publishers, New Delhi.

2. Gupta P. K. (2017). Genetics, Rastogi Publication, Meerut.

Reference Books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & Sons, India. 8th edition.
2. Sinnot, E.W., Dunn, L.C. and Dobzhansky, T. (1985) Principles of Genetics, Tata Mc Grow Hill, New Delhi
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W.H. Freeman and Co., U.S.A. 10th edition.
5. Strickberger, M.W. Genetics, Pearson Publishers, 3rd Edition
6. Rastogi V. B. (2017). Genetics, Kedar Nath & Ram Nath, Meerut

Core Paper VIII

MOLECULAR BIOLOGY

Unit-I

Nucleic acids: Carriers of genetic information: Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty), Types of genetic material, denaturation and renaturation, cot curves. Organization of DNA and structure of RNA- Prokaryotes, Viruses, Eukaryotes, Fraenkel-Conrat's experiment. Organelle DNA - mitochondria and chloroplast DNA. The Nucleosome -Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Unit-II

(i) The replication of DNA: Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5′ end of linear chromosome; Enzymes involved in DNA replication.

(ii) Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)

(iii) Processing and modification of RNA: Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I & group II intron splicing, alternative splicing eukaryotic mRNA processing (5′ cap, 3′

polyA tail); Ribozymes, exon shuffling; RNA editing and mRNA transport.

Unit-III

Mechanism of Transcription: Transcription in prokaryotes and eukaryotes;
Regulation of transcription in prokaryotes and eukaryotes: Principles of transcriptional regulation; Prokaryotes: Operon concept- Regulation of lactose metabolism and tryptophan synthesis in *E.coli.* Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing

Unit-IV

Translation (Prokaryotes and eukaryotes): Ribosome structure and assembly; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

PRACTICAL

1. Preparation of LB medium and raising E. coli.
2. Isolation of genomic DNA from suitable plant material.
3. RNA estimation by orcinol method.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
6. Study of Barr body from buccal smear preparation.

Text Books:

1. Gupta P. K. (2017). Molecular Biology, Rastogi Publication, Meerut.

Reference Books:

1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4. Sheeler, P. and Bianchi, D.E. (2009) Molecular Biology of the Cell, Willey Publisher, New Delhi
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W.H. Freeman and Co., U.S.A. 10th edition.
6. Alberts, B. et al. 2014. Molecular Biology of the cell Garland Science. 6th Edition
7. Power, C. B. (2017) Cell Biology, Himalaya Publishing House, New Delhi

8. Sahu, A.C. (2017). Essentials of Molecular Biology, Kalynai Publishers, New Delhi.

Core Paper IX

PLANT ECOLOGY & PHYTOGEOGRAPHY

Unit-I

(i) Introduction Concept of ecology, Autoecology, Synecology, system ecology, Levels of organization. Inter-relationships between the living world and the environment, the components of environment, concept of hydrosphere and lithosphere and dynamism, homeostasis.

(ii) Light, temperature, wind and fire: Variations; adaptations of plants to their variation.

Unit-II

(i) Soil: Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.

(ii) Water: Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Unit-III

Biotic interactions and Population ecology: Characteristics and Dynamics.

Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit-IV

(i) Ecosystems: Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.

(ii) Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

(iii) Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Phytogeographical division of India; Vegetation of Odisha.

PRACTICAL

1. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)
2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
3. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
4. Study of morphological adaptations of hydrophytes, xerophytes, halophyles (two

each).

5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
6. Quantitative analysis of herbaceous vegetation for frequency, density and abundance in the college campus.
7. Field visit to familiarize students with ecology of different sites.

Text Books:

1. Sharma, P.D. (2017). Fundamentals of Ecology. Rastogi Publications, Meerut, India.

Reference Books:

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
4. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
5. Santra, S. C. (2015) Environmental Science. New Central Book Agency (P) Ltd. Kolkata.
6. Das M. C. and Das S. P. (2009). Fundamental of Ecology. Tata MGrow Hill, New Delhi.
7. Shukla R.S. and Chandel P.S. (2016). A Text Book of Plant Ecology. S Chand Publication, New Delhi

Core Paper X

PLANT SYSTEMATICS

Unit-I

Plant identification, Classification, Nomenclature; Biosystematics. Identification: Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access

Unit-II

Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).

Botanical nomenclature: Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit-III

(i) Systematics- an interdisciplinary science: Evidence from palynology, cytology, phytochemistry and molecular data.

(ii) Systems of classification: Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (up to series) and Hutchinson (up to series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

Unit-IV

Phylogeny of Angiosperms: Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin& evolution of angiosperms; co- evolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

Families of Angiosperms : Descriptive studies of Magnoliaceae, Rosaceae, Rubiacae, Poaceae, Orchidaceae, Musaceae, Acanthaceae, Apocynaceae, Asclepiadaceae, Lamiaceae.

PRACTICAL

(i) Study of vegetative and floral characters of available materials of the families included in theory syllabus (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification).

(ii) Field visit, plant collection and herbarium preparation and submission. Mounting of properly dried and pressed specimen of at least fifteen wild plants with herbarium label (to be submitted in the record book)

Text Books:

1. Sharma O. P. (2009) Plant Taxonomy, Tata Mc Grow Hill, New Delhi

Reference Books:

1. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi.3rdedition.
2. Jeffrey, C. (1982). An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Saxena, H. O. and Brahman, M..The Flora of Orissa, CSIR Publication.
5. Bose T. K. (2009). Trees of the World, Regional Plant Resource Centre, Bhubaneswar, Odisha, India
6. Radford, A.E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York.
7. Hanes, H. H. (2009). Botany of Bihar and Orissa,

8. Mohanty, C. R. (2017). Text Book of Plant Systematics, Kalynai Publisher, New Delhi.
9. Subrahmainayam, M. S. (2011) Modern Plant Taxonomy, Vikash Publishing House, New Delhi
10. Pandey, B. P., (2017). Taxonomy of Angiosperm. S. Chand Publication.

Core Paper XI

REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Unit-I

(i) Introduction: History and scope.

(ii) Anther: Anther wall: Structure and functions, micro-sporogenesis, callose deposition and its significance.

(iii) Pollen biology: Micro-gametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.

Unit-II

Ovule: Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– mega-sporogenesis and mega-gametogenesis; Types and ultrastructure of different mature embryo sacs (Details of *Polygonum* type), Developmental pattern of mono-, bi- and tetrasporic embryo sacs.

Unit-III

(i) Pollination and fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.

(ii) Self incompatibility: Basic concepts; Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intraovarian and *in vitro* pollination; Modification of stigma surface.

Unit-IV

(i) Endosperm: development, structure and functions

(ii) Embryo: Types of embryogeny; General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; Embryo- endosperm relationship; Nutrition of embryo; Embryo development in *Paeonia*.

(iii) Seed: Structure, importance and dispersal mechanisms

(iv) Polyembryony and apomixes: Introduction; Classification; Causes and applications.

PRACTICAL

(i) Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic

representation.

(ii) Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall (micrograph); Pollen viability: Tetrazolium test, Germination: Calculation of percentage germination in different media using hanging drop method.

(iii) Ovule: Types-anatropous, orthotropous, amphitropous/ campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs). Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.

(iv) Embryogenesis: Study of development of dicot embryo through permanent slides/photographs; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

(v) Tracing the path of pollen tube.

(vi) Study of haustorial endosperm.

Text Books:

1. Singh, V., Pandey, P.C, and Jain, D.K. (2017). Reproductive Biology of Angiosperms, Rastogi Publications, Meerut

Reference Books:

1. Maheswari, P. (2009). Embryology of Angiosperms.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
4. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.
5. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
6. Mishra, B. K. (2017). Reproductive Biology of Angiosperms, Kalyani Publishers, New Delhi.

Core Paper XII

PLANT PHYSIOLOGY

Unit-I

(i) Plant water relationship: Water Potential and its components, plasmolysis and imbibitions, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, trans-membrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, anti-transpirants, mechanism of stomatal movement.

(ii) Translocation in the phloem: Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.

Unit-II

(i) Mineral nutrition: Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.

(ii) Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, and antiport.

Unit-III

Plant growth regulators: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene. Brassinosteroids and Jasmonic acid.

Unit-IV

(i) Physiology of flowering: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy. Senescence: Types and causes.

(ii) Phytochrome: Discovery, chemical nature, role of phytochrome in photo-morphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).
6. To study the phenomenon of seed germination (effect of light).
7. To study the induction of amylase activity in germinating barley grains
8. To demonstrate suction due to transpiration.
9. Measurement of relation between transpiration and transpiring surface.
10. Measurement of cuticular resistance to transpiration.

Text Books:

1. Sinha, R. K. (2015). Modern Plant Physiology, Narosa Publishing House, New

Delhi.

Reference Books:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Salisbury, F. B. and Ross, C. W. Plant Physiology Wadsworth Publishing Company, California
5. Sahoo, A. C. (2018). Outlines of Plant Physiology Kalynai Publishers, New Delhi.
6. Srivastava, N. K.. (2017). Plant Physiology, Rastogi Publications, Meerut.
7. Pandey and Sinha (2011). Plant Physiology, Vikash Publishing House, New Delhi

Core Paper XIII

PLANT METABOLISM

Unit-I

(i) Concept of metabolism: Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes).

(ii) Mechanisms of signal transduction: Calcium, phospholipids, cGMP, NO.

Unit-II

Carbon assimilation: Historical background, photosynthetic pigments, role of photosynthetic pigments, Red drop and Emerson Enhancement Effect, antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, C_3, C_4 pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction. Photorespiration.

Unit-III

(i) Carbon Oxidation: Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.

(ii) ATP-Synthesis: Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photo- phosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.

Unit-IV

(i) Lipid metabolism: Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluco-neogenesis and its role in mobilisation of lipids during seed germination, α oxidation.

(ii) Nitrogen metabolism: Nitrate assimilation, free living and symbiotic biological nitrogen fixation (examples of legumes and non-legumes); Nitrification, Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and trans-amination.

PRACTICAL

1. Isolation and quantitization of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. Demonstration of absorption spectrum of photosynthetic pigments.
7. Assay of the enzyme Catalase.
8. Photoreduction of dye by isolated chloroplasts.

Text Books:

1. Gupta, S, K. (2017). Plant Metabolism, Rastogi Publication, Meerut.

Reference Books:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
4. Sahoo, A. C. (2018). Outlines of Plant Metabolism, Kalynai Publishers, New Delhi.

Core Paper XIV

PLANT BIOTECHNOLOGY

Unit-I

Plant Tissue Culture: Historical perspective; Aseptic tissue culture techniques, Composition of media; Nutrient and hormone requirements (role of vitamins and hormones). Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids;Cryopreservation; Germplasm Conservation).

Unit-II

Recombinant DNA technology-I: Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC, MAC, HAC).Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning).

Unit-III

Recombinant DNA technology-II: Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, Methods of gene transfer- *Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit-IV

Applications of Biotechnology: Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

PRACTICAL

1. a) Preparation of tissue culture (MS) medium.
   (b) Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.
2. Study of another culture through photographs.
3. Preparation of artificial seeds.
4. Study of Bt cotton through photographs.
5. Isolation of plasmid DNA.
6. Gel electrophoresis (demonstration).

Text Books:

1. Chawla, H. S. (2010). Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Reference Books:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

3. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
4. Singh, B. D. (2018). Plant Biotechnology Kalynai Publishers, New Delhi.
5. Gupta, P. K. (2017). Plant Biotechnology, Rastogi Publication, Meerut.
6. Dubey, R. C. (2017). Advanced Biotechnology, S, Chand Publication, New Delhi

Discipline Specific Elective Paper-I

ANALYTICAL TECNIQUES IN PLANT SCIENCES

Unit-I

Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Flow cytometry (FACS); Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit-II

Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, $CsCl_2$gradient, analytical centrifugation, ultracentrifugation. Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment. Spectrophotometry: Principle and its application in biological research.

Unit-III

Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography. Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit-IV

Biostatistics: Statistics, data, population, samples, variables, parameters; Representation of Data: Tabular, Graphical; Measures of frequency and central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variance, standard deviation; Chi-square test for goodness of fit. Test of significance: comparison of large, small and paired samples (T-Test) and correlation.

PRACTICAL

1. Study of different microscopic techniques for chromosome study
2. Study of PCR Demonstration.
3. To separate pigments by paper chromatography.
4. To separate phytochemicals by thin layer chromatography.
5. To estimate protein through Lowry's methods.
6. To separate proteins using PAGE.

7. To separate DNA (marker) using AGE.
8. Spectrometric estimation of total sugar by Anthrone method.
9. Chi-square analysis of mendelian ratio.
10. T-Test.

Text Books:

1. Patil, C. S. (2017). Advanced Analytical Techniques, ABE Books, New Delhi.

Reference Books:

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Micro technique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.
5. Aneja, K. R. (2014). Laboratory manual of microbiology and biotechnology, Medtech, New Delhi

Discipline Specific Elective Paper-II

NATURAL RESOURCE MANAGEMENT

Unit-I

(i) Natural resources: Definition and types.
(ii) Sustainable utilization :Concept, approaches (economic, ecological and socio-cultural).
(iii) Land: Utilization (agricultural, horticultural, silvicultural); Soil degradation and management.
(iv) Water: Fresh water (rivers, lakes, groundwater, water harvesting technology, rain water storage and utilization.

Unit-II

Biological Resources: Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting; IPR; CBD; National Biodiversity Action Plan).

Forests: Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management.

Unit-III

(i) Energy: Renewable and non-renewable sources of energy-solar, wind, tidal, geothermal and bioenergy resources.
(ii) Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint.

Unit-IV

Resource Accounting; Waste management. National and international efforts in resource management and conservation

PRACTICAL

i. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation.
ii. Collections of data on forest cover of specific area.
iii. Measurement of dominance of woody species by DBH (diameter at breast height) method.
iv. Calculation and analysis of ecological footprint.
v. Ecological modeling.
vi. Estimation of soil moisture content and soil texture.
vii. Estimation of soil porosity
viii. Estimation of soil water-holding capacity.
ix. Estimation of soil organic matter and soil carbon

Text Books:

1. Pandey, B. W. 2005. Natural Resource Management. Mittal Publication, New Delhi

Reference Books:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Discipline Specific Elective Paper-III

HORTICULTURAL PRACTICES AND POST-HARVEST TECHNOLOGY

Unit-I

(i) Introduction: Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism.

(ii) Ornamental plants: Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants [rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (*Opuntia*, *Agave* and spurges)]

Unit-II

(i) Fruit and vegetable crops: Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops.

(ii) Horticultural techniques: Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations.

(iii) Landscaping and garden design :Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.

Unit-III

(i) Post-harvest technology: Importance of post harvest technology in horticultural crops; Evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing loses during storage and transportation;

(ii) Disease control and management : Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices;

Unit-IV

Horticultural crops - conservation and management: Documentation and conservation of germplasm; Role of micropropagation and tissue culture techniques; Varieties and cultivars of various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture.

PRACTICAL

i. Identification and description of salient features of ornamental plants included in the syllabus.
ii. Horticultural techniques (Drip irrigation, surface irrigation, furrow and border irrigation).
iii. Study of practice of asexual propagation methods (grafting, cutting, layering, budding)
iv. Planning and layout of parks and avenues
v. Handing of harvested fruits, vegetables and cut flowers
vi. Methods of fruit preservation
vii. Basic tissue cultures technique

Text Books:

1. Peter, K. V. (2009). Basics of Horticulture, Kalyani Publishers, New Delhi.

Reference Books:

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas

of Major Flowering Trees in India. Macmillan Publishers, India.
3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4. Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.
6. Pandey, P. H. (2007). Principles and Practices of Post Harvest Technology, Kalyani Publishers, New Delhi.

Discipline Specific Elective Paper-IV

INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

Unit-I

(i) Scope of microbes in industry and environment: Bioreactors/Fermenters and fermentation processes: Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations. Components of a typical bioreactor, Types of bioreactors- laboratory.

(ii) Microbial production of industrial products: Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying.

Unit-II

Microbial enzymes of industrial interest and enzyme immobilization: Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).

Unit-III

Microbes and quality of environment: Distribution of microbes in air; Isolation of microorganisms from soil, air and water.

Microbial flora of water: Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality.

Unit-IV

Microbes in agriculture and remediation of contaminated soils: Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots.

PRACTICAL

1.Principles and functioning of instruments in microbiology laboratory
2.Hands on sterilization techniques and preparation of culture media
3. Screening microorganisms for industrial use.
4. Mycorrhiza, arbuscular mycorrhizal colonization in plant roots
5. Determination of BOD, COD, TDS and TOC of water samples;
6. Microorganisms as indicators of water quality

Text Books:

1. P. D. Sharma. (2017) Environmental Microbiology. Rastogi Publications, Meerut.

Suggested Readings

1. Pelzar, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.
3. Pradipta K. Mohapatra (2008). Text Book of Environmental Microbiology, I. K. International Publishing House, New Delhi
4. A. K. Rath (2018). Industrial and Environmental Microbiology, Kalyani Publishers, New Delhi.

OR

Discipline Specific Elective Paper-IV

DISSERTATION / PROJECT WORK

Identification of problem	Review of Literature	Methodology	Findings	Analysis	Viva-Voce	Total
10	10	10	25	25	20	100

** = Students who score more than ≥60% in aggregate are eligible for project work

Generic Elective Paper I A

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATES)

Unit-I

Microbes :Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic **cycle**, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit-II

(i) Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Morphology and life- cycles of the following: *Chlamydomonas, Oedogonium*, *Nostoc and Fucus, Vaucheria, Polysiphonia,* Economic importance of algae.

(ii) Fungi : Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Puccnia, Agaricus* Basidiomycota); Symbiotic Associations-Lichens:

Unit-III

(i) **Bryophytes:** General characteristics, adaptations to land habit, Classification, Range of thallus organization, Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria* (Developmental details not to be included).

(ii) **Pteridophytes:** General characteristics, classification, early land plants (*Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris* (Developmental details not to be included).Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.

Unit-IV

Gymnosperms: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum*. (Developmental details not to be included).Ecological and economical importance.

PRACTICAL

1. Gram staining
2. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus* and *Polysiphonia* through temporary preparations and permanent slides.
3. *Rhizopus and Penicillium*: Asexual stage from temporary ounts and sexual structures through permanent slides.
4. *Puccinia* and *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.

5. *Marchantia and Funaria*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
6. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
7. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
8. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
9. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Text Books:

1. Mitra, J.N., Mitra, D. and Choudhury, S.K. Studies in Botany Volume 1. Moulik Publisher, Kolkata. Ninth Revised Edition

Reference Books:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi.2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, Mac Millan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
9. Pandey, B. P. (2017), Botany for degree studies (as per CBCS). S. Chand
10. Acharya, B. S. and Mishra, B. K. (2018). Plant Biodiversity, Kalyani Publishers, New Delhi.

Generic Elective Paper IIA

PLANT PHYSIOLOGY AND METABOLISM

Unit-I

(i) Plant-water relations: Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

(ii) Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

(iii) Translocation in phloem.: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

Unit-II

(i) Photosynthesis: Photosynthetic Pigments (*Chl* a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C_3, C_4 and CAM pathways of carbon fixation.

(ii) Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative Phosphorylation.

Unit-III

(i) Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

(ii) Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit-IV

(i) Plant growth regulators: Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

(ii) Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on hotomorphogenesis; Vernalization.

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.

Text Books:

1. A. C. Sahu (2018). Plant Physiology and Metabolism. Kalyani Publishers, New Delhi.

Reference Books:

1. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. H. S. Srivatava. Plant Physiology, Rastogi Publications, New Delhi

Generic Elective Paper IB
PLANT ECOLOGY AND TAXONOMY

Unit-I

(i) Ecological factors: Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes

(ii) Plant communities : Characters; Ecotone and edge effect; Succession; Processes and types

Unit-II

(i) Ecosystem : Structure; Biotic and abiotic components, energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

(ii) Phytogeography: Principal biogeographical zones, Endemism.

Unit-III

(i) Introduction to plant taxonomy: Identification, Classification, Nomenclature.

(ii) Identification : Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit-IV

(i) Taxonomic hierarchy: Ranks, categories and taxonomic groups

(ii) Botanical nomenclature: Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

(iii) Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Hutchinson (upto series).

(iv) Taxonomic description of the families : Malvaceae, Fabaceae, Asteraceae and Poaceae, Apocynaceae, Lamiaceae and Musaceae.

PRACTICAL

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta)*, Root parasite
5. (*Orobanche*), Epiphytes, Predation (Insectivorous plants)
6. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
7. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law .
8. Study of vegetative and floral characters of the families as in theory syllabus (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification).
9. Mounting of properly dried and pressed specimen of any ten wild plant's with herbarium label (to be submitted in the record book).

Text Books:

1. Sharma, P.D. (2017). Fundamentals of Ecology. Rastogi Publications, Meerut, India.

Reference Books:

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
5. Sahu, A. C. (2017). Plant Ecology and Phytogeography, Kalyani Publishers, New Delhi.
6. Das, M. C. and Das, S. P. (2009). Fundamental of Ecology. Tata MGrow Hill, New Delhi.
7. Shukla, R.S. and Chandel, P.S. (2016). A text book of Plant Ecology. S Chand Publication, New Delhi
8. Mohanty, C. R. (2017). Text Book of Plant Systematics, Kalynai Publisher, New Delhi.

Generic Elective Paper IIB

PLANT ANATOMY AND EMBRYOLOGY

Unit-I

(i) Meristematic and permanent tissues : Root and shoot apical meristems; Simple and complex tissues

(ii) Organs :Anatomy of dicot and monocot root stem and leaf.

Unit-II

(i) Secondary Growth: Vascular cambium – structure and function, seasonal activity. Secondary growth in and stem, Wood (heartwood and sapwood)

(ii) Adaptive and protective systems: Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit-III

(i) Structural organization of flower: Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

(ii) Pollination and fertilization : Pollination mechanisms and adaptations; Double fertilization;

Unit-IV

(i) Endosperm: Endosperm types, structure and functions.

(ii) Embryo: Dicot and monocot embryo; Structure and development, Embryo endosperm relationship.

(iii) Seed-structure and development, appendages and dispersal mechanisms.

PRACTICAL

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous**.**

Text Books:

1. Singh, Pandey and Jain (2017). Anatomy of Angiosperms, Rastogi Publication, Meerut.

Reference Books:

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
3. C. R. Mohanty (2018). Plant Anatomy and Embryology. Kalyani Publishers, New Delhi.

BOTANY Papers for PASS students

Discipline Specific Core – 4 papers
Discipline Specific Elective – 2 papers
Marks per paper – Mid term: 15 marks, End term: 60 marks, Practical: 25 marks,
Total – 100 marks

Credit per paper – 6
Teaching hours per paper – 40 hours (theory) + 20 hours (practical)

Semester	Course Opted	Course Name	Credit	Marks
Semester-I	DSC-1(Theory),	Paper-I, Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4	75
	DSC-1 (Practical)	Paper –I, Biodiversity (Microbes, Algae, Fungi and Archegoniate)	2	25
Semester -II	DSC-2(Theory),	Paper-II, Plant Ecology and Taxonomy	4	75
	DSC-2 (Practical),	Paper-II, Plant Ecology and Taxonomy	2	25
Semester-III	DSC-3(Theory),	Paper-III, Plant Anatomy and Embryology	4	75
	DSC-3 (Practical),	Paper-III, Plant Anatomy and Embryology	2	25
Semester-IV	DSC-4(Theory),	Paper-IV, Plant Physiology and Metabolism	4	75
	DSC-4 (Practical)	Paper-IV, Plant Physiology and Metabolism	2	25
Semester-V	DSE-1(Theory),	Botany Paper-I – Economic Botany and Biotechnology	4	75
	DSE-1 (Practical),	Botany paper-I – Economic Botany and Biotechnology	2	25
Semester-VI	DSE-2(Theory),	Botany paper-II – Cell and Molecular Biology	4	75
	DSE-2 (Practical),	Botany paper-II – Cell and Molecular Biology	2	25
		Total:	36	600

Discipline Specific Core Paper I
Biodiversity (Microbes, Algae, Fungi and Archegoniate)

THEORY

Unit 1: Microbes:
Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination, Economic importance. **Algae:** General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas, Oedogonium*, *Fucus*. Economic importance of algae.

Unit 2: Fungi
General characteristics of fungi, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium, Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota); Symbiotic Associations- Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 3: Archegoniate and Bryophyte
Unifying features of archegoniates, Transition to land habit, Alternation of generations.
General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 5: Pteridophytes & Gymnosperms
General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.
General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

PRACTICAL

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium, Gram staining
3. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs)*, Oedogonium, Fucus** (* *Fucus* - Specimen and permanent slides)
4. ***Penicillium***: Asexual stage from temporary mounts and sexual structures through permanent slides.

5. ***Puccinia***: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
6. ***Agaricus***: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
7. **Mycorrhiza**: ecto mycorrhiza and endo mycorrhiza (Photographs)
8. ***Marchantia*** & ***Funaria***- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. of reproductive organ l.s. sporophyte .
9. ***Selaginella & Equisetum***- morphology, w.m. leaf with ligule, t.s. stem, ts/l.s of reproductive organ
10. ***Cycas & Pinus*** - morphology (roots, bulbil, leaf), t.s. root, v.s. leaflet, whole mount or v.s. of reproductive organs

Text Books

1. Singh, Pandey and Jain (2017). Microbiology and Phycology, Rastogi Publication, Meerut.
2. B. K. Mishra (2017), Mycology and Phytopathology, Kalynai Publishers, New Delhi.
3. Singh, Pandey and Jain (2017). Archegoniate, Rastogi Publication, Meerut.

Suggested Readings

a. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
b. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
c. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
d. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
e. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
f. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
g. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
h. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Discipline Specific Core Paper II
Plant Ecology and Taxonomy
THEORY

Unit 1: Ecological factors

Introduction to plant ecology and taxonomy. Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 2: Plant communities and Ecosystems

Characters; Ecotone and edge effect; Succession; Processes and types. Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit 3: Phytogeography and Plant Taxonomy

Principle biogeographical zones; Endemism. Identification, Classification, Nomenclature. Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access, Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. Taxonomic hierarchy: Ranks, categories and taxonomic groups

Unit 4: Classification & Botanical nomenclature

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). Biometrics, numerical taxonomy and cladistics: cluster analysis; phenograms, cladograms (definitions and differences).

PRACTICAL

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta)*, Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
6. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position

according to Bentham & Hooker's system of classification): Brassicaceae, Asteraceae, Solanaceae, Lamiaceae, Liliaceae

7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Text Books

1. Sharma, P.D. (2017). Fundamentals of Ecology. Rastogi Publications, Meerut, India.
2. O. P. Sharma (2009) Plant Taxonomy, Tata M Grow Hill, New Delhi

Suggested Readings

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Discipline Specific Core Paper III
Plant Anatomy and Embryology
THEORY

Unit 1: Tissues, Organs and special tissues

Root and shoot apical meristems; Simple and complex tissues. Structure of dicot and monocot root stem and leaf. Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 2: Structural organization of flower

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 3: Pollination and fertilization

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. Apomixis and polyembryony**:** Definition, types and practical applications.

Unit 4: Embryo and endosperm

Endosperm types, structure and functions; Dicot and monocot embryo; Embryoendosperm relationship.

PRACTICAL

1. Study on different types of tissues: parenchyma, collenchymas, sclerenchyma, Xylary elements, Phloem
3. Stem, root and leaf anatomy: Monocot, Dicot, Secondary growth.
4. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
5. Structure of anther (young and mature), tapetum (amoeboid and secretory).

6. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
7. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development.
8. Calculation of percentage of germinated pollen in a given medium.

Text Books

1. Singh, Pandey and Jain (2017). Anatomy of Angiosperms, Rastogi Publication, Meerut.
2. Singh, Pandy and Jain (2017). Reproductive Biology of Angiosperms, Rastogi Publications, Meerut

Suggested Readings

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Discipline Specific Core Paper IV
Plant Physiology and Metabolism
THEORY

Unit 1: Plant-water relations and nitrogen metabolism

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit **2: Mineral nutrition and Phloem translocation**

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Translocation in phloem: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 3: Photosynthesis and respiration

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3 and C4. Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation.

Unit 4: Enzyme, Plant growth regulators and Plant response

Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition. Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by

excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Suction due to transpiration.

Text Books

1. R. K. Sinha, (2015). Modern Plant Physiology, Narosa Publishing House, New Delhi.
2. S, K. Gupta (2017). Plant Metabolism, Rastogi Publication, Meerut.

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

Discipline Specific Elective Paper I
Economic Botany and Biotechnology
THEORY

Unit 1: Origin of Cultivated Plants, Cereals and Legumes

Concept of centres of origin, their importance with reference to Vavilov's work. Rice cultivation process, Economic importance. Cereals:- Wheat -Origin, morphology, uses. Legumes: General account with special reference to Gram and soybean

U nit 2: Spices and Beverages

General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses). Tea (morphology, processing, uses)

U nit 3: Oils and Fats and Fibre Yielding Plants

General description with special reference to groundnut. General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

U nit 4: Plant tissue culture and molecular techniques

Introduction to biotechnology. Micropropagation; Anther culture, haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications. Protoplast culture, Hybrid and Cybrids. DNA Fingerprinting; Molecular DNA markers i.e. PCR, RAPD, RFLP.

PRACTICAL

1. Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea,

Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Text Books:

1. B. P. Pandey (2017) Economic Botany. S. Chand Publication, New Delhi.
2. H. S. Chawla (2010). Introduction to Plant Biotechnology. Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi.

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Discipline Specific Elective Paper II
Cell and Molecular Biology
THEORY

Unit 1: Techniques in Biology

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy.

Unit 2: Cell and Cell Organelles

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast - Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes:_Structures, composition, functions in animals and plants and biogenesis. Nucleus:_Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization.

Unit 3: Cell Membrane, Cell Wall and Cell Cycle

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.

Unit 4: Genetic material, transcription, gene expression and Cell Cycle

DNA: Miescher to Watson and Crick- historic perspective, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes), Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression: Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes. Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

PRACTICAL

1) To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2) Study of the photomicrographs of cell organelles
3) To study the structure of plant cell through temporary mounts.
4) To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5) Preparation of temporary mounts of striated muscle fiber
6) Study of mitosis and meiosis (temporary mounts and permanent slides).
7) Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8) Measure the cell size (either length or breadth/diameter) by micrometry.
9) Study the structure of nuclear pore complex by photograph (from Gerald Karp)
10) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
11) Study DNA packaging by micrographs.
12) Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Text Books

1. B. D. Singh (2017). Fundamental of Genetics, Kalynai Publishers, New Delhi.
2. H. S. Chawla (2010). Introduction to Plant Biotechnology. Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi.

Suggested Readings

1) Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2) De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3) Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4) Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

OPTIONAL FOR SECC II PAPER

SKILL ENHANCEMENT COURSE (SECC II Option I)

BIO-FERTILIZERS

Unit-I

General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. Azospirillum: isolation and mass multiplication, Azotobacter: classification, characteristics – crop response to Azotobacter inoculums, maintenance and mass multiplication.

Unit-II

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

Unit-III

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Unit-IV

Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

Text Books:

1. Mahendra Rai, (2006). Hand book of Microbial Bio-fertilizers. CRC Press.

Reference Books:

1. Dubey, R.C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New -Delhi.
6. Vayas, S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic. Farming Akta Prakashan, Nadiad
7. Pravin Chandra Dwivedi. (2008). Biofertilizers. Pointer Publishers.

SKILL ENHANCEMENT COURSE (SECC II Option II)

NURSERY AND GARDENING

Unit-I

Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion – Seed production technology - seed testing and certification.

Unit-II

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber, shed root, shade house and glass house.

Unit-III

Gardening: definition, objectives and scope - different types of gardening – landscape and home gardening - parks and its components - plant materials and design – computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

Unit-IV

Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

Text Books:

1. Saidaiah Pidigam, Sindhuja S., Geetha Amarapalli. (2018)Text Book of Nursery, Gardening and Floriculture, Kalyani Publishers, New Delhi.

Reference Books:

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National - Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

SKILL ENHANCEMENT COURSE (SECC II Option III)

ETHNOBOTANY

Unit-I

(i) Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

(ii) Methodology of Ethnobotanical studies a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit-II

Role of ethnobotany in modern Medicine Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) Azadiractha indica b) Ocimum sanctumc) Vitex negundo. d) Gloriosa superba e) Tribulus terrestris f) Pongamia pinnata g) Cassia auriculata h) Indigofera tinctoria. Role of ethnobotany in modern medicine with special example Rauvolfia sepentina, Trichopus zeylanicus, Artemisia, Withania.

Unit-III

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit-IV

Ethnobotany and legal aspects Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Text Books:

1. Faulks, P.J. 1958.An introduction to Ethnobotany, Moredale pub. Ltd

Reference Books:

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
3. Lone et al, Palaeo ethnobotany
4. S.K. Jain (ed.) 1989. Methods and approaches in Ethnobotany. Society of Ethnobotanists, Lucknow, India.
5. S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
6. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
7. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
8. Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine –

INA –SHREE Publishers, Jaipur-1996
9. Rath, A. K. and Mishra, S. R. (2017). Ethnobotany, Kalyani Publishers, New Delhi..

SKILL ENHANCEMENT COURSE (SECC II Option IV)
MUSHROM CULTIVATION

Unit-I

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus*. Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag.

Unit-II

Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.

Unit-III

Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fiber content - Vitamins.

Unit-IV

Food Preparation: Types of foods prepared from mushroom. Research Centers - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Text Books:

1. B. C. Suman and V. P. Sharma. (2007). Mushroom Cultivation in India. Daya Publishing House, New Delhi.

Reference Books:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.
5. Anon. (2010).The Cultivation of Mushrooms - An Outline of Mushroom Culture, Read Book Design, New Delhi

CAPACITY BUILDING OF FACULTY

Following modules have been proposed for training of faculties:

- Isolation and quantification of nucleic acids following spectrophotometric and gel electrophoresis techniques
- Techniques of Chromatography
- Micrometry and Haemocytometry
- Tissue Culture Techniques
- PCR techniques
- Chromosome techniques

The above module may be of 3-4 weeks duration with 30 participants.

LIST OF EQUIPMENTS

Sl. No.	List of Equipments	Quantity
01	Dissecting Microscope (Indian Make)	2 no.
02	Compound Microscope (Indian Make) with photographic attachment	2 no.
03	Occular and Stage Micrometer (Indian Make)	1 no.
04	Uv Spectrophotometer (Indian Make)	1 no.
05	Cold Centrifuge (Indian Make)	1 no.
06	Refrigerator (Indian Make)	1 no.
07	Soil Thermometer (Indian Make)	1 no.
08	Anemometer (Indian Make)	1 no.
09	Psychrometer (Indian Make)	1 no.
10	Rain gauge (Indian Make)	1 no.
11	pH meter (Indian Make)	1 no.
12	Herbarium Press (Indian Make)	1 set
13	Hot air Oven (Indian Make)	1 no.
14	Electronic Balance (Indian Make)	1no.
15	Gel Electrophoresis (Indian Make) Vertical and submarine	1 no.

16.	Power Pack for electrophoresis	1 no.
17	Blood Testing Kit (Indian Make)	1 no.
18	Laminar Flow (Indian Make)	1 no.
19	BOD Incubator (Indian Make)	1 no.
20	Autoclave (Indian Make)	1 no.

SYLLABUS
2018-19

CHOICE BASED CREDIT SYSTEM

M.Sc. (Botany)

SEMESTER SYSTEM

DHENKANAL AUTONOMOUS COLLEGE
DHENKANAL

Outlines of M.Sc. (Botany) Syllabus

Semester-I	Core Papers Name	Mark	Credit
Core Papers:			
Paper-BOT-101	Diversity of Plants-I	100	06
Paper-BOT-102	Diversity of Plants-II	100	06
Paper-BOT-103	Cell & Molecular Biology of Plants	100	06
Paper-BOT-104	Plant Biochemistry	100	06
Paper-BOT-105	Practical pertaining to Theory Papers – BOT-101, BOT-102, BOT-103, BOT-104	100	06
	TOTAL	500	30
Semester-II			
Paper- BOT-201	Cytogenetics, Plant Breeding & Biostaticstics	100	06
Paper- BOT-202	Biotechnology & Genetic Engineering of Plants	100	06
Paper- BOT-203	Plant Physiology	100	06
Paper- BOT-204	Plant Taxonomy, Ecology & Evolution	100	06
Paper- BOT-205	Practicals Pertaining to Theory Papers- BOT-201, BOT-202, BOT-203, BOT-204	100	06
	TOTAL	500	30
Semester-III			
Paper BOT-301	Plant Development, Reproduction and Economic Botany	100	06
Paper-BOT-302	Conservation Biology	100	06
Paper-BOT-303 (Allied Elective Courses)	Plant physiology and Developmental biology	100	06
Paper-BOT-304 (Free Elective Courses)	Plants & Environment (A)	100	06
Paper-BOT-305	Advanced Practical	100	06
	TOTAL	500	30
Semester-IV			
Core elective papers (optional):	**Only One Special paper + Dissertation + Seminar presentation**		
Paper-BOT-401 (A)	Biochemistry and Molecular Biology -I	100	06
Paper- BOT-402 (A)	Biochemistry and Molecular Biology - II	100	06
Paper-BOT-403	Dissertation	200	12
Paper-BOT-404	Seminar presentation	100	06
	TOTAL	500	30
	GRAND TOTAL	2000	120

Semester – I

DIVERSITY OF PLANTS-I

PAPER-BOT-101 *100 Marks/ 6 Credits*

UNIT-I

History and development of microbiology, Bergey's manual for classification of bacteria, Whittaker's 5 kingdom concept, Carl Woese's 3 domain classification, characteristics of prokaryotic and eukaryotic microbes, isolation, culture and maintenance of microorganisms, Microbial growth, Roles of microbes in agriculture and industry, Factors influencing growth of microbes.

UNIT-II

Structure and reproduction of Eubacteria, Cyanobacteria, Archaea, Actinomycetes, Mycoplasma, Rickettsiae, Spirochaetes, Virus, Viroids, Prions, Biofertilizers: cyanobacteria, *Rhizobium*, PSB, Mycorrhizae and *Azotobacter*.

UNIT-III

Algae in diversified habitats (terrestrial, freshwater and marine), classification based on pigment, food reserve and flagella, thallus organization, reproduction. Life cycles in algae. Salient features of Chlorophyta, Bacillariophyta, Dinophyta, Phaeophyta and Rhodophyta, algal bloom and toxins, algae as food, seaweed cultivation.

UNIT-IV

Classification of fungi, structure and reproduction of Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Degeneration of sex in fungi, nutrition in fungi, heterothallism, heterokaryosis.

UNIT-V

Plant diseases caused by viruses, bacteria, mycoplasma and fungi, disease symptoms, modes of infection and dissemination, disease resistance, defense mechanism and control methods, host-parasite relationship, fungal toxins and their mode of action.

DIVERSITY OF PLANTS –II

PAPER- BOT-102 *100 Marks/ 6 Credits*

UNIT-I

Origin, evolution and classification of Bryophytes, Ecological significance of bryophytes, structure and reproduction of Anthocerotales, Marchantiales, Metzgeriales, Jungermanniales, Sphagnales, Funariales and Polytrichales, Progressive sterilization of sporogenous tissues, evolution of gametophytes in bryophytes.

UNIT-II

Origin, evolution and classification of pteridophytes, General account of Psilophytales, fossil lycophytes, Sphenophytes, fossil ferns. Stellar evolution; Origin of heterospery, Heterospory and seed habit.

UNIT-III

Structure, reproduction and evolution of Psilopsida, Lycopsida, Sphenopsida and Pteropsida, soral evolution, origin, morphology and evolutionary significance of sporocarp.

UNIT-IV

Evolution and classification of Gymnosperms, Geological time scale, fossilization process, General account of Pteridospermales, Cycadeoidales, Pentoxyllales, fossil Ginkgoales, Cordaitales and fossil Coniferales.

UNIT-V

Structure and reproduction of Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitscilales, and Gnetales. Complexities and gametophytes in gymnosperm, Evolution of female gametophytes; variation in the structure of pollen grains.

CELL & MOLECULAR BIOLOGY OF PLANTS

PAPER-* BOT-103** ***100 Marks/ 6 Credits

UNIT-I

Cell Wall: Structure & functions; biogenesis; growth.

Plasma membrane: Structure, models, electrical properties of membrane & functions; sites for ATPases, ion carriers, channels and pumps; receptors

Plasmodesmata: Structure; role in movement of molecules & macromolecules; comparison with gap junctions.

Plant Vacuole: Tonoplast membrane; ATPases, transporters as storage organelle.

UNIT-II

Chloroplast: Structure, genome organization, gene expression, RNA editing, nucleochloroplastic interaction.

Mitochondria: Structure, genome organization, Biogenesis.

Other cellular organelles: Structure & functions of microbodies, golgi apparatus, Lysosomes, endoplasmic reticulum.

UNIT-III

Nucleus: Structure, nuclear pores, nucleosome organization, DNA structure, A, B & Z forms, replication, damage & repair.

Transcription: Plant promoters & transcription factors, splicing, m-RNA transport, Nucleolus, t-RNA, micro-RNA.

UNIT-IV

Ribosomes: Structure, site of protein synthesis, mechanism of translation initiation, elongation & termination.

Stability of proteins, Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). *Protein sorting*: Targeting of proteins to organelles, mechanism of sorting and regulation of target transport.

UNIT-V

Cell shape & motility: The cytoskeleton, organization & role of microtubules and microfilaments, motor movements, implications in flagellar & other movements.

Cell cycle and apoptosis: Control mechanisms, role of cyclins & cyclin dependent kinases, retinoblastoma & E2F proteins, cytokinesis & cell plate formation, mechanism of programmed cell death.

PLANT BIOCHEMISTRY

PAPER- BOT-104 *100 Marks/ 6 Credits*

UNIT-I

Principles of Biophysical Chemistry: Reaction kinetics: equilibrium and law of mass action, concept of reaction rates. Thermodynamics: Concept and Laws of thermodynamics, biological applications;

Fundamentals of Biochemistry: Proteolysis of water and hydrogen ion concentration, pH, Buffers;Solution and Colligative properties; *Stabilizing interactions*: Vanderwaals, Electrostatic, Hydrogen bonding and Hydrophobic interactions; *Metabolism and bioenergetics:* Generation and utilization of ATP, coupled reaction, group transfer, biological energy transducers.

UNIT-II

Carbohydrate: Structure, Physical & chemical properties, Biological activity of monosaccharide, oligosaccharide and polysaccharide

UNIT-III

Proteins: Amino acid Classification, structure and properties, Proteins : Primary, Secondary, tertiary and quaternary structure, determination of amino acid sequence, Protein folding.

UNIT-IV

Lipids: Classification, Structure, Physical and chemical properties of essential non essential fatty acids, triglycerides, phospholipids, wax.

Secondary metabolites: Importance of secondary metabolites, biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

UNIT-V

Enzymes: Nomenclature and Classification of enzymes, Enzyme kinetics: Michaelis-Menten equation and Briggs-Haldane modification; Determination of Km, Competitive, non-competitive and un-competitive inhibition of enzymes, Determination of inhibition constant. Mechanism of action of Chymotrypsin and Ribonuclease, Regulation of enzyme activity (covalent modification, feedback regulation and allosteric control)

PRACTICALS PERTAINING TO THEORY PAPERS -BOT-101,BOT-102, BOT-103 & BOT-104

***PAPER-* BOT-105** *100 Marks/ 6 Credits*

Semester-I ***(Diversity of Plants-I, Diversity of Plants-II, Cell & Molecular Biology of Plants, Plant Physiology & Biochemistry)***

Reference books

Smith G M Crptogamic Botany Vol I Algae and Fungi Mc Graw Hill Publ.

Smith G M Crptogamic Botany Vol II Bryophytes and Pteridophytes Mc Graw Hill Publ.

Kumar, H. D. (1988). Introductory Phycology. East-West Press, New Delhi.

Maloy, S. R., Cronan, J. E. Jr. and Freifielder, D. (2008). Microbial Genetics, 2nd Ed. Norosa, New Delhi.

Mehrotra, R. S. and Aneja, R. S. (1998). An Introduction to Mycology, New Age International, New Delhi.

Prescott, L. M., Harley, J. P. and Klen, D. A. (1999). Microbiology, 4th Ed. WCB- McGra-Hill, New Delhi.

Alexopoulus, C. J., Mims, C. W. and Blackwel, M. (1996). Introductory Mycology, John Wiley, New York.

Pandey. D.C. A Text Book on Algae (simple Photosynthetic Plants)

Vashista, B. R. (1995) Botany for Degree students, Vol I & II Chand & Co, New Delhi.

Sharma, O.P. (1990). Text book of Algae. Tata McGraw Hill Publishing Co., Ltd., New Delhi.

Mehrothra, R.S. Plant Pathology -Tata McGraw Hill Publishing Co. New Delhi

Rangaswami,G.& A.Mahadevan. (1994) Diseases of Crop plants in India (4th Ed) Prentice Hall of India (P) Ltd. New Delhi.1998.

Vashishtha series for Algae. Fungi Bryophyta Pteridophyta and Gymnosperms S Chand Publ.

Sharma, O.P. Text book of Fungi-Tata McGraw Hill Publishing Co. New Delhi.

Srivastava, J.P. Introduction to Fungi. Central Book Dept. Allahabad, India.

Dubey. H.C. (1990) An introduction of fungi. 2nd Edition. Vikas Publishers. ISBN PB : 9788125914334.

Parihar, N. S. (1991). Bryophyta. Central Book Depot, Allahabad.

Parihar, N. S. (1991). Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

Bhatnagar, S. P. and Moitra, A. (1996). Gymnosperms. New Age International, New Delhi.

Maloy, S. R., Cronan, J. E. Jr. and Freifielder, D. (2008). Microbial Genetics, 2nd Ed. Norosa, New Delhi.

Chamberlin, C. J. (1935). Gymnosperms: Structure and Evolution. Dover Publications, New York.

Cooper G. M. (1997). The Cell: A molecular approach. ASM Press, Washington, D. C., USA.

Buchachnanan, B. B., Grissem, W. and Jones, R. L. J., (2000). Biochemistry and molecular biology of plants. American Society of plant physiologists, Rockville, USA

Malacinski, G. M and Feidfelder, D (1998). Essentials of Molecular Biology, 3rd Ed. Jones and Bartel, London.

Lewine, B. (2004) Gene VIII, Person-Prentice Hall, London.

Devlin, R. N. and Witham, F. H. (1983). Plant Physiology. CBS Publishers, Delhi.

Salisbury, F. B. and Ross, C. W. (1992). Plant Physiology, 4th Edition Wadsworth Publication California, USA.

Noggle, G.R. and Fritz G.J. (1983) Introductory Plant Physiology. 2nd edition, 2010

Boyer, R. (2004). Modern Experimental Biochemistry, 3rd Ed. Pearson Educational Publication, Singapore.

Taiz, L. and E. Zeiger. 2002. Plant Physiology. 3rd Edition. Sinauer Associates, Inc., Sunderland, MA. 690 pp.

David Freifielder (1995). Molecular cell biology - 2nd Edition, Narosa publishing House.

Karp, G. Cell and Molecular Biology: Concepts and Experiments, 2000. John Wiley and Sons, New York.

Benjamin Lewin, Genes VIII, 2004, Pearson Prentice Hall, New Jersey.

Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, S. Lawrence Zipursky, James Darnell. 2004. Molecular Cell Biology, Fifth Edition, W. H. Freeman and Company, New York.

Sawhney , R Singh Introductory Practical Biochemistry Narosa Publishing House Pvt Ltd

Rangaswamy, D (1988) Disease of crop plants in India, Prentice Hall India, Ltd New Delhi.

Asada, Y, Bbushnell, NR Ouchi. S, and vance, P (1982) Plant infection. The physiology and Biochemical basis, Springer Verlag, Berlin Nee York.

Kosuge, T and Nester, EN (1984) Plant microbe interaction – molecular and genetic perspectives, MacMillan, New York.

Semester – II

CYTOGENETICS, PLANT BREEDING & BIOSTATISTICS

PAPER- BOT-201 *100 Marks/ 6 Credits*

UNIT-I

Chromatin organization: Chromosome structure, and Models, nucleolus, Euchromatin and heterochromatin, Chromosome banding, telocentric chromosome, isochromosome and B chromosome, Cell cycle, Molecular basis of cell division, Initiation of Meiosis Karyotype and its significance. *Genetic recombination and mapping*: Critical appreciation of Mendel's Law, Gene interactions, Linkage and crossing over, two and three-point cross, Coincidence coefficient and interference, Molecular basis of recombination, Role of Rec A and Rec BCD, physical mapping of genes on chromosomes, sex determination in plants. UNIT-II

Structural and numerical alternation in chromosomes: Spontaneous and induced mutations, Physical and chemical mutagens, Chromosomal aberrations, Meiotic behaviour of deletion, duplication, inversion and translocation, Molecular basis of gene mutation, DNA damage and repair mechanisms, Euploids and aneuploids-classification, origin, induction, cytological features and genetic analysis, Role of polyploidy in evolution and practical significance in crop improvement. *Plant Breeding*: Method of plant breeding – introduction & selection (Pedegree, back cross, mass selection, bulk method), male sterility and heterosis breeding, mutation breeding.

UNIT-III

Genetics and Prokaryotes and Eukaryotic Oragnelles: Genetic transformation, transduction and conjugation in bacteria, Gene mapping in bacteria, Genetic recombination in bacteriophages and mapping of phage genome, Genetics of mitochondria and chloroplasts, Cytoplasmic male sterility, Transposable genetic elements.

UNIT-IV

Molecular cytogenetics: Nuclear DNA content, C-value paradox, nucleic acid denaturation and renaturation, *Co t* curve and its significance, introns and RNA splicing, Genetic code, Regulation of gene expression in prokaryotes and eukaryotes, Restriction mapping, RFLP, RAPD, AFLP, *in situ* hybridization, Flow cytometry.

UNIT-V

Statistical Methods: Sampling methods, Sampling distribution, parametric and non-parametric statistics, measures of central tendency and dispersion, mean, mode & median, Mean deviations coefficient of variance (CV).Standard deviations, Standard error of mean, probability distribution (normal, binominal and poison), confidence intervals, regression and correlation, tests of significance (t-test, and χ^2 test), analysis of variance.

BIOTECHNOLOGY & GENETIC ENGINEERING OF PLANTS

PAPER BOT-202 *100 Marks/ 6 Credits*

UNIT-I

Plant cell, tissue & organ culture: History, scope and concept of cellular differentiations, totipotency, Fundamental aspects of morphogenesis: organogenesis and somatic embryogenesis, Clonal propagation, Artificial seeds, Hybrids through embryo rescue. Androgenesis and production of haploids, Callus and cell suspension culture, Production of somaclonal variants, production of secondary metabolites in cultures, Cryopreservation.

UNIT-II

Somatic hybridization and cybridization: Factors affecting protoplast isolation, culture and plant regeneration, Protoplast fusion-chemical fusion & electrofusion mechanism & techniques, Selection of heterokaryotic fusion products, biochemical selection and physical selection (micromanipulation, flow cytometric characterization and cell sorting), Analysis of hybrids, Somatic hybrids and cybrids for crop improvement.

UNIT-III

Recombinant DNA technology: Gene cloning-principles, Cloning vectors-plasmids, phages, cosmids & phagemids; Artificial chromosomes, Polymerase Chain Reaction-principles, types and applications, RT-PCR; Genomic and c DNA libraries; Construction of recombinant DNA molecules and their mobilization into bacteria; Analysis of recombinant clones, DNA sequencing.

UNIT-IV

Genetic Engineering of plants: Methods for gene transfer to plants, *Agrobacterium* mediated and direct gene delivery, Gene tagging, detection of foreign gene and gene products; Southern blotting, Northern blotting and Western blotting; Chloroplast transformation, Gene targeting, Transgenic plants for crop improvement, Intellectual property rights, possible ecological risks and ethical concerns.

UNIT-V

Biological methods: UV/Visible Spectrophotometry, Atomic Absorption Spectrophotometry fluorescence spectroscopy, NMR & ESR Spectroscopy, Mass Spectrometry, Electrophoresis, ELISA, Radioisotopes, their detection and measurement, molecular imaging of radioactive materials, Electron Microscopy–Scanning and transmission, Image processing, Chromatography. Centrifugation techniques, pH and Oxygen Electrode. Northern, Southern and Western Hybridization.

PLANT PHYSIOLOGY

PAPER -BOT-203 *100 Marks/ 6 Credits*

UNIT-I

Membrane transport and translocation of water and solutes: Uptake, transport and translocation of water, ion, solutes and macromolecules by membrane transport through xylem and phloem; transpiration and stomatal movement, mechanism of loading and unloading of photoassimilates.

UNIT-II

Photosynthesis: Photosynthetic pigments and light harvesting complexes, mechanism of electron transport, photoprotective mechanisms; CO_2 fixation: C_3, C_4 and CAM pathways, Photorespiration.

UNIT-III

Respiration and lipid metabolism: Glycolysis, TCA cycle, electron transport and ATP synthesis, alternate oxidase system, structure and functions of lipids, fatty acid biosynthesis, structure and function of carbohydrates.

UNIT-IV

Nitrogen metabolism: Biological nitrogen fixation, mechanism of nitrate uptake and reduction, nitrate and ammonium assimilation, amino acid biosynthesis.

Sensory Photobiology: Pigments as photoreceptors, structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins, photoperiodism

Stress Physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water temperature and salt) stresses. Metal toxicity, oxidative stress.

UNIT-V

Flowering and Senescence: Mechanism of flowering, Vernalization, biological clocks. Molecular mechanism of senescence and aging in plants.

Plant Growth regulators: Biosynthesis, storage, breakdown and transport of plant hormones; Mechanism of action, physiological effects and applications of plant growth regulators. Growth movement, measurement and indices.

PAPER- BOT-204 *100 Marks/ 6 Credits*

UNIT-I

(i) Introduction and scope of Plant Anatomy: Applications in systematics, forensics and phannacognosy.
(ii) Tissues: Classi?cation of tissues; Simple and complex tissues (no phylogeny); cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Cell wall ingrowths and transfer cells, aderustation and incrustation, Ergastic substances.

UNIT-II

(i) *Stem :* Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Types of vascular bundles; Anatomy of dicot and monocot stem.

Vascular Cambium : Structure, function and seasonal activity of cambium; secondary growth in stem (normal and anomalous). Root Stem transition.

(ii) *Leaf :* Anatomy of dicot and monocot leaf, Kranz anatomy.

UNIT-III

Physical and biotic environment, Biotic and abiotic interactions, concept of habitat and niche, niche width and overlap, fundamentals and realized niche, resource partitioning and character displacement, Population characteristic, population growth curves, population regulation, life history strategies (r and k selections), concept of metapopulation- Demes, Dispersal. Interdemic extinctions, age structure populations, Species interactions: types and interspecific competion, herbivory, carnivory, pollination and symbiosis,

UNIT-IV

Community ecology: nature, structure and its attributes, levels of species diversity and its measurement. Edges and Ecotones, ecological succession: types, mechanism, changes involved in succession, climax concept. *Ecosystem Ecology:* Structure, function, energy flow, mineral cycling (C, N, P), Primary Production and decomposition, structure and functions of Indian ecosystems: terrestrial (forest and grassland) and aquatic (fresh water, marine and estuarine).

UNIT-V

Evolution: Lamark and Darwin concept of variation, adaptation and natural selection, evolution of prokaryotes, origin and evolution of eukaryotes, anaerobic and aerobic metabolism, origin and development of major group of organisms in geological time scale, molecular evolution.

Population genetics: Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

PRACTICALS PERTAINING TO THEORY PAPERS - BOT-201, BOT-202, BOT-203, BOT-204

PAPER- **BOT-205**

100 Marks/ 6 Credits

Semester-II ***(Cytogenetics, Plant Breeding & Biostaticstics, Biotechnology & Genetic Engineering of Plants, Plant Physiology, Plant Taxonomy, Ecology & Evolution)***

Reference books

Glick, B. R. and Pasternak (2003). Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, Washington, D. C., USA.

Kyte, L. and Kleyn, J. (1996). Plants From Test Tube to: an Introduction to Micropropagation, 3rd Ed. Timber press, Port land, USA.

Pollard, W. J. and Walker (1990). Plant Cell and Tissue Culture Vol VI. Humana press Clifton, USA.

Subramanyam N.S. (1995). Modern Plant Taxonomy, 1st Edition, Vikas Publication House Pvt Ltd. Publisher

Sharma O.P. (2009). Plant Taxonomy, 2nd Edition Tata McGraw Hill Publisher

Sambamurty, A. V. S. S. (2005). Taxonomy of Angiosperms. I. K. International Pvt.Ltd., New Delhi.

Mitra, J.N. (1964). An Introduction to Systematic, Oxford & IBH Publishers, New Delhi, Calcutta-823pp

Lawrence G.H. (1951) Taxonomy of Vascular Plants. 1st edition. Prentice Hall College Div Publishers, ISBN-13: 978-0023681905, 823 pp.

Sharma, P.D. (1991)..Ecology and Environment. 10th ed. 2005. Rastogi Publications, ISBN, 8171339050, 9788171339051. 640 pp.

M.C. Dash. (2004) Fundamentals of Ecology. 4th Edition Mc Graw Hill Education publishers. 504pp.

Gomez, K. A. and Gomez, A. A. ((1984). Statistical Procedures for Agricultural Research, 2nd Ed. John Weley, New York.

Kormondy, E. J. (1996). Concepts of Ecology, Prentice-Hall India, New Delhi.

Odum, E. P. (1971). Fundamentals of Ecology, Saundas, Philadelphia, USA.

Misra, B. N. and Misra, M. K. (1998). Introductory Practical Biostatistics, Naya prokash, kolkata.

Smith, R. L. (1996). Ecology and Field Biology. Harper Collins, New York.

Subrahmanyam, N. S. and Sambamurty, A. V. S. S. (2000). Ecology. Narosa, New Delhi.

Kothari, A. (1997). Understanding Biodiversity: Life sustainability and Equity. Orient Longman, New york.

Negi, S. S. (1993). Biodeiversity and its Conseravation in India. Indus Publishing Company, New Delhi.

Simmonds, N. W. (1979). Evolution of Crop Plants. Longman, New York.

Bewley, J.D. and Black, M. (1994). Seed: physiology of Development and Germination. Plenum, New York.

Bhojwani, S.S. and Bhatnagar, S. P. (2008). The Embryology of Angiosperms. Vikas Publishing House, New Delhi.

Raghavan, V (1997). Molecular Embryology of Flowering Plant. Cambridge University Press, Cambridge.

Raghavan, V. (1999). Developmental Biology of Flowering Plants. Springer-Verlag, New York.

K. Wilson and Walker J. Practical Biochemistry- Principles and Techniques. 5th Edn. Tata Mc. Graw Hill Publishers.

P. Maheshwari (1950). Introduction to the Embryology and Angiosperms. Mc Graw Hill NY.

Semester – III

PLANT DEVELOPMENT AND REPRODUCTION, ECONOMIC BOTANY

100 Marks/ 6 Credits

PAPER- BOT-301

UNIT-I

Differentiation and Development: Difference between animal and plant cell development with unique features in plant cell development, use of mutants in seedling development; Molecular analysis of shoot apical meristem; root apical meristem & leaf growth, leaf development and phyllotaxy, transition to flowering, vascular tissue differentiation of root, shoot & leaf, Floral development & homoeotic mutants in *Arabidopsis* & *Antirrhinum.*

UNIT-II

Developmental Biology: Molecular and cytological analysis of endosperm & fruit development, fruit ripening and its manipulation; polyembryony, apomixes, seed germination; seed dormancy, bud dormancy, types & programmed cell death in life cycle of plants, metabolic changes associated with senescence and its regulation. Influence of hormones & environmental factors on senescence.

UNIT-III

Male gametophyte: Structure of anthers, microsporogenesis, role of tapetum, pollen development, male sterility, male nuclei dimorphism and hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen allergy, pollen embryos.

UNIT-IV

Female gametophyte: Ovule development, megasporogenesis, organization of the embryo sac, structure of the embryo sac cells, floral characteristics, pollination mechanisms and vectors, breeding systems, structure of pistil. *Developmental Embryology:* pollen-stigma interactions, sporophytic and gametophytic self incompatibility (cytological, biochemical and molecular aspects), double fertilization, *in vitro* fertilization.

UNIT-V

Economic Botany: Origin and domestication of cultivated plants, world centres of diversity of domesticated plants, plant introduction and secondary centre origin, evolution and uses of food, forage, fodder, fibre and oil-yielding crops. Uses of medicinal and aromatic plants, Important firewood and timber yielding plants and nonwood forest products, plants used as avenue trees for shade, pollution control and aesthetics.

CONSERVATION BIOLOGY

PAPER -BOT-302

100 Marks/ 6 Credits

UNIT-I

Concepts and concerns of biodiversity, biodiversity status, monitoring and documentation, major drivers of biodiversity changes, plant introduction, Invasion and its impact on biodiversity, biodiversity mapping

UNIT-II

Resource conservation: Survey and regeneration of bioresources, endemism and hot spots, endangered plants, red data book, convention of biological diversity.

Principles of conservation, extinction, environmental status of plants based on IUCN, Salient features of Biodiversity Act and rules. Strategies for resources conservation and management strategies.

UNIT-III

In situ conservation: International efforts and Indian initiatives; protected areas in India – Sanctuaries, national parks, biosphere reserves, wetlands and mangroves for conservation of wild biodiversity.

UNIT-IV:

Ex situ conservation: Principles and practices; botanical gardens, field gene banks, seed banks, cryobanks, general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR). ICAR, CSIR, DBT and ICRISAT.

UNIT-V

Intellectual Property Rights and their Protection: Sovereign Rights, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Patenting of biological materials.

Semester-III

Paper-Bot-303

100 Marks/60

PLANT SYSTEMATICS

Unit-I

Plant identification, Classification, Nomenclature, Biosystematics, Identification : Field invento
Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virt
herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access

Unit-II

Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarc
Species concept (taxonomic, biological, evolutionary).
Botanical nomenclature: Principles and rules (ICN); Ranks and names; Typification, author citation, v
publication, rejection of names, principle of priority and its limitations; Name of hybrids.

Unit-III

(i) Systematics and interdisciplinary science : Evidence from palynology, cytol
phytochemistry and molecular data.

(ii) Systems of classification : Major contributions of Theophrastus, Bauhin, Tournef
Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronq
Classificationi systems of Bentharn and Hooker (up to series) and Hutchinson (up to seri
Brief reference of Angiosperm Phylogeny Group (APG III) classification. Englerr & Prantle

Unit-IV

Phylogeny of Angiosperms: Terms and concept (primitive and advanced, homology and anal
parallelism and convergence, monophyly, paraphyly, polyphyly and clades). Origin & evolutio
angiosperms; co-evolution of angiosperms and animals; methods of illustrating evolutionary relation
(phylogenetic tree, cladogram)

Unit-V

Families of Angiosperms : Descriptive studies of Magnoliaceae, Rosaceae, Rubiacae, Poa
Orchidaceae, Musaceae, Acanthaceae, Apocynaceae, Asclepiadaeae, Lamiaceae, Asteraceae & Apiaceae

PRACTICAL

(i) Study of vegetative and floral characters of available materials of the families includ
theory syllabus (Description, V.S. flower, section of ovary, floral diagrams, floral form
and systematic position according to Bentham & Hooker's system of classification).

(ii) Field visit, plant collection and herbarium preparation and submission. Mounting of pr
dried and pressed specimen of at least fifteen wild plants with herbarium label (
submitted in the record book).

Free Elective:

PLANTS AND ENVIRONMENT

PAPER -BOT-304 (A) *100 Marks/ 6 Credits*

UNIT-I

Environment and the plants: concept of environment and its components: atmosphere, hydrosphere, lithosphere and biosphere, physical and chemical environment. *Biogeography:* Major terrestrial Biomes (Vegetation types of the world and India), theory of Iceland Biogeography, Biogeographical zones of India.

UNIT-II

Plants for environmental protection: salt tolerant plants (Mangroves) and their role for environmental protection, nature and characteristics of mangroves and their distribution in India (Sundarban and Bhitarkanika), deforestation and afforestation, social forestry, agroforestry, waste land and mine reclamation.

UNIT-III

Phytoremediation and Phytomining: concept and definition of Phytoremediation and Phytomining, methods of phytoremediation: phytoextraction, rhizofiltration, phytodetoxification, phytovolatilization, role of hyperaccumulators, biomining and bioleaching.

UNIT-IV

Environmental pollution: Environmental pollution (Water, air and soil)- their effects and control measures, global environmental changes (Green house effects and global climatic changes),

Plants and pollution control: Bioindicators of water and air pollution: Algae and lichens as indicator plants, role of lichens on phytoair monitoring, insecticidal plants, plants as natural pesticides.

UNIT-V

Bioenergy and aerobiology: concept of biomass and bioenergy, energy plantation, petro plants, bioethanol and methane production, energy from solar and wind sources, rain water harvesting technology. Aerobiology: importance and scope of aerobiology, aerobiology and crop diseases, aerobiology and pollen allergy.

ADVANCED PRACTICALS

PAPER- BOT-305

1. T. S. / L. S. of Anther, Ovary and Ovule of angiosperms
2. Observation of permanent slides related to embryology
3. Microtome of RAM and SAM, material fixation, block preparation, section cutting and staining
4. *In-vitro* germination of pollen grains
5. DNA isolation and Purification, quality check in spectrophotometer and gel electrophoresis
6. PCR analysis
7. Tissue culture techniques, media preparation, different stages
8. Karyotype analysis, chromosomal anomaly, comet assay
9. Microbial culture, Gram staining, endospore staining, Micorrhiza fungi staining
10. Antimicrobial assay
11. Isolation, purification and algal culture
12. Quantitative analysis of protein, carbohydrate, chlorophyll, proline, sugar etc
13. Phytochemical isolation, qualitative and quantitative analysis of phytochemicals by Spectrophotometer/TLC/HPLC etc
14. Protoplast isolation and fusion
15. Synthetic seed preparation/ immobilization technique

Semester-III ***(Plant Development, Reproduction and Economic Botany,*** **Conservation Biology,** ***Plant Physiology and Developmental Biology, Plants and Environment / Environmental Studies)***

Reference books

Krishnamurthy, K.V. 2004. An advanced textbook on Biodiversity Principles and Practice. Oxford and IBH Publishing Co. Pvt. Ltd.

Das, R. C., Baral. J. K., Sahu, N. C. and Misra, M. K. (1998). The Environmental Divide: The Dilemma of Developing Countries. A. P. H. Publication, New Delhi.

Heywood, V. H. and Watson, R. T. (1995). Global Biodiversity Assessment. Cambridge University Press, UK.

Hill, M. K. (1997). Understanding Environmental Pollution. Cambridge University Press, UK.

Mason, C. F. (1991). Biology of Freshwater Pollution. Longman, New York.

K.V. Krishnamurthy An Advanced Textbook on Biodiversity Principles and Practice, Oxford & IBH Publishing Co. Pvt. Ltd.

Gomez, K. A. and Gomez, A. A. ((1984). Statistical Procedures for Agricultural Research, 2nd Ed. John Weley, New York.

Misra, B. N. and Misra, M. K. (1998). Introductory Practical Biostatistics, Naya prokash, kolkata

Semester – IV

CORE ELECTIVE PAPER (OPTIONAL): A student has to select Paper-BOT-401 & BOT-402 from anyone of the followings Biochemistry and Molecular Biology / Biotechnology and Plant Genetic Manipulation / Cytogenetics and Cell Biology/ Environmental Biotechnology / Microbial Technology / Biosystematics

BIOCHEMISTRY AND MOLECULAR BIOLOGY-I

PAPER-BOT-401 (A) *100 Marks/ 6 Credits*

UNIT-I

UNIT-I

Metabolism of Aminoacid- Amino acid pool, aminoacid biosynthesis- general account, Metabolism of Glycine, Alanine, Branched chain aminoacid, Hydroxyl aminoacid, Aromatic aminoacid, Aspartate derived aminoacid, Glutamate derived aminoacid, Sulphur containing aminoacid, Basic aminoacid Iminoacid , Regulation of aminoacid biosynthesis.

UNIT-II

Nucleic acid metabolism- Composition of nucleic acid, Biosynthesis & degradation of Purine & pyrimidine nucleotides. Regulation of nucleotide biosynthesis, synthesis of deoxyribonucleotides from ribonucleotides.

UNIT-III

Carbohydrate Metabolism: Regulation of Calvin cycle, HSK pathway, CAM pathway, Glycolysis, TCA cycle and oxidative pentose phosphate pathway, electron transport chain (Chloroplast and Mitochondrial), photophosphorylation and oxidative phosphorylation, Hydrolysis and biosynthesis of starch and sucrose.

UNIT-IV

Lipid Metabolism: Biosynthesis and hydrolysis of triacylglycerols, structural lipids of membrances, fatty acids; Oxidation of fatty acids; Gluconeogenesis. Cell signaling and signal transduction.

UNIT-V

Immune system: Lymphocytes and accessory cells, Immunoglobulins, MHC, Toll like receptors, mechanism of immune response and generation of antibody diversity, Effectors, compiements, hypersensitivity and autoimmunity, AIDS and other immunodeficiency, vaccines, Hybridoma and Mabs, Immunological techniques (ELISA, RIA, western blot, immunoprecipitation, FISH and GISH.

BIOCHEMISTRY AND MOLECULAR BIOLOGY-II

PAPER- BOT-402 (A)

100 Marks/ 6 Credits

UNIT-I

DNA replication, Transcription: Enzymes and necessary protein in DNA replication, DNA damage, repair and recombination, Prokaryotic and eukaryotic transcription mechanisms, posttranscriptional modification of RNA, Nuclear export of m-RNA.

Were in last sem Unit -III

UNIT-II

Translation: Prokaryotic and eukaryotic translation, Regulation and posttranslational modification of proteins, protein import into nucleus, chloroplast, mitochondria and peroxisomes. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors.

Underlined portions were in last sem Unit-IV.

UNIT-III

Gene Regulation: Regulation of gene expression in prokaryotes and eukaryotes (lac-operon, trp-operon, ara-operon, attenuation and anti-termination).

UNIT-IV

Genetic Marker: t-DNA and transposon tagging, targeted gene replacement, augmentation, gene knockout, vector engineering, gene correction and editing, molecular makers in genome analysis, (RFLP, RAPD and AFLP, ISSR and SSR and SNP).

UNIT-V

Antisense and Ribozyme technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping. Biochemistry of ribozyme (hammer-head, hairpin and other ribozymes), designing of ribozymes. Applications of antisense and ribozyme technologies.

DISSERTATION

PAPER-403 **200 Marks (12 Credits)**

Semester-IV *(Biochemistry and Molecular Biology, Biotechnology and Plant Genetic Manipulations, Cytogenetics and Cell Biology, Environmental Biotechnology, Microbial Technology, Biosystematics).*

SEMINAR PRESENTATION

PAPER-404 **100 Marks (6 Credits)**

Semester-IV *(Biochemistry and Molecular Biology, Biotechnology and Plant Genetic Manipulations, Cytogenetics and Cell Biology, Environmental Biotechnology, Microbial Technology, Biosystematics.*

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Reference books

Nelson, D.L., Cox M.M. (2008) Lehninger Principles of Biochemistry, 5th edn. Macmillan Publisher. 1158 pp.

Zubay G.L. (1983) Biochemistry, 4th edition, 1999. Addison-Wesley publishers, 1268pp.

Voet, D. and Voet, JG. (2004) Biochemistry. 3rd edition John Wiley and Sons publisher; New York. 1616 pp. ISBN: 978-0471193500.

Stryer L. (2002). Biochemistry, 5th Revised edition, W.H.Freeman & Co publisher, 1050 pp. ISBN: 978-0716746843.

Palmer, T. and Bonner, P.L. (2007). Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2nd edn, Woodhead Publishing, ISBN: 9781904275275, 432 pp.

Goodwin T. W. and Mercer E. I. (1990). Introduction to Plant Biochemistry, Second Edition, Pergamon Publisher, 660 pp.

Lea PJ and Leagood RC (1999) Plant Biochemistry and Molecular Biology. Wiley, San Diego.

David Freifielder (1995). Molecular cell biology - 2nd Edition, Narosa publishing House.

Karp, G. Cell and Molecular Biology: Concepts and Experiments, 2000. John Wiley and Sons, New York.

Benjamin Lewin, Genes VIII, 2004, Pearson Prentice Hall, New Jersey.

Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, S. Lawrence Zipursky, James Darnell. 2004. Molecular Cell Biology, Fifth Edition, W. H. Freeman and Company, New York.

Buchanan, B. B., Grissem, W. and Jones, R. L. (2000). Biochemistry and molecular biology of plants. American Society of plant physiologists, Rockville, USA

Trevor Palmer (1991) Understanding enzymes. 3rd edition. E. Horwood publisher, ISBN: 9780139282508, 399 pp.

Mathews, C. K., Van Holde, K. E. and Ahern, K. G. (2000). Biochemistry, Addison-Wesley Publishing Company, San Francisco, USA.

Goodwin, T. W. and Mercer, E. I. (1985). Introduction to Plant Biochemistry, 2nd ed. Pergamon, Oxford.

Richard A.Goldsby, Thomas J. Kindt & Barbara A. Osborne. Kuby Immunology (4th Ed.). W.H.Freeman and Company

Sawhney , R Singh Introductory Practical Biochemistry Narosa Publishing House Pvt Ltd

Sadasivam S and Manickam A 1996. Biochemical methods. 2nd edn. New Age International, ISBN: 9788122409765. 256 pages

STATE MODEL SYLLABUS FOR UNDER GRADUATE COURSE IN CHEMISTRY

(Bachelor of Science Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

Course structure of UG Chemistry Honours

Semester	Course	Course Name	Credits	Total marks
I	AECC-I	AECC-I	04	100
	C-I	Inorganic Chemistry-I	04	75
	C-I Practical	Inorganic Chemistry-I Lab	02	25
	C-II	Physical Chemistry-I	04	75
	C-II Practical	Physical Chemistry-I Lab	02	25
	GE-I	GE-I	04	75
	GE-I Practical	GE-I Lab	02	25
			22	**400**
II	AECC-II	AECC-II	04	100
	C-III	Organic Chemistry-I	04	75
	C-III Practical	Organic Chemistry-I Lab	02	25
	C-IV	Physical Chemistry-II	04	75
	C-IV Practical	Physical Chemistry-II	02	25
	GE-II	GE-II	04	75
	GE-II Practical	GE-II Lab	02	25
			22	**400**
III	C-V	Inorganic Chemistry-II	04	75
	C-V Practical	Inorganic Chemistry-II Lab	02	25
	C-VI	Organic Chemistry-II	04	75
	C-VI Practical	Organic Chemistry-II Lab	02	25
	C-VII	Physical Chemistry-III	04	75
	C-VII Practical	Physical Chemistry-III Lab	02	25
	GE-III	GE-III	04	75
	GE-III Practical	GE-III Lab	02	25
	SECC-I	SECC-I	04	100
			28	**500**
IV	C-VIII	Inorganic Chemistry-III	04	75
	C-VIII Practical	Inorganic Chemistry-III Lab	02	25

	C-IX	Organic Chemistry-III	04	75
	C-IX Practical	Organic Chemistry-III Lab	02	25
	C-X	Physical Chemistry-IV	04	75
	C-X Practical	Physical Chemistry-IV Lab	02	25
	GE-IV	GE-IV (Theory)	04	75
	GE-IV Practical	GE-IV (Practical)	02	25
	SECC-II	SECC-II	04	100
			28	**500**
V	C-XI	Organic Chemistry-IV	04	75
	C-XI Practical	Organic Chemistry-IV	02	25
	C-XII	Physical Chemistry-V	04	75
	C-XII Practical	Physical Chemistry-V	02	25
	DSE-I	DSE-I	04	75
	DSE-I Practical	DSE-I Lab	02	25
	DSE-II	DSE-II	04	75
	DSE-II Practical	DSE-II Lab	02	25
			24	**400**
VI	C-XIII	Inorganic Chemistry- IV	04	75
	C-XIII Practical	Inorganic Chemistry-IV	02	25
	C-XIV	Organic Chemistry-V	04	75
	C-XIV Practical	Organic Chemistry-V	02	25
	DSE-III	DSE-III	04	75
	DSE-III Practical	DSE-III Lab	02	25
	DSE-IV	DSE-IV	04	75
	DSE-IV Practical	DSE-IV Lab	02	25
	OR			
	DSE-IV	Dissertation	06	100*
			24	**400**
		TOTAL	**148**	**2600**

Discipline Specific Elective Papers: (Credit: 06 each)

(4 papers to be selected by students of Chemistry Honours): DSE (1-IV)

1. Polymer Chemistry
2. Green Chemistry
3. Industrial Chemicals & Environment
4. Inorganic Materials of Industrial Importance
5. *Dissertation (can be opted as alternative of DSE-IV only and of 6 credits. **Dissertation content: 60, Seminar cum Viva: 20)**
6. Analytical Methods in Chemistry (Alternative)

CHEMISTRY

HONOURS PAPERS:

Core course – 14 papers

Discipline Specific Elective – 4 papers (out of the 6 papers suggested)

Generic Elective for non-Chemistry students – 4 papers. Incase the University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical- 25 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper – 40 hours Theory classes + 20 hours Practical classes

CORE PAPER 1

INORGANIC CHEMISTRY-I

Unit-I

Atomic structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom, Sommerfeld's modification. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle, Schrödinger's wave equation (time independent) and its significance, Derivation of Schrödinger's wave equation (for hydrogen atom) in Cartesian coordinate, significance of ψ and ψ^2. Normalized and orthogonal wave functions. Sign of wave functions; Setting of Schrödinger's equation in polar coordinates (derivation not required), radial and angular wave functions for hydrogen atom. Radial and angular distribution curves; Shapes of s, p, d and f orbitals; Quantum numbers and their significance. Pauli's Exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations**.**

Unit-II

Periodicity of elements

Periodicity of Elements: s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-blocks. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling's/ Mulliken's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization. Sanderson's electron density ratio.

Unit-III

Chemical bonding-I

(i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation. Madelung constant, Born-Haber cycle and its application, Solvation energy.

(ii) Covalent bond: Valence Bond theory (Heitler-London approach). Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements, equivalent and non-equivalent hybrid orbitals, Resonance and resonance energy.

Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions (CO^+, NO^+, NO^-).

Unit-IV

Chemical bonding-II

VSEPR theory, shapes of simple molecules and ions containing lone and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic

character from dipole moment and electronegativity difference.

(i) Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators.

(ii) Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process**.**

Oxidation-reduction: Redox equations, standard electrode potential and its applications to inorganic reactions. Principles involved in some volumetric analyses (iron and copper).

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry Wiley India, 5th Edn., 2008.
2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017
4. Malik, Tuli, Madan Selected Topic in Inorganic Chemistry, S. Chand, New Delhi, 17th Ed., 2010.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

CORE PAPER I LAB

Students are required to learn the followings:

i. Calibration and use of apparatus
ii. Preparation of solutions of different Molarity/Normality of titrants.

List of experiments

(A) Acid-Base Titrations

i. Estimation of carbonate and hydroxide present together in mixture.

ii. Estimation of carbonate and bicarbonate present together in a mixture.

iii. Estimation of free alkali present in different soaps/detergents

(B) Oxidation-Reduction Titrimetry

i. Standardization of $KMnO_4$ with standard sodium oxalate and estimation of Fe (II) using standardized $KMnO_4$ solution.

ii. Estimation of percentage of oxalic acid and sodium oxalate in a given mixture.

iii. Estimation of Fe (II) and Fe (III) in a mixture by standard $K_2Cr_2O_7$ solution.

Reference text Books:

1. J. Mendham, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1st Edn., CBS Publishers & Distributors Pvt Ltd., (2017).

CORE PAPER II

PHYSICAL CHEMISTRY- I

Unit-I

Gaseous state-I

Kinetic molecular model of a gas: ~~postulates and derivation of the kinetic gas equation~~; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, ~~calculation of σ from η; variation of viscosity with temperature and pressure~~.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. van der Waal's equation of state, its derivation and application in explaining real gas behaviour. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Unit-II

Liquid state

Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Ionic equilibria- I

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono- and diprotic acids.

Unit- III: Solid state

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analyses of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals (stoichiometric and non- stoichiometric). Glasses and liquid crystals.

Unit-IV

Ionic equilibria - II

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer

range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma & Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn. 2017.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017
4. Castellan G. W. Physical Chemistry 4thEdn. Narosa (2004).

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications
2. Mortimer R. G., Physical Chemistry, Elsevier (Academic Press), 3rd Ed (2008).
3. Ball D. W. Physical Chemistry Thomson Press, India (2007).
4. Engel T. & Reid P., Physical Chemistry, 3rd Ed. Pearson (2013)

CORE PAPER II LAB

Surface tension measurements.

a. Determine the surface tension by (i) drop number (ii) drop weight method.
b. Study the variation of surface tension of detergent solutions with concentration.

Viscosity measurement using Ostwald's viscometer.

a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
b. Study the variation of viscosity of sucrose solution with the concentration of solute.

pH- metry

a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
b. Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide.
c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
d. Determination of dissociation constant of a weak acid.

Ionic equilibria

a. Determination of solubility product of PbI_2 by titrimetric method.

Reference Books

1. Khosla, B. D. Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
2. Garland, C. W., Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry, 8th Ed.; McGraw-Hill, New York (2003).
3. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry, Viva Books (2009).
4. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co., New York (2003).

CORE PAPER – III

ORGANIC CHEMISTRY I

Unit –I:

Basics of organic chemistry

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and heterolytic fission with suitable examples. Curly arrow rules; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and relative stability of carbocations, carbanions, free radicals and carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Carbon-carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Unit – II:

Stereochemistry

Fischer Projection, Newmann and Sawhorse Projection formulae; Geometrical isomerism: cis–trans and, syn-anti isomerism, E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with one and two chiral-centres, Distereoisomers, meso-structures, Racemic mixture and resolution, inversion. Relative and absolute configuration: D/L and R/S designations.

Unit – III:

Chemistry of aliphatic hydrocarbons

Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration- demercuration, hydroboration oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2- and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformational analysis of alkanes (ethane and n-butane): Relative stability with energy diagrams. Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms.

Unit – IV:

Aromatic hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups

Recommended Text Books:

1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
3. Kalsi, P. S., Stereochemistry Conformation and Mechanism; 8thEdn, New Age International, 2015.

Reference Books:

1. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013)
2. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.
3. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER III LAB

Students are required to learn the followings:

- Checking the calibration of the thermometer

- Determination of melting point, effect of impurities on the melting point – mixed melting point of two unknown organic compounds
- Determination of boiling point of liquid compounds [boiling point lower than and more than 100°C (up to 160°C) by distillation and capillary method respectively](**e**.g., ethanol, cyclohexane, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide etc.).

List of experiments

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid groups and identification of unknown organic compounds of CHO system (without element detection).
2. Separation and purification of any one component of following binary solid mixture based on the solubility in common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, etc. and determination of melting point.

   Benzoic acid/p-Toluidine; p-Nitrobenzoic acid/p-Aminobenzoic acid; p-Nitrotolune/p-Anisidine etc.
3. Chromatography
   - Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
   - Separation of a mixture of two sugars by ascending paper chromatography
   - Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

CORE PAPER IV
PHYSICAL CHEMISTRY II

Unit-I:

Chemical thermodynamics

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat(q), work(w), internal energy(U) and statement of first law; enthalpy(H), relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.

Unit-II

Carnot cycle, efficiency of heat engine, Carnot theorem

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters, inversion temperature, Gibbs-Helmholtz equation, Maxwell relations, thermodynamic equation of state.

Unit-III

Systems of variable composition

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical equilibrium

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient (Vant Hoff's reaction). Equilibrium constants and their

quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. Le Chatelier principle (quantitative treatment) and its applications.

Unit-IV

Solutions and Colligative Properties

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties: (i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma & Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
3. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3rdEdn. 2017
4. Castellan G. W. Physical Chemistry 4th Ed. Narosa (2004).

Reference Books:

1. Engel T. & Reid P., Physical Chemistry 3rd Ed. Pearson (2013).
2. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
3. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.

CORE PAPER IV LAB
THERMOCHEMISTRY

a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

c) Calculation of the enthalpy of ionization of ethanoic acid.

d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

e) Determination of basicity/ proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

f) Determination of enthalpy of hydration of copper sulphate.

g) Determination of heat of solution (ΔH) of oxalic acid/benzoic acid from solubility measurement.

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry, New Age International: New Delhi (2001).
3. Viswanathan, B., Raghavan, P.S. Practical Physical Chemistry, Viva Books (2009)

CORE PAPER V
INORGANIC CHEMISTRY-II

Unit-I

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

Acids and Bases

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) application of HSAB principle.

Unit-II

Chemistry of *s* and *p* Block Elements - I

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Hydrides and their classification ionic, covalent and interstitial.

Basic beryllium acetate and nitrate.

Unit-III

Chemistry of *s* and *p* Block Elements - II

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes. Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

Unit-IV

Noble Gases

Occurrence and uses, rationalization of inertness of noble gases, clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects

and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry Wiley India, 5th Edn., 2008.
2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
4. Shriver D. E., Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn.(2010).

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. I, CBS Publications, 2nd Ed. 2010.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

CORE PAPER V LAB

Iodometric / Iodimetric titrations

(i) Standardization of sodium thiosulphate solution by standard of $K_2Cr_2O_7$ solution.

(ii) Estimation of Cu(II) using standard sodium thiosulphate solution (Iodimetrically).

(iii) Estimation of available chlorine in bleaching powder iodometrically.

Inorganic preparations

(i) Cuprous oxide (Cu_2O)

(ii) Cuprous chloride(Cu_2Cl_2)

(iii) Manganese(III) phosphate($MnPO_4.H_2O$)

(iv) Aluminium potassium sulphate (K_2SO_4. $Al_2(SO_4)_2.24H_2O$ - Potash alum).

(v) Lead chromate ($PbCrO_4$)

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson, 2009.
2. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).
3. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt. Ltd., (2017).

CORE PAPER VI

ORGANIC CHEMISTRY-II

Unit-I

Chemistry of Halogenated Hydrocarbons

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN_1, SN_2 and SN_i mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazonium salts, nucleophilic aromatic substitution; SNAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

Unit-II

Alcohols, Phenols, Ethers and Epoxides

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, Ammonia derivatives and $LiAlH_4$.

Unit-III

Carbonyl Compounds

Structure, reactivity and preparation:

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation,

Perkin, Cannizzaro and Wittig reaction, Beckmann rearrangements, α halo form reaction and Baeyer Villiger oxidation, - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV.; Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Unit-IV

Carboxylic Acids and their Derivatives

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic, lactic, malic, tartaric, citric, maleic and fumaric acids;

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

Sulphur containing compounds: Preparation and reactions of thiols and thioethers**.**

Recommended Text Books:

1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
3. Mendham, J.,et al, A. I. Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson, 2009.

Reference Books:

1. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013)
2. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.
3. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER VI LAB

Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:
   a. Using conventional method.
   b. Using green approach

ii. Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.

iii. Bromination of any one of the following:
   a. Acetanilide by conventional methods
   b. Acetanilide using green approach (Bromate-bromide method)

iv. Nitration of any one of the following:
   a. Acetanilide/nitrobenzene by conventional method
   b. Salicylic acid by green approach (using ceric ammonium nitrate).

The above derivatives should be prepared using 0.5-1g of the organic compound.

Calculate percentage yield, based upon isolated yield (crude) and theoretical yield.

Purification of the crude product by recrystallisation from water/alcohol, or sublimation, whichever is applicable and determination of melting point.

Reference Books

1. Vogel, A. I. Elementary Practical Organic Chemistry, Part 1: Small scale Preparations, Pearson (2011)
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.,* Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis,* University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: QualitativeAnalysis,* University Press (2000).

CORE PAPER VII

PHYSICAL CHEMISTRY-III

Unit-I

Phase Equilibria-I

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems, Clausius- Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications (H_2O and sulphur system).

Phase diagrams for systems of solid-liquid equilibria involving eutectic (Pb-Ag system, desilverisation of lead), congruent (ferric chloride-water) and incongruent (sodium sulphate-water) melting points, completely miscible solid solutions (intermediate, medium, maximum freezing points).

Unit-II

Phase Equilibria-II

Three component systems, water-chloroform-acetic acid system, triangular plots.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, partial miscibility of liquids, CST, miscible pairs, steam distillation.

Nernst distribution law: its derivation and applications.

Unit-III

Chemical Kinetics

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of orders.

Kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, qualitative treatment of the theory of absolute reaction rates.

Unit-IV

Catalysis

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Surface chemistry:

Physical adsorption, chemisorption, adsorption isotherms (Langmuir, Freundlich and Gibb's isotherms), nature of adsorbed state.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma & Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017
4. Castellan G. W. Physical Chemistry 4th Edn. Narosa (2004).

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
2. Levine, I. N. *Physical Chemistry 6thEd.,* Tata McGraw-Hill (2011).
3. Ball D. W. Physical Chemistry Thomson Press, India (2007).
4. Engel T. & Reid P., Physical Chemistry 3rd Ed. Pearson (2013)

CORE PAPER VII LAB

1. Determination of distribution coefficients of:
   (a) Iodine between water and carbon tetrachloride.
   (b) Acetic/ benzoic acid between water and cyclohexane.
2. Study the equilibrium of at least one of the following reactions by the distribution method:
   - $I_2\,(aq) + I^- \rightarrow I_3^-(aq)$
   - $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$
3. Study the kinetics of the following reactions.
   (i) Integrated rate method:
   a) Acid hydrolysis of methyl acetate with hydrochloric acid.

b) Saponification of ethyl acetate.

(ii) Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.

4. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W., Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

CORE PAPER VIII

INORGANIC CHEMISTRY-III

Unit-I

Coordination Chemistry

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, Labile and inert complexes.

Crystal field theory, measurement of CFSE weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq in octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar geometry. Qualitative aspect of ligand field and MO Theory.

Unit-II

Transition Elements-I

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Ebsworth diagrams). Difference between the first, second and third transition series.

Unit-III

Transition Elements-II

Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy).

Lanthanoids and Actinoids

Electronic configuration, oxidation states, colour, spectral and magnetic properties,lanthanide contraction, separation of lanthanides (ion-exchange method only).

General features of actinoids, separation of Np, Pm, Am from U.

Unit-IV

Bioinorganic Chemistry

Metal ions present in biological systems, classification of elements according to their action in biological system. Na/K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

Iron and its application in bio-systems, Haemoglobin and myoglobin.

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5th Edn., 2008.
2. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
3. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
4. Shriver D. E. Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn..

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Bioinorganic Chemistry, Asim Kumar Das, Books & Allied (P) Ltd. 1st Ed. 2015.
3. Selected Topic in Inorganic Chemistry, Mallick, Madan and Tuli, S. Chand Publisher. 17th Ed. 2010.

4. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

CORE PAPER VIII LAB

Inorganic preparations

Preparation of complexes:

i. Hexamine nickel(II), $[Ni(NH_3)_6]Cl_2$
ii. Potassium trioxalatoferrate (III) trihydrate
iii. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
iv. Tetraamminecarbonatocobalt (III) nitrate

Complexometric titration

i. Estimation of Ca by EDTA
ii. Estimation of Mg by EDTA

Gravimetric Analysis:

i. Estimation of nickel (II) using dimethylglyoxime (DMG).
ii. Estimation of copper as CuSCN
iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
iv. Estimation of Al(III) by precipitating with oxine and weighing as $Al(oxine)_3$ (Aluminium Oxinate).

Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

i. Ni(II) and Co(II)
ii. Fe(III) and Al(III)

Reference Books:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS (1978).
2. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).
3. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt Ltd., (2017).

CORE PAPER IX

ORGANIC CHEMISTRY-III

Unit-I

Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles.

Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

Unit-II

Diazonium Salts

Preparation and their synthetic applications.

Polynuclear Hydrocarbons

Reactions of naphthalene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene. Polynuclear hydrocarbons.

Unit-III

Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine. Fischer indole synthesis and Madelung synthesis,

Derivatives of furan: Furfural and furoic acid (preparation only).

Unit-IV

Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action.

Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Terpenes

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and α- terpineol.

Recommended Text Books:

1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Advanced Organic Chemistry, 2nd Edition, Arun Bahl & B S Bahl, S. Chand Publisher, 2012.

Reference Books:

1. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013)
2. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.
3. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER IX LAB

Qualitative organic analysis of organic compounds

1. Detection of extra elements (N, X, S) in organic compounds by Lassaigne's test.
2. Qualitative analysis of unknown organic compounds containing simple functional groups under CHN system (amine, nitro, amide and imide), determination of melting/ boiling point, and preparation of their derivative.

Reference Books

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
3. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
4. Ghoshal, A., Mahapatra, B., Nad, A. K. An Advanced Course in Practical Chemistry, New Central Book Agency (2007).

CORE PAPER X

PHYSICAL CHEMISTRY-IV

Unit-I

Conductance-I

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules.

UNIT-II

Conductance-II

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

Unit-III

Electrochemistry-I

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.

Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass electrodes.

Unit-IV

Electrochemistry-II

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Electrical properties of atoms and molecules

Basic ideas of electrostatics, Electrostatics of dielectric media. Clausius-Mosotti equation and Lorenz-Laurentz equation (no derivation), Dipole moment and molecular polarizabilities and their measurements.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma & Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
3. Kapoor, K. L., Text Book of Physical Chemistry, Mac Grow Hill, 3rdEdn., 2017
4. Castellan G. W. Physical Chemistry 4th Ed. Narosa (2004).

Reference Books:

1. Engel T. & Reid P., Physical Chemistry 3rd Ed. Pearson (2013).
2. Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill (2011).
3. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
4. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.

CORE PAPER X LAB

Conductometry

I. Determination of cell constant.

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations:

   i. Strong acid vs. strong base

   ii. Weak acid vs. strong base

   iii. Strong acid vs. weak base

Potentiometry

I Perform the following potentiometric titrations:

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Dibasic acid vs. strong base

Reference Books:

1. Khosla, B. D., Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
2. Garland, C. W. Nibler, J. W. & Shoemaker, D. P., Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C., Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co., New York (2003).
4. Viswanathan, B., Raghavan, P.S., Practical Physical Chemistry, Viva Books (2009).

CORE PAPER XI
ORGANIC CHEMISTRY-IV

Unit-I

Organic Spectroscopy-I

UV Spectroscopy: Types of electronic transitions, λ_{max}, Lambert-Beer's law and its limitations, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward rules for calculation of λ_{max} for the following systems: α, β the unsaturated aldehydes: ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

Unit-II

Organic Spectroscopy-II

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O and N containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in simple functional group analysis.

Unit-III

Organic Spectroscopy-III

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift andfactors influencing it; Spin-spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics; Interpretation of NMR spectra of simple compounds.

Mass Spectroscopy- Basic principle, Fragmentation pattern, instrumentation, determination of m/e ratio. Application of mass spectroscopy on CH_4, C_2H_6, *n*-butane and *neo*-pentane.

Applications of IR, UV & NMR for identification of simple organic molecules.

Unit-IV

Carbohydrates

Occurrence, classification and their biological importance.

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

Disaccharides – Structure elucidation of maltose; Polysaccharides – Elementary treatment of starch, cellulose.

Recommended Text Books:

1. Kemp William, Organic Spectroscopy, 3rd Edition, Palgrave Publisher, 1991.
2. Davis, B. G., Fairbanks, A. J., Carbohydrate Chemistry, Oxford Chemistry Primer, Oxford University Press.
3. J Kalsi P. S., Spectroscopy of Organic Compounds, 5th Edition, New Age International Publishers, 2016.
4. Advanced Organic Chemistry, 2nd Edition, Arun Bahl & B S Bahl, S. Chand Publisher, 2012.

Reference Books:

1. Y R Sharma, Elementary Organic Spectroscopy, 5th Edition, S. Chand & Company, 2013.
2. Jag Mohan, Organic Spectroscopy and Applications, Narosa Publishers, 2012.
3. Graham Solomons T. W., Fryhle, Craig B., Snyder Scott A, Organic Chemistry, Wiley Student Ed, 11th Edition (2013).

4. Jonathan Clayden, Nick Greeves, Stuart Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.
5. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

CORE PAPER XI LAB

1. Qualitative analysis of carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
2. Qualitative analysis of unknown organic compounds containing simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.
3. Quantitative estimation of sugars:
   (c) Estimation glucose by titration with Fehling's solution.
   (d) Estimation of sucrose by titration with Fehling's solution.
   (e) Estimation glucose and sucrose in a given mixture.
4. Identification of labelled peaks in the ^{1}H NMR spectra of the known organic compounds explaining the relative δ-values and splitting pattern.
5. Identification of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (CORE PAPERH, O-H, N-H, CORE PAPERO, CORE PAPERN, CORE PAPERX, C=C, C=O, N=O, C≡C, C≡N stretching frequencies; characteristic bending vibrations are included).

Reference Books:

1. Vogel, A.I. *Quantitative Organic Analysis,* Part 3, Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

CORE PAPER XII

PHYSICAL CHEMISTRY V

Unit-I

Quantum Chemistry-I

Quantum mechanical operators, Postulates of quantum mechanics, Schrödinger equation and its application to particle in one-dimensional box (complete solution) - quantization of energy levels, zero-point energy, normalization of wave functions, probability distribution functions, nodal properties. Extension to three-dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

Rigid rotator model of rotation of diatomic molecule: Schrödinger equation, transformation to spherical polar coordinates. Separation of variables (Preliminary treatment).

Unit-II

Chemical Bonding

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wave functions, detailed solution not required) and their limitations. Localized and non-localized molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules.

Unit-III

Molecular Spectroscopy-I

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic

molecules, modes of vibration. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Unit-IV

Molecular Spectroscopy-II

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation.

Photochemistry

Characteristics of electromagnetic radiation, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching, chemiluminescence.

Recommended Text Books:

1. McQuarie D., Quantum Chemistry, University Science Publishers, 2007
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
3. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2010).
4. Prasad R K., Quantum Chemistry, New Age International Publishers, 4th Edn, 2010.
5. Rohatagi Mukherjee K K., Fundamentals of Photochemistry, Wiley Eastern Ltd., 1992.

Reference Books:

1. Puri, Sharma & Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
2. Kapoor, K. L., Text Book of Physical Chemistry, McGraw Hill, Vol. II, IV.
3. Levine, I. N. Quantum Chemistry, PHI.

CORE PAPER XII LAB

Spectroscopy/Colorimetry

1. Study of absorption spectra (visible range) of $KMnO_4$ and determine the λ_{max}

value. Calculate the energies of the transitions in kJ mol^{-1}, cm^{-1}, and eV.

2. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/ $KMnO_4$/ $K_2Cr_2O_7$ in a solution of unknown concentration.
3. Determine the dissociation constant of an indicator (phenolphthalein).

Spectrophotometric titration

1. Determine the concentration of HCl against 0.1 N NaOH spectrophotometrically.
2. To find the strength of given ferric ammonium sulfate solution of (0.05 M) by using EDTA spectrophotometrically.
3. To find out the strength of $CuSO_4$ solution by titrating with EDTA spectrophotometrically.
4. To determine the concentration of Cu(II) and Fe(III) solution photometrically by titrating with EDTA.

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W., Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).
4. J. N. Gurtu, R. Kapoor, Experimental Physical Chemistry.

CORE PAPER XIII
INORGANIC CHEMISTRY-IV

Unit-I

Organometallic Compounds-I

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands.

Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of

3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Unit-II

Organometallic Compounds-II

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethyl aluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation), structure and aromaticity, comparison of aromaticity and reactivity with that of benzene.

Unit-III

Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinson's Catalyst)
2. Hydroformylation (Co salts)
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)

Theoretical Principles in Qualitative Analysis (H_2S Scheme)

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride and phosphate) and need to remove them after Group II.

Unit-IV

Thermodynamic & kinetic aspects and reaction mechanism of metal complexes

Thermodynamic and kinetic stability, Stepwise and overall formation constants and their relationship, factors affecting stability. Introduction to inorganic reaction mechanisms-types of reaction and classification of substitution reaction. Substitution reaction of square planar complexes, Trans effect and its applications, theories of trans-effect (electrostatic polarization and Static π-Bonding Theory). Kinetics of octahedral substitution (classification of metal ions based on water exchange rate), General mechanism of ligand substitution reactions in octahedral complexes (D, I, I_d, I_a).

Recommended Text Books:

1. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd Ed., 2017.
3. Shriver D. E. Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn.
4. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996-0307.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Selected Topic in Inorganic Chemistry, Mallick, Madan and Tuli, S. Chand Publisher. 17th Ed. 2010.
3. Mehrotra R.C. and Singh, A. *Organometallic Chemistry,* New Age International Publishers, 2nd Edn, 2000.
4. Gupta B. D. and Elias A. J., Basic Organometallic Chemistry, 2nd Edn., University Press (2013).

CORE PAPER XIII LAB

- Qualitative analysis of mixtures containing 4 radicals (2 anions and 2 cations). Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

  CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}, F^-, Cl^-, Br^-, I^-, NO_3^-, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}.

- Mixtures may contain one insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or

combination of interfering anions e.g. CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^- , NO_3^- and I^-.

- Spot tests should be done whenever possible.

Reference Books:

1. Vogel's Qualitative Inorganic Analysis, 7th Ed, Revised by G. Svehela, 4th Ed., Person (2007).
2. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1st Edn., CBS Publishers & Distributors Pvt Ltd., (2017).

CORE PAPER XIV
ORGANIC CHEMISTRY-V

Unit-I

Amino Acids, Peptides and Proteins

Amino acids: Classification; α-Amino acids - Synthesis, ionic properties and reactions.

Zwitterions, pK_a values, isoelectric point and electrophoresis.

Peptides: Classification, Determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, CORE PAPER protecting and CORE PAPER activating groups - Solid-phase synthesis.

Proteins: Structure of proteins, protein denaturation and renaturation

Unit-II

Enzymes

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereo specificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

Nucleic Acids

Components of nucleic acids, Nucleosides and nucleotides;

Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine;

Structure of polynucleotides.

Unit-III

Lipids

Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Concept of Energy in Biosystems

Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism and anabolism).

Overview of catabolic pathways of fat and protein.

Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types.

Unit-IV

Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

Dyes

Classification, colour and constitution; Mordant and Vat dyes; Chemistry of dyeing. Synthesis and applications of: *Azo dyes* – Methyl orange and Congo red (mechanism of Diazo Coupling); *Triphenylmethane dyes* - Malachite Green, and crystal violet; *Phthalein dyes* – Phenolphthalein and Fluorescein.

Recommended Text books

1. Nelson, D.L., Cox, M.M. and Lehninger, A.L. Principles of Biochemistry. 6th Edn. W.H. Freeman and Co. (2013).
2. Kar Ashutosh, Medicinal chemistry, New Age International (P) Ltd., (2007)
3. Debojyoti Das, Biochemistry, (Part-I) Academic Publishers (1979)

Reference Books:

1. Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.

2. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill.
5. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry, 6th Edition. W.H. Freeman and Co. (2002).
6. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).
7. The Tools of Biochemistry (1977; Reprint 2011) Cooper, T.G., Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.

CORE PAPER XIV LAB

1. Preparations of the following compounds
   i. Aspirin
   ii. Methyl orange
2. Estimation of phenol and aniline by bromination method.
3. Saponification value of an oil/ fat/ ester.
4. Estimation of glycine by Sorenson's formalin method.
5. Estimation formaldehyde (formalin).
6. Estimation of ascorbic acid in fruit juices/Vitamin C tablet (Iodometric method)
7. Determination of Iodine number of an oil/ fat.

Reference Books:

1. Arthur, I. Vogel, Elementary Practical Organic Chemistry, Part-1 Small scale preparations, Indian Edition, Pearson (2011).
2. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
3. Arthur, I. Vogel, *Quantitative Organic Analysis,* Pearson.
4. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).

Discipline Specific Elective Paper-1

POLYMER CHEMISTRY

Unit-I

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

Unit-II

Mechanism & Kinetics of Polymerization:

Polymerization reactions – addition and condensation, mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting **point**.

Unit-III

Molecular weight of polymers and their determination (M_n, M_w, M_v, M_z) by end group analysis, viscometry and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (T_g) and it determination: WLF equation, Outlines of factors affecting glass transition temperature (T_g).

Unit-IV

Properties of polymers (physical, thermal and mechanical properties)

Preparation, structure, properties and applications of the following polymers: polyolefins (polyethylene, polypropylene), polystyrene, polyvinyl chloride, polyvinyl acetate, polyacrylamide, fluoro polymers (Teflon), polyamides (nylon-6 and nylon 6, 6). Thermosetting polymers - phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, conducting polymers (polyacetylene, polyaniline). Brief outline of biodegradable polymers.

Recommended Text Books:

1. V. R. Gowarikar, Jayadev Sreedhar, N. V. Viswanathan, Polymer Science 1st Edition, New Age International Publishers, 1986.

2. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, 3rd Edition, McGraw Hill Education, 2010.
3. P. Bahadur & N.V.Sastry, Principles of polymer science, Narosa Publishing house, New Delhi 2002.
4. Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley- Interscience (1984)

Reference books

1. L.H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
2. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
3. Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).
4. Nayak P.L., Polymer Chemistry, Kalyani Publisher (2017).

Discipline Specific Elective Paper I LAB

Polymer synthesis (At least three experiments)

1. Preparation of nylon-6,6 / Polyaniline.
2. Preparations of phenol-formaldehyde resin-novalac/ phenol-formaldehyde resin resold.
3. Preparation of urea-formaldehyde resin.
4. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
   a. Purification of monomer.
   b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN).
5. Redox polymerization of acrylamide.
6. Precipitation polymerization of acrylonitrile.

Polymer characterization/analysis (At least two different experiments)

1. Determination of molecular weight by viscometry:
   a. Polyacrylamide / Polystyrene
   b. Polyvinyl pyrolidine (PVP)
2. Determination of acid value/ saponification value of a resin.

3. Determination of hydroxyl number of a polymer using colorimetric method.
4. Estimation of the amount of HCHO in the given solution by sodium sulphite method
5. Analysis of some IR spectra of polymers – Identification of labelled peaks in IR spectra of known polymer.

Reference Books:

1. Hundiwale G.D., Athawale V.D., Kapadi U.R. and Gite V. V., Experiments in Polymer Science, New Age Publications (2009).
2. Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
3. Joel R. Fried, Polymer Science and Technology, 2nd Ed. Prentice-Hall (2003).
4. Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd Ed. John Wiley & Sons (2002).
5. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005).

Discipline Specific Elective Paper-II
GREEN CHEMISTRY

Unit-I

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.

Principles of Green Chemistry and Designing a Chemical synthesis- I

Twelve principles of Green Chemistry. Explanations of principle with special emphasis on - Designing green synthesis processes: Prevention of Waste/ by-products; maximize the incorporation of the materials used in the process into the final products (Atom Economy) with reference to rearrangement, addition, substitution and elimination reactions; Prevention/ minimization of hazardous/ toxic products; Designing safer chemicals; Use of safer solvents and auxiliaries (e.g. separating agent) - green solvents (supercritical CO_2, water, ionic liquids), solvent less processes, immobilized solvents.

Unit-II

Principles of Green Chemistry and Designing a Chemical synthesis-II

Explanation of green chemistry principles with special emphasis on:

Energy efficient processes for synthesis - use of microwaves and ultrasonic energy. Selection of starting materials (use of renewable feedstock); avoidance of unnecessary derivatization (e.g. blocking group, protection groups, deprotection); Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products use of chemically safer substances for prevention of chemical accidents, inherent safer design greener - alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol); real-time, in-process monitoring and control to prevent the formation of hazardous substances; development of green analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

Unit-III

Examples of Green Synthesis/ Reactions and some real world cases-I

Green Synthesis of the following compounds: adipic acid, catechol, methyl methacrylate, urethane, disodium iminodiacetate (alternative to Strecker synthesis), paracetamol, furfural.

Microwave assisted reactions: Applications to reactions (i) in water: Hofmann Elimination, hydrolysis (of benzyl chloride, methyl benzoate to benzoic acid), Oxidation (of toluene, alcohols); (ii) reactions in organic solvents: Diels-Alder reaction and Decarboxylation reaction.

Ultrasound assisted reactions: Applications to esterification, saponification, Simmons-Smith Reaction (Ultrasonic alternative to Iodine).

Unit-IV

Examples of Green Synthesis/ Reactions and some real world cases- II

Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments; Designing of Environmentally safe marine antifoulant; Right fit pigment: synthetic azopigments to replace toxic organic and inorganic pigments; Synthesis of a compostable and widely applicable plastic (poly lactic acid) from corn; Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

Future Trends in Green Chemistry

Oxidizing and reducing reagents and catalysts; multifunctional reagents; Combinatorial green

chemistry; Proliferation of solvent less reactions; Green chemistry in sustainable development. (Bio-diesel, bio-ethanol and biogas).

Recommended Text Books:

1. Anastas P.T. & Warner J.K.: Green Chemistry- Theory and Practical, Oxford University Press (2000).
2. Ahluwalia V.K. & Kidwai M.: New Trends in Green Chemistry, Anamalaya Publishers, New Delhi (2004).
3. Kumar V., An Introduction to Green Chemistry, Vishal Publishing Co., (2015).

Reference Books:

1. Matlack A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
2. Das Asim K. amd Das Mahua , Environment Chemistry with Green Chemistry, Books and Allied (P) Ltd. (2010)

Discipline Specific Elective Paper II LAB

At least five experiments should be done:

1. Acetylation of primary amine (Aniline to N-phenylacetamide) using Zn dust.
2. Nitration of salicylic acid by green method (Using calcium nitrate and acetic acid).
3. Bromination of acetanilide using ceric ammonium nitrate/KBr.
4. Microwave assisted nitration of Phenols using $Cu(NO_3)_2$.
5. Detection of elements in organic compounds by green method (Sodium carbonate fusion).
6. Base catalyzed Aldol condensation (Synthesis of dibenzalpropanone).
7. Vitamin C clock reaction using vitamin C tablets, tincture of iodine, hydrogen peroxide and liquid laundry starch. Effect of concentration on clock reaction.
8. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.
9. Diels Alder reaction in water: Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.
10. Preparation and characterization of nanoparticles (Cu, Ag) using plant extract.
11. Preparation of propene by following two methods or any other reactions like addition, elimination, substitution showing atomic economy can be studied

    (I) Triethylamine ion + OH^- → Propene + Trimethylpropene + water

$$\text{(II) 1-propanol} \xrightarrow{H_2SO_4/\Delta} \text{propene + water}$$

Reference Books:

1. Monograph on Green Chemistry Laboratory Experiments, edited and published by Green Chemistry Task Force Committee, DST Govt. of India, p. 1-79.
2. Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC (2002).
3. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment:A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN978-93-81141-55-7 (2013).

Discipline Specific Elective Paper-III
INDUSTRIAL CHEMICALS AND ENVIRONMENT

Unit-I

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production uses storage and hazards in handling of the following gases: oxygen, nitrogen, argon, hydrogen, acetylene, carbon monoxide, chlorine, sulphur dioxide.

Inorganic Chemicals: Manufacture, application and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate.

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

Unit-II

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone. Major sources of air pollution.

Pollution by SO_2, CO_2, CO, NO_x, and H_2S and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, removal of sulphur from coal.

Unit-III

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, fertilizer. Sludge disposal.

Industrial waste management: incineration of waste. Water treatment and purification (reverse osmosis, ion exchange). Water quality parameters for wastewater, industrial water and domestic water.

Unit-IV

Energy and Environment

Sources of energy: Coal, petrol and natural gas. Nuclear fusion/fission, solar energy, hydrogen, geothermal, tidal and hydel.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis

Introduction to biocatalysis: Importance in green chemistry and chemical industry.

Recommended Text Books:

1. De, A. K. *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi, 2010.
2. Stocchi E., *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Reference Books:

1. Felder R.M. and Rousseau R.W., *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
2. Dara S. S., *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
3. Miller G.T., Environmental Science, 11th edition. Brooks/ Cole (2006).
4. Mishra, Environmental Studies, Selective and Scientific Books, New Delhi (2005).

Discipline Specific Elective Paper III LAB

1. Determination of Dissolved Oxygen (DO) in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Reference Books:

1. Dara S. S., A Textbook on Experiments and Calculations in Engineering Chemistry S Chand & Company; 9th revised edition (2015).
2. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
3. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
4. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.

Discipline Specific Elective Paper-IV

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

Unit I

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and nonsilicate glasses). Manufacturing and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Unit II

Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Unit III

Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings, metal spraying and anodizing.

Unit IV

Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon, decarbonization, demanganization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment nitriding, carburizing). Composition and properties of different types of steels.

Chemical explosives: Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Recommended Text Books:

1. Stocchi E., *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
3. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.

Reference Books:

1. Felder R.M. and Rousseau R.W., *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
2. Dara S. S., *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
3. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.

Discipline Specific Elective Paper-IV LAB

List of Practicals

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Determination of composition of dolomite (by complexometric titration).
5. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
6. Analysis of Cement.
7. Estimation of Iron from Cement Volumetrically
8. Preparation of pigment (zinc oxide).

Reference Books

1. Dara S. S., A Textbook on Experiments and Calculations in Engineering Chemistry S Chand & Company; 9th revised edition (2015).
2. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
3. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley

Publishers, New Delhi.
4. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
5. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
6. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
7. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.

Alternative to DSC CORE PAPER IV

Discipline Specific Elective Paper- V

DISSERTATION

A project work is to be carried out by the student in consultation with the teachers of the department. The report of work (dissertation) in a standard format is to be submitted and presented for evaluation.

Distribution of marks

(a) Project Report/Dissertation (Proper documentation of literature, data, discussion etc. and logical flow of work undertaken): 50 Marks
(b) Seminar/Presentation: 30 marks
(c) Viva voce: 20 marks

Brief Guidelines to Project Work:

1. Students shall undertake the project work (experimental/theoretical) related to any branch of chemistry/Chemical science under the guidance of teacher(s) from the department or jointly with teachers/research personnel of other institutes.
2. The following activities have been outlined as guidelines (not exhaustive):
   - Physiochemical studies (pH, conductivity, turbidity, etc.) of different wetlands (ponds, lakes, river etc.)
   - Analysis of iron in pond / tube well / river water.
   - Analysis of Hardness of water samples.
   - Adulteration detection activities in food stuff and other edible items.
   - Extraction and preliminary characterization of useful chemicals (as far as possible) from plants.
   - Solubility, surface tension, and viscosity measurements of some solution of practical

relevance, (cough syrup, soap solution, pesticides, fertilizers.. etc.)

- Pollution related activities (Industrial/Agricultural/Municipal etc.)
- Nutrition related activities, (essential metal detection in food, cereals, pulses, fruits etc.).
- Small synthetical work (inorganic/Organic/Polymeric compounds)

2. The UG level project work is a group activity, maximum number of students being limited to three. HOD to notify the name of teacher(s) for supervising the project work of each group. A teacher can guide more than one group, if necessary.
4. No two groups in the same institution are permitted to do project work on the same problem.
5. Each student shall prepare and submit the project report separately for evaluation. Two copies of project report are required to be submitted in bound form (spiral/paperback).
6. The project report shall be divided as:

Chapter I: Introduction (Introduction on the topic, review of literature, objective and scope of the work)
Chapter II: Materials and methods
Chapter II: Results and discussion
Chapter IV: Conclusions and Scope of future studies
Chapter V: References

Reference Books:

1. M. A. Malati, An Investigative, Integrated Approach to Practical Project Work; Mid-Kent College of Higher/Further Education, UK (October 1999); Imprint: Woodhead Publishing; ISBN: 978-1-898563-47-1.
2. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) Practical skills in chemistry. 2nd Ed., Prentice-Hall, Harlow.

<u>Alternative for Discipline Specific Elective (DSE) Papers</u>

Discipline Specific Elective Paper-VI

ANALYTICAL METHODS IN CHEMISTRY

Unit I

UV-Visible and IR Spectrometry

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Unit II

Qualitative and quantitative aspects of analysis

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Flame Atomic Absorption Spectrometry

Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Unit III

Thermal and electro-analytical methods of analysis

Theory of thermo-gravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

Classification of electro-analytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.

Unit IV

Separation techniques

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: TLC and HPLC.

Recommended text books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed., The English Language Book Society of Longman.
2. Skoog, Holler and Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Indian Reprint (2017).
3. Christian, Gary D; Analytical Chemistry, 6th Ed., John Wiley & Sons, New York, 2004.

Reference books

1. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W. H. Freeman, 2001.
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed., Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
4. Pavia, Lamman, Kriz and Vyvyan, Introduction to Spectroscopy, Cengage Learning, 3rd Indian Reprint (2017).
5. Dash U N , Analytical Chemistry.

Discipline Specific Elective Paper -VI LAB

1. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.
2. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.
3. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.

4. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.
5. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
6. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.
7. Analysis of soil: determination of pH of soil, total soluble salt, estimation of calcium, magnesium, phosphate, nitrate.
8. Separation of metal ions from their binary mixture.
9. Separation of amino acids from organic acids by ion exchange chromatography.
10. Determination of dissolved oxygen in water.
11. Determination of chemical oxygen demand (COD).

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G. H. Jeffery and others) 5th Ed., The English Language Book Society of Longman.
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed., Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

GENERIC ELECTIVE (GE)

Generic Elective Paper I (Theory)

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Section A: Inorganic Chemistry-I

Unit-I

Atomic Structure

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Quantum numbers and their significance, shapes of s, p and d atomic orbitals, nodal planes.

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbital, Anomalous electronic configurations.

Unit-II

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics, energy considerations. Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules and its applications.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s*-*s*, *s*-*p* and *p*-*p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, NO). Comparison of VB and MO approaches.

Section B: Organic Chemistry-I

Unit- III

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive effect, Electrometric effect, Resonance and hyperconjugation. Cleavage of bonds: Homolysis and heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Hückel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis-trans nomenclature; CIP Rules: R/ S (for one chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).

Unit-IV

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons) *Preparation:* Catalytic hydrogenation, Wurtz reaction,Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Up to 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis-alkenes (Partial catalytic hydrogenation) and trans-alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti- Markownikoff's addition), Hydration, Ozonolysis.

Alkynes: (Up to 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,ozonolysis.

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5thEdn., 2008.

2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd Ed., 2017.
3. Shriver D. E., Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn.
4. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, Pearson Education, 4th Ed. 2002.
5. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Bhal Arun & Bhal B S , Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
7. Kalsi, P. S. Stereochemistry Conformation and Mechanism; 8th Edn, New Age International, 2015.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.
3. Mallick, Madan and Tuli, S. Chand Selected Topic in Inorganic Chemistry, 17thEdn. 2010.
4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications.

Generic Elective Paper I LAB

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl) in organic compounds (containing up to two extra elements)

2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

Generic Elective Paper II (Theory)

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

Section A: Physical Chemistry-I

Unit-I

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics.

Chemical Equilibrium

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases.

Unit- II

Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B: Organic Chemistry-II

Unit- III

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Alkyl and Aryl Halides

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SN_i) reactions.

Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Unit- IV

Alcohols, Phenols and Ethers (Up to 5 Carbons)

Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes and ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, Alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer Tiemann Reaction, Gattermann -Koch Reaction,

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): Formaldehyde, acetaldehyde, acetone and benzaldehyde

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co, 47th Edn., 2017.
3. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3rdEdn. 2017.
4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
2. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Generic Elective Paper II LAB

Section A: Physical Chemistry

Thermochemistry (any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.

6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH measurements

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b) Preparation of buffer solutions:

- Sodium acetate-acetic acid
- Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water) and determination of melting.
2. Preparations, recrystallisation, determination of melting point and calculation of quantitative yields of the followings:

(a) Bromination of Phenol/Aniline

(b) Benzoylation of amines/phenols

(c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
4. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

Generic Elective Paper III (Theory)

CHEMISTRY OF S- AND P-BLOCK ELEMENTS, STATES OF MATTER & CHEMICAL KINETICS

Section A: Inorganic Chemistry-II

Unit-I

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Fe, Cu, Ni): electrolytic, oxidative refining, Parting process, van Arkel-de Boer process and Mond's process.

***s*- and *p*-Block Elements**

Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling & Mulliken scales). Allotropy in C, S, and P.

Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

Unit-II

Compounds of *s*- and *p*-Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements.

Concept of multicentre bonding (diborane).

Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

Hydrides of nitrogen (NH_3, N_2H_4, N_3H, NH_2OH); Oxoacids of P, S and Cl; Halides and oxohalides: PCl_3, PCl_5, $SOCl_2$.

Section B: Physical Chemistry- II

Unit-III

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Unit-IV

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, and CsCl (qualitative treatment only). Defects in crystals.

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5th Edn., 2008.

2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
3. Shriver D. E., Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn.
4. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co, 47th Edn., 2017.
5. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3rd Edn. 2017.

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

Generic Elective Paper -III LAB

Section A: Inorganic Chemistry

Qualitative analysis of inorganic slat mixture using H_2S: not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions: CO_3^{2-}, S^{2-}, SO_3^{2-}, NO_3^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, F^-

(Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
    a. Acid hydrolysis of methyl acetate with hydrochloric acid.
    b. Saponification of ethyl acetate.
    c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. Svehla, G, Vogel's Qualitative Inorganic Analysis, 7th Ed, 4th Ed., Pearson Education (2007).

2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
3. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1st Edn., CBS Publishers & Distributors Pvt Ltd., (2017).

Generic Elective Paper- IV (Theory)

ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

Section A: Inorganic Chemistry- III

Unit-I

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. π-acceptor behaviour of carbon monoxide. Synergic effects (VB approach).

Unit-II

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, and structural role (bones).

Section B: Organic Chemistry- III

Unit-III

Polynuclear and heteronuclear aromatic compounds

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having up to 6 carbon).

Unit-IV

Application of Spectroscopy (UV-Visible, IR) to Simple Organic Molecules

Electromagnetic radiations, electronic transitions, λ_{max} & ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes and α, β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

Recommended Text Books:

1. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
2. Shriver D. E., Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn.
3. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Das Asim K., Bioinorganic Chemistry, Books & Allied (P) Ltd. 1st ed. 2015.
3. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.
4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Generic Elective Paper IV LAB

Section A: Inorganic Chemistry

1. Preparation of following compounds (Any two)

a. Cuprous oxide (Cu_2O)

b. Cuprous chloride, Cu_2Cl_2

c. Manganese(III) phosphate, $MnPO_4.H_2O$

d. Lead chromate ($PbCrO_4$)

2. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)

- Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or
- Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}

Section B: Organic Chemistry

Systematic qualitative organic analysis of organic compounds possessing mono-functional groups (-COOH, phenolic, aldehyde, ketone, amide, nitro, amines) and preparation of one derivative.

Reference Books

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Edn, Pearson, 2009.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).
4. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1st Edn., CBS Publishers & Distributors Pvt. Ltd., (2017).

Course structure of UG Chemistry Pass

Semester	Course	Course Name	Credits	Total marks
I	DSC-I DSC-I Practical	Atomic structure, bonding, general organic chemistry &aliphatic hydrocarbons	04 02	75 25
II	DSC-II DSC-II Practical	Chemical energetics, equilibria & functional organicchemistry	04 02	75 25
III	DSC-III DSC-III Practical	Chemistry of s- and p-block elements, states of matter &chemical kinetics	04 02	75 25
IV	DSC-IV DSC-IV Practical	Organometallics, bioinorganic chemistry, polynuclear hydrocarbons and UV, IR spectroscopy	04 02	75 25
V	DSE-I DSE-I Practical	Polymer chemistry	04 02	75 25
VI	DSE-II DSE-II Practical	Industrial chemicals and Environment	04 02	75 25
			36	**600**

CHEMISTRY PAPERS FOR PASS STUDENTS

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical: 25 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper – 40 hours theory classes + 20 hours practical classes

Discipline Specific Core Paper I (Theory)

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Section A: Inorganic Chemistry-1

Unit-I

Atomic Structure

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Quantum numbers and their significance, shapes of s, p and d atomic orbitals, nodal planes.

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit-II

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics, energy considerations. Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules and its applications.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, NO). Comparison of VB and MO approaches.

Section B: Organic Chemistry-1

Unit- III

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive effect, Electrometric effect, Resonance and hyperconjugation. Cleavage of bonds: Homolysis and heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Hückel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis-trans nomenclature; CIP Rules: R/ S (for one chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).

Unit-IV

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons) *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Up to 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenesand dehydrohalogenation of alkyl halides (Saytzeff's rule); cis-alkenes (Partial catalytic hydrogenation) and trans-alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis,

Alkynes: (Up to 5 Carbons) *Preparation:* Acetylene from $CaC_2$and conversion intohigher

alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.
Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,ozonolysis.

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5th Edn., 2008.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
3. Shriver D. E. Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn..
4. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
5. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Bhal Arun & Bhal B S, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
7. Kalsi, P. S. Stereochemistry Conformation and Mechanism; 8thEdn, New Age International, 2015.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.
3. Mallick, Madan and Tuli, S. Chand Selected Topic in Inorganic Chemistry, , 17thEdn. 2010.
4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Discipline Specific Core Paper-I LAB

Section A: Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO4.
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.

4. Estimation of Fe(II) ions by titrating it with K2Cr2O7 using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

Section B:Organic Chemistry

1. Detection of extra elements (N, S, Cl) in organic compounds (containing up to two extra elements)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
   (c) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
   (d) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press

Discipline Specific Core Paper II (Theory)

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

Section A: Physical Chemistry-1

Unit-I

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics.

Chemical Equilibrium

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases.

Unit- II

Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle

Section B: Organic Chemistry-II

Unit- III

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Alkyl and Aryl Halides

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SN_i) reactions.

Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Unit- IV

Alcohols, Phenols and Ethers (Up to 5 Carbons)

Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes and ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer Tiemann Reaction, Gattermann-Koch Reaction,

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): Formaldehyde, acetaldehyde, acetone and benzaldehyde

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction.

Recommended Text Books:

1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co, 47th Edn., 2017.
3. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3rd Edn. 2017.
4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
2. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Discipline Specific Core Paper II LAB

Section A: Physical Chemistry

Thermochemistry (any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

1. pH measurements

   Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
2. Preparation of buffer solutions:
   - Sodium acetate-acetic acid
   - Ammonium chloride-ammonium hydroxide

   Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water) and determination of melting.
2. Preparations, recrystallisation, determination of melting point and calculation of quantitative yields of the followings:

   (a) Bromination of Phenol/Aniline

   (b) Benzoylation of amines/phenols

   (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
4. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

Discipline Specific Core Paper III (Theory)

CHEMISTRY OF S- AND P-BLOCK ELEMENTS, STATES OFMATTER & CHEMICAL KINETICS

Section A: Inorganic Chemistry-II

Unit-I

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Fe, Cu, Ni): electrolytic, oxidative refining, Parting process, van Arkel-de Boer process and Mond's process.

***s*- and *p*-Block Elements**

Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling & Mulliken scales). Allotropy in C, S, and P.

Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

Unit-II

Compounds of *s*- and *p*-Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements.

Concept of multicentre bonding (diborane).

Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

Hydrides of nitrogen (NH_3, N_2H_4, N_3H, NH_2OH); Oxoacids of P, S and Cl; Halides and

oxohalides: PCl_3, PCl_5, $SOCl_2$.

Section B: Physical Chemistry- II

Unit-III

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Unit-IV

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, and CsCl (qualitative treatment only). Defects in crystals.

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular

reactions. Comparison of the two theories (qualitative treatment only).

Recommended Text Books:

1. Lee J. D., Concise Inorganic Chemistry, Wiley India, 5th Edn., 2008.
2. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
3. Shriver D. E. Atkins P. W., Inorganic Chemistry, Oxford University Press, 5th Edn..
4. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co, 47th Edn., 2017.
5. K. L. Kapoor, Text Book of Physical Chemistry, Mac Grow Hill, 3rd Edn. 2017.

Reference Books:

1. Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
2. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.

Discipline Specific Core Paper III LAB

Section A: Inorganic Chemistry

Qualitative analysis of inorganic slat mixture using H_2S: not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions: CO_3^{2-}, S^{2-}, SO_3^{2-}, NO_3^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, F^-

(Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

1. Chemical Kinetics
2. Study the kinetics of the following reactions.
3. Initial rate method: Iodide- persulphate reaction
4. Integrated rate method:
    a. Acid hydrolysis of methyl acetate with hydrochloric acid.
    b. Saponification of ethyl acetate.
    c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. Svehla, G, Vogel's Qualitative Inorganic Analysis, 7th Ed, 4th Ed., Pearson Education (2007).
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
3. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt Ltd., (2017).

Discipline Specific Core Paper - IV (Theory)

ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

Section A: Inorganic Chemistry- III

Unit-I

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. π-acceptor behaviour of carbon monoxide. Synergic effects (VB approach).

Unit-II

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, and structural role (bones).

Section B: Organic Chemistry-III

Unit-III

Polynuclear and heteronuclear aromatic compounds

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having up to 6 carbon).

Unit-IV

Application of Spectroscopy (UV-Visible, IR) to Simple Organic Molecules

Electromagnetic radiations, electronic transitions, λ_{max} & ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes and α, β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

Recommended Text Books:

1. Puri, Sharma, Kalia, Principles of Inorganic Chemistry, Vishal Pub. Co., 33rd ed., 2017.
2. Shriver D. E. Atkins P. W., Inorganic Chemistry, Oxford University Press, 5thEdn..
3. Huheey J. E., Keiter E. A. and Keiter R. L., Inorganic Chemistry – Principles of structure and reactivity, , Pearson Education, 4th Ed. 2002.
4. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Arun Bahl & B S Bahl, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.

Reference books

1. Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.

2. Das Asim K., Bioinorganic Chemistry, Books & Allied (P) Ltd. 1st ed. 2015.
3. Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.
4. Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

Discipline Specific Core Paper -IV LAB

Section A: Inorganic Chemistry

1. Preparation of following compounds (Any two)

a. Cuprous oxide (Cu_2O)

b. Cuprous chloride, Cu_2Cl_2

c. Manganese(III) phosphate, $MnPO_4.H_2O$

d. Lead chromate ($PbCrO_4$)

2. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)

- Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or
- Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}

Section B: Organic Chemistry

Systematic qualitative organic analysis of organic compounds possessing mono-functional groups (-COOH, phenolic, aldehyde, ketone, amide, nitro, amines) and preparation of one derivative.

Reference Books

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Edn, Pearson, 2009.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).
4. Gulati Shikha , Sharma Gulati JL and Manocha, Shagun, Practical Inorganic Chemistry, 1stEdn., CBS Publishers & Distributors Pvt. Ltd., (2017).

Discipline Specific Elective (DSE) - Pass

Discipline Specific Elective Paper –I

POLYMER CHEMISTRY

Unit-I

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

Unit-II

Mechanism & Kinetics of Polymerization:

Polymerization reactions – addition and condensation, mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Unit-III

Molecular weight of polymers and their determination (M_n, M_w, M_v, M_z) by end group analysis, viscometry and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (T_g) and it determination: WLF equation, Outlines of factors affecting glass transition temperature (T_g).

Unit-IV

Properties of polymers (physical, thermal and mechanical properties).

Preparation, structure, properties and applications of the following polymers: polyolefins (polyethylene, polypropylene), polystyrene, polyvinyl chloride, polyvinyl acetate, polyacrylamide, fluoro polymers (Teflon), polyamides (nylon-6 and nylon 6,6). Thermosetting polymers - phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, conducting polymers (polyacetylene, polyaniline). Brief outline of biodegradable polymers.

Recommended Text Books:

1. V. R. Gowarikar, Jayadev Sreedhar, N. V. Viswanathan, Polymer Science 1st Edition, New Age International Publishers, 1986.

2. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, 3rd Edition, McGraw Hill Education, 2010.
3. P. Bahadur & N.V.Sastry, Principles of polymer science, Narosa Publishing house, New Delhi 2002.
4. Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley- Interscience (1984)

Reference books

1. L.H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
2. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
3. Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).
4. Nayak P.L., Polymer Chemistry, Kalyani Publisher (2017).

Discipline Specific Elective Paper -I LAB

Polymer synthesis (Any three)

1. Preparation of nylon-6,6 / Polyaniline
2. Preparations of novalac resin/resold resin.
3. Preparation of urea-formaldehyde resin
4. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
5. Purification of monomer
6. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
7. Redox polymerization of acrylamide
8. Precipitation polymerization of acrylonitrile

Polymer characterization/analysis

1. Determination of molecular weight by viscometry:
   Polyacrylamide/Polystyrene
   Poly vinyl pyrolidine (PVP) in water
2. Determination of acid value / saponification value of a resin
3. Determination of hydroxyl number of a polymer using colorimetric method.
4. Estimation of the amount of HCHO in the given solution by sodium sulphite method

5. Analysis of some IR spectra of polymers

Reference Books:

1. Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
2. Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)
3. Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)
4. L.H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
5. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
6. Seymour/Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

Discipline Specific Elective Paper –II
INDUSTRIAL CHEMICALS AND ENVIRONMENT

Unit-I

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, hydrogen, acetylene, carbon monoxide, chlorine, sulphur dioxide.

Inorganic Chemicals: Manufacture, application and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate.

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

Unit-II

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in

atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone. Major sources of air pollution.

Pollution by SO_2, CO_2, CO, NO_x, and H_2S and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, removal of sulphur from coal.

Unit-III

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources andnature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, fertilizer. Sludge disposal.

Industrial waste management: incineration of waste. Water treatment and purification (reverse osmosis, ion exchange). Water quality parameters for wastewater, industrial water and domestic water.

Unit-IV

Energy and Environment

Sources of energy: Coal, petrol and natural gas. Nuclear fusion/fission, solar energy, hydrogen, geothermal, tidal and hydel.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis

Introduction to biocatalysis: Importance in green chemistry and chemical industry.

Recommended Text Books:

1. De, A. K. *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi, 2010.
2. Stocchi E., *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Reference Books:

1. Felder R.M. and Rousseau R.W., *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
2. Dara S. S., *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
3. Miller G.T., Environmental Science, 11th edition. Brooks/ Cole (2006).
4. Mishra, Environmental Studies, Selective and Scientific Books, New Delhi (2005).

Discipline Specific Elective Paper II LAB

INDUSTRIAL CHEMICALS & ENVIRONMENT

1. Determination of Dissolved Oxygen (DO) in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Reference Books:

1. Dara S. S., A Textbook on Experiments and Calculations in Engineering Chemistry S Chand & Company; 9th Revised edition (2015).
2. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
3. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
4. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi

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SKILL ENHANCEMENT COMPULSORY COURSES (SECC)

Optional for SECC II paper

Skill Enhancement Compulsory Courses (SECC Option-I)

PESTICIDE CHEMISTRY

(Credits-02) Max. Marks: 50
THEORY (Each class 1 hr.): (Mid Sem – 10; End Sem – 40)

30 Lectures

Unit-I

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship.

Unit- II

Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene); Organophosphates (Malathion, Parathion).

Unit- III

Synthesis and technical manufacture and uses of representative pesticides in the following classes:
Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Unit-IV

Ecofriendly pesticides.
Safety measures: Environmental aspects and degradability.

Reference Book:

1. R. J. W. Cremlyn: *Pesticides:* John Wiley and Sons Ltd (1978)
2. D.S. Reddy, M. Pushpa Latha, Pesticides, New Vishal Publications (2015).
3. Roy N. K., Chemistry of Pesticides. CBS Publisher & Distributors P Ltd; 1st Ed. (2010)

Skill Enhancement Courses (SECC Option-II)

FUEL CHEMISTRY

(Credits-02)-Max. Marks: 50
THEORY (Each class 1 hr.): (Mid Sem – 10; End Sem – 40)

30 Lectures

Unit- I

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value

Unit- II

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro

gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Unit -III

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Unit- IV

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
3. B.K. Sharma: *Industrial Chemistry,* Goel Publishing House, Meerut.

List of topics included in CBCS syllabus requiring training of College Teachers for 21 days

Theory (15 days)

1. Quantum Chemistry
2. Organometallics
3. Coordination Chemistry
4. Polymer Chemistry
5. Green Chemistry
6. Organic Chemistry

Practical (6 days)

1. Green chemistry and other new practical's introduced in the new CBCS syllabus

List of minimum instrument required for undertaking practical classes of UG-CBCS in Chemistry (Core and DSC Practicals)

Sl.	**Name of the instrument**	**Numbers**
1.	Ostwald's viscometer	02
2.	Tensiometer (Surface tension measurements)	01
3.	Digital pH-meter with accessories	02
4.	Digital Conductivity meter with accessories	02

5.	Potentiometer with accessories	01
6.	Colorimeter	01
7.	Calorimeter with accessories (precision thermometer)	01
8.	Visible spectrophotometer (single beam)	01
9.	Magnetic stirrer (with/without hot plate)	02
10.	Heating mantle	01
11.	Melting point apparatus	02
12.	Vacuum pump for filtration	01
13.	Single distillation units (All glass) 2lit/hr capacity	02
14.	Single pan digital balance with precision 0.01 gm and 0.001 gm	02
15.	Water bath (Electrical)	01
16.	Fume hood	01
17.	Kipp's apparatus (PP)	02
18.	Fire extinguishers	02
19.	Aspirator for chromatographic developer	01
20.	Air oven (up to 300^{o}C)	01
21.	Microwave oven (kitchen quality)	01

22.	Small lab accessories like glassware, plastic wares, laboratory wires and other small accessories as per requirement.	

MASTER OF SCIENCE IN CHEMISTRY

(SEMESTER PATTERN)

CHOICE BASED CREDIT SYSTEM SYLLABUS
TWO YEAR FULL TIME PROGRAMME

COURSE OF STUDIES

(AS PER U.G.C. MODEL SYLLABUS)

(2022 -2023)

P. G. DEPARTMENT OF CHEMISTRY
DHENKANAL (A) COLLEGE
DHENKANAL

COURSE OF STUDIES
FOR THE M. Sc. EXAMINATION IN CHEMISTRY
DHENKANAL (A) COLLEGE, DHENKANAL

(2022-2023)

PREFACE

Master of Science (M.Sc.) in Chemistry is a full time two years post-graduation programme of Utkal University. The choice based credit system (CBCS) syllabus in M. Sc. Chemistry is comprised of four semesters, having total of 80 credits (1800 marks). There are 13 theory papers carrying FOUR credits each with 100 full marks. Out of which mid and end semester examinations carry 30 marks and 70 marks, respectively. The duration of end semester examination is THREE hours. Besides there are 4practical papers (4 credit each and full mark 100) with end semester examination of six hours duration. There is a compulsory seminar paper in 3rd semester of 4 credits (100 Marks). Each student has to give a seminar presentation on a topic related to chemistry. The fourth semester has a compulsory project work of 8 credits (200 marks). Students are required undertake a project work after completion of 2nd semester and submit project report in the 4th semester for evaluation.

Each theory paper will contain 4 units. Four Questions will be set from each unit with long and short answer type questions bearing 14 marks each with alternative options. Fifth question will be two short notes from all units bearing 14 marks 2 out of four). The question paper will comprise both subjective and objective with problem oriented approach.

PROGRAM OBJECTIVES:

- To impart knowledge in fundamental aspects of all branches of chemistry (Organic, Inorganic, Physical and Polymer Chemistry) along with the current scientific status and new developments in Chemistry.
- To acquire deep knowledge in the specific areas like spectroscopy, solid state chemistry, environmental chemistry etc.
- To teach the students about good laboratory practices, safety of oneself and others in the laboratory.
- To acquire the different practical skills, hand on training on basic equipment, and data analysis for research and better job prospective.
- To train the students in accepting the challenges in Chemistry and to become a responsible citizen in the society.

PROGRAM OUTCOMES:

On completion of the M.Sc. Chemistry programme, the students will:

- Acquire the in-depth functional knowledge of the fundamental principles and contemporary practices of chemistry and ability to use them to investigate, explain and predict the new phenomena.
- Acquire skills to design, execute and document of laboratory experiments at a level suitable to succeed at an entry level position in research, academia, or chemical industry.
- Develop an awareness of social, economic, environmental and technological implication of chemistry.
- Find job opportunities in Chemical, pharmaceutical, and other chemistry based industries; Research & Development in various scientific/academic institutions.
- Have the ability to disseminate research results orally, and in writing.

Structure of syllabus for CBCS Semester Pattern

M.Sc. (Chemistry) Programme effective from the session- (2022 -23)

SEMESTER I

Core Paper	**Subject (Paper)**	**Code**	**Credit**	**Full Marks**	**Total Marks**
Theory-CT-1	Inorganic Chemistry-I	CH-401	4	100	**500 Total Credit-20 (Marks and credits of Add on course is not included)**
Theory-CT-2	Organic Chemistry- I	CH -402	4	100	
Theory-CT-3	Physical Chemistry –I	CH -403	4	100	
Theory-CT-4	Spectroscopy-I	CH-404	4	100	
Practical-CP-1	Inorganic Chem-I Organic Chem. -I	CH -405 CH-406	2 2	50 50	
Add on course					
Theory					
Theory					

SEMESTER II

Core Paper	**Subject (Paper)**	**Code**	**Credit**	**Full Marks**	**Total Marks**
Theory-CT-5	Inorganic Chemistry-II	CH -407	4	100	**500 Total Credit-20 (Marks and credits of Add on course is not included)**
Theory-CT-6	Organic Chemistry-II	CH -408	4	100	
Theory-CT-7	Physical Chemistry-II	CH -409	4	100	
Theory-CT-8	Spectroscopy-II	CH -410	4	100	
Practical-CP-2	Inorganic Chem.-II Organic Chem.-II	CH -411 CH-412	2 2	50 50	
Add on course					
Theory					
Theory					

SEMESTER III

Core Paper	**Subject (Paper)**	**Code**	**Credit**	**Full Marks**	**Total Marks**
Theory-CT-9	Pericyclic reactions, Photochemistry	CH -501	4	100	**500 Total Credit-20 (Marks and credits of Add on course is not included)**
Theory-CT-10	Bioinorganic & Supra-molecular Chemistry	CH -502	4	100	
Theory-CT-11	Polymer Chemistry	CH -503	4	100	
Practical-CP-3	Physical Chem.-I Applied Chem.-I	CH -504 CH-505	2 2	50 50	
Seminar-CS-1	Seminar	CH-506	4	100	
Add on courses					

SEMESTER IV

Core Elective Papers	**Subject (Paper)**	**Code**	**Credit**	**Full Marks**	**Total Marks**
Theory-CT-12	Bioorganic chemistry	CH -507	4	100	**500 Total Credit-20 (Marks and credits of Add on course is not included)**
Theory-CT-13	Organic synthesis	CH -508	4	100	
Dissertation - CD-1	Project work	CH -509	8	200	
Practical	Physical Chem.-II Applied Chem.-II	CH -510 CH-511	2 2	50 50	
Add on course					

Total Credit = 80, Total full marks = 2000

*****Add on course is open to M. Sc. students of Physics, Chemistry, Zoology, Botany, Biotechnology, Geology and Pharmacy. ***Add on course is open to any discipline Dhenkanal (A) College, Dhenkanal**

SEMESTER-I

CH 401: INORGANIC CHEMISTRY-I

Mid Sem: 30 marks End Sem: 70 marks

Objective:

(i) To understand the concepts of bonding and stereochemistry of main group elements, (ii) To learn about the formation and stability of metal complexes and their determination and (iii) Mechanistic aspects of different types of reaction of metal complexes in solution.

Outcome: At the end of the course the student will

(i) Acquire the knowledge and have the ability to describe the bonding and stereochemistry of different inorganic compounds and ions. (ii) Be able understand the concept stability constant, its determination and application in different fields (iii) Understand the reactions and mechanism of different types of reactions in coordination compounds and their applications in practical fields.

UNIT I

Stereochemistry and Bonding in Main Group Compounds

VSEPR, Bent rule and energetics of hybridization, Walsh diagrams (tri-and penta-atomic molecules), d_{π}-p_{π} bonds, some simple reactions of covalently bonded molecules.

Wade's rule, Styx number, carboranes, isolobal analogy, Lipscom topology, applications of boron compounds, synthesis and structures of S-N cyclic compounds.

UNIT II

Metal –Ligand Equilibria in Solution

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ions and ligands, chelate and macrocyclic effect and their thermodynamic origin, determination of binary formation constants by pH- metry and spectrophotometry.

UNIT III

Reaction Mechanism of Transition Metal Complexes

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic applications of valence bond and crystal field theories, kinetics of octahedral substitution. Acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, Reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes. The trans effect, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, Inner sphere type reactions

Books Recommended:

1. Advanced Inorganic Chemistry, F. A. Cotton, M. Bochmann, C. A. Murillo, G. Wilkinson, 6th Ed., Wiley India (2007).
2. Inorganic Chemistry, J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, 4th Ed., Pearson Education (2006).
3. Chemistry of the Elements, N.N. B. Greenwood and A. Earnshow, Pergamon, 2nd Ed (1997)
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier, 2nd Ed., (1984).
5. Comprehensive Coordination Chemistry eds., G. Wilkinson, R. D. Gillards and J. A. McCleverty, Pergamon (2003).
6. Fundamental Concepts of Inorganic Chemistry, Vol. 2, 4 & 5; Asim K. Das, CBS Publisher, 2nd Ed., (2013).
7. Mechanism of Inorganic Reactions, F. Basolo and R.G. Pearson, Wiley Eastern, (1967).

8. Inorganic Chemistry, K.F. Purcell & J.C. Kotz, Cengage Learning, Indian Ed., (2010).
9. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, Willey, 3rd Ed., (2006).

CH 402: ORGANIC CHEMISTRY - I

Mid Sem : 30 marks

End Sem: 70 marks

Objective:

To understand the molecular details in greater depth on following topics: aromaticity, stereochemistry, and substitution reactions in aliphatic compounds.

Outcome:

Upon completion of this course students will be able to: (i) Understand the fundamental aspects of aromaticity, nonaromaticity and antiaromaticity, (ii) Feel the structural details of organic compounds and the origin of optical activity of the chiral molecules, (iii) Understand the origin of stereoselectivity as far as asymmetric catalysis is concern, and the basic mechanism of substitution reactions in aliphatic compounds.

UNIT I

Structure, Reactivity and Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π- molecular orbitals, annulenes, antiaromaticity, ψ-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, Catenanes and Rotaxanes.

UNIT II

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Hard and soft acids and bases.

Effect of structure on reactivity- resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationships, substitutent and reaction constants. Taft equation.

UNIT III

Stereochemistry

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotropic and diastereotropic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis using chiral reagent, chiral catalysts, chiral auxiliary and chiral substrates (*Felkin-Anh* model and *Cram's* rule). Optical activity in the absence of chiral carbon (biphenyls, allenes, spiranes, transcycloalkene and metallocenes), chirality due to helical shape.

UNIT IV

Aliphatic Nucleophilic Substitution

The S_N2, S_N1, S_Ni mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group

mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance

Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.
Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Substitution

Bimolecular mechanisms - SE2 and SEi. The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Books Recommended

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R. J. Sundberg, Plenum.
3. A Guide Book of Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H. O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M.Coxon, Blackie Academic & Professional.
8. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherjee and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds, Ernest L. Eliel and Samuel H. Wilen, Wiley.
11. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
12. Basic Stereochemistry of Organic molecules, Subrata Sen Gupta, Oxford University Press; First edition.
13. Organic synthesis: Clayden, Greeves, Warren and Wouthers, Oxford Univ. Press.

CH 403: PHYSICAL CHEMISTRY - I

Mid Sem : 30 marks

End Sem: 70 marks

Objective:

The topics covered under the course are inherently very fundamental and intended to provide the basic understanding at atomic and subatomic level. The objective of the course to study and understand the concept of energy, the transfer of energy into work, capacity of energy to function, entropy, enthalpy, chemical potentials, thermodynamic laws, criterion for determination of the feasibility or spontaneity of a given transformation, partial molar properties, their determinations. The course is designed in a manner in which a bridge between classical thermodynamics and quantum mechanics can be established.

Outcome:

Understanding the underlying concepts and realization of quantum mechanics will be useful in solving problems at realistic atomic and molecular level, in particularly in the field of spectroscopy and analytical chemistry. Understanding thermodynamics requires knowledge of how the microscopic world operates and importance of reversible and irreversible processes.

UNIT I
Quantum Chemistry
Introduction to Exact quantum Mechanical Results

Postulates of quantum mechanics, Schrodinger equation and discussion of solutions of the

Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotator, the hydrogen atom.

UNIT II

Approximate Methods

The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom.

Angular Momentum

Ordinary angular momentum, generalized angular momentum, eigenfunctions for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular moments, spin, antisymmetry and Pauli exclusion principle.

Molecular Orbital Theory

Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc.

UNIT III

Statistical Thermodynamics

Thermodynamic probability concept of ensemble. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers) Maxwell- Boltzmann, Bose-Einstein and Fermi Dirac statistics.

Partition functions-translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions.

UNIT IV

Heat capacity behaviour of solids-chemical equilibria and equilibrium constant in terms of partition functions, Fermi–Dirac statistics, applications to metal. Bose-Einstein statistics-application to helium. Bose-Einstein condensate.

Non Equilibrium Thermodynamics

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrim stationary states, phenomenological equations

Books Recommended

1. Physical Chemistry , P.W.Atkins and J. D. Paulo, Oxford, 2013, 10th edition New Delhi.
2. Introduction to Quantum Chemistry, A.K.Chandra, Tata McGraw Hill, 1997, 4th edition, New Delhi.
3. Quantum Chemistry, Ira N. Levine, Pearson, 2007, 5th edition, New Delhi.,
4. Quantum Chemistry, D. A. McQuarrie and Simon, Viva, 2007, 1st edition, New Delhi.
5. Molecular Quantum Mechanics, Atkins and Friedman, Oxford Univ. Press, 1997, 3rd edition, New York.
6. Quantum Chemistry, J. P. Lowe, Academic Press, 2nd edition, New York.
7. Quantum Chemsitry- R.K. Prasad, New Age International (P) Ltd
8. Quantum Chemsitry through problems and solution- R. K. Prasad, New Age International (P) Ltd
9. A textbook of Physical chemistry – H.K. Moudgil
10. Physical Chemistry, T. Engel and P. Reid, Pearson, 2006, 1st edition, New Delhi.
11. Thermodynamics, G. N. Lewis and M. Randall, McGraw Hill, 2nd edition, 1961, New York.
12. Molecular Thermodynamics, D. A. McQuarrie and Simon. Viva, 2009, 1st edition, New

Delhi.
13. Non Equilibrium Thermodynamics, S.R. deGroot and Mazur, Dover, New York.
14. Introductory Statistical Thermodynamics, T. Hill, Dover, 1986, New York.
15. Statistical Thermodynamics, Oxford, Oxford Chemistry Primer vol. 58, 1997.
16. Introduction to Statistical Mechanics, R. Bowley and M. Sanchez, Clarendon press,
17. Statistical Mechanics and Thermodynamics, C. Garrod, Oxford Univ. Press, 1995, New York.
18. Introduction to thermodynamics of irreversible processes, 2nd edition, Interscience, 1961, New York.

CH 404: SPECTROSCOPY- I

Mid Sem: 30 marks
End Sem: 70 marks

Objective: To impart knowledge of different spectroscopic technique for structural elucidation of organic compounds.
Outcome: Upon completion of this course students will be able to understand how Ultraviolet and Visible Spectroscopy, Infrared Spectroscopy, Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry are powerful technique to analyze the structural details of organic compounds, and predict different unknown compound based on UV-Vis, IR, $_1$HNMR, $_{13}$CNMR and mass spectroscopic data.

UNIT I

Ultraviolet and Visible Spectroscopy

Various electronic transitions (185–800 nm), Beer–Lambert Law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polynes Fleser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

Infrared Spectroscopy

Instrumentation and sample handling, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugatged carbonyl compounds) Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance, FTIR.
IR of gaseous, solids and polymeric materials.

Optical Rotatory Dispersion (ORD) and Circular Dichroism(CD).

Definition, deduction of absolute configuration, octant rule for ketones.

UNIT II

Nuclear Magnetic Resonance Spectroscopy

Chemical shift values and correlation for protons bonded to carbon (Aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carbodylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two,three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE). Resonance of other nuclei- F, P.

UNIT III

Carbon-13 NMR Spectroscopy

General considerations, chemical shift (Aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy – COSY, NOESY, DEPT, INEPT, APT and INDEQUATE techniques.

UNIT IV

Mass Spectrometry

Introduction, ion production – El, Cl, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrngement. Nitrogen

rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books Recommended

1. Textbook of Organic Chemistry 1st Ed., P. S. Kalsi, New Age International (P) Ltd. Pub.
2. Organic Chemistry, R. T. Morrison, & R. N. Boyd, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Organic Spectroscopy, W. Kemp, Palgrave
4. A Complete Introduction to Modern NMR Spectroscopy, Roger S. Macomber, Willey Publication, (1997).
5. Modern NMR Spectroscopy : A Guide for Chemists. J. K. M. Sanders, B. K. Hunter. Oxford UniversityPress, (1993).
6. Principles of nuclear magnetic resonance in one and two dimensions. R. R. Ernst, Geoffrey Bodenhausen, and Alexander Wokaun. Oxford University Press, (1987).
7. Spectrometric Identification of Organic Compounds, R. M. Silverstein, F. X. Webster, D. J. Kiemle, D. L. Bryce, Willey, 8th Ed., (2015).

CH 405: Practical-1 Full Marks 50

Objective:

INORGANIC CHEMISTRY PRACTICAL-I

(i) Qualitative analysis of inorganic salts mixture containing acid and basic radicals with insoluble compound (ii) To separate the mixture of cations and anions by chromatographic technique (iii) To learn the best laboratory practice

Outcome:

(i) Ability to separate and identify different cations and anion from a mixture of inorganic salts. (ii) Understanding the principles of separation and analysis of different ions and their applications in real fields. (iii) Learn the techniques of chromatographic separation of mixture of cations and anions

Qualitative Analysis of inorganic mixture

Semi micro qualitative analysis of inorganic mixtures containing anions, common cations, less common metal ions (W, Mo, Ce, Th, Zr, V and U) and insoluble (sulphate, oxides, halide).

Ion Exchange Chromatography

Separation of mixture of cations and anions by

(a) Paper Chromatography
(b) Column Chromatography – Ion exchange: Co(II)/Ni(II); Cd(II)/Mg(II)

Books recommended

1. Inorganic Experiments, J. Derck Woollins., VCH.
2. Microscale Inorganic Chemistry, Z. Szafran, R. M. Pike and M. M. Singh, Wiley.
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrand.
4. An Advanced Course of Practical Chemistry, Nad, Ghosal & Mahapatra, Central Publisher (2000).
5. Vogel's Qualitative Inorganic Analysis, 7th Ed, Revised by G. Svehela, 4th Ed., Person (2007).

ORGANIC CHEMISTRY PRACTICAL-I

Full Marks-50

Objective:

To introduce the theory and procedures of qualitative analysis of unknown organic compounds in a mixture by conventional methods as well by chromatography and IR spectra.

Outcome:
Upon completion of this course students will be able to

1) Understand how to detect the presence of different functional groups
2) Demonstrate/apply the techniques involved in organic binary mixture separation
3) Understand how to characterize different functional groups using IR spectroscopy technique.
4) Understand the art of identifying the unknown organic compounds.

Qualitative Analysis

Identification of unknown organic compounds, separation, purification and identification of compounds of binary mixture (both are solids, one liquid & one solid) using TLC & column chromatography, Chemical tests. IR spectra to be used for functional group identification.

Books Recommended

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C.Johnson, & M. Miller, Prantice Hall.
2. Systematic Qualitative Organic Analysis, H. Middleton, Edward Arnold (Publisher).
3. Hand Book of Organic Analysis, Qualitative & Quantitative, M.T.Clarke, Edward Arnold (Publisher).
4. Vogel's Text Book of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
5. Macroscale and Microscale Organic Experiments, K.L.Williamson, D.C.Heath.
6. A Text Book of Practical Organic Chemistry (Qualitative). Arthur I.Vogel.

SEMESTER-II

CH 406: INORGANIC CHEMISTRY-II

Mid Sem: 30 marks
End Sem: 70 marks

Objective:

1. To understand the theoretical basis of boding of structurally different coordination compounds.
2. To understand the basis of electronic spectra of metal complexes as well as to understand the basis of anomalous magnetic behaviour of metal complexes.
3. To impart knowledge on preparative methods, structure and bonding of metal-π complexes and cultures.

Outcome: On completion of this course student will be able to:

1. Understand and explain the bonding in coordination and organometallic compounds. Describe the fundamental requirement to interpret the electronic spectra of metal complexes for prediction of their properties.
2. Describe the synthesis, structure and bonding of metal carbonyls, metal nitrosyls, dioxygen, dinitrogen complexes as well as metal clusters.

UNIT I

Metal-Ligand Bonding

Crystal Field Theory and its limitations, Elementary idea of Angular overlap model, Molecular orbital theory for octahedral, tetrahedral and square planar complexes, σ and π-bonding in molecular orbital theory.

UNIT II

Electronic Spectra and Magnetic Properties of Transition Metal Complexes.

Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1 –d^9 states), calculations of Dq, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereo-chemical information, anomalous magnetic moments, magnetic exchanges coupling and spin crossover.

UNIT III

Metal π-Complexes

Metal Carbonyls, Structure and bonding, Vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls. Preparation, bonding, structure and important reactions of transition metal nitrosyls, dinitrogen and dioxygen complexes, ligating behavior of tertiary phosphines.

UNIT IV

Metal Clusters

Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

Books Recommended:

1. Advanced Inorganic Chemistry, F. A. Cotton, M. Bochmann, C. A. Murillo, G. Wilkinson, 6th Ed., Wiley India (2007).

2. Inorganic Chemistry, J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, 4th Ed., Pearson Education (2006).
3. Chemistry of the Elements, N.N. B. Greenwood and A. Earnshow, Pergamon, 2nd Ed (1997)
4. Inorganic Electronic Spectroscopy, A.B.P.Lever, Elsevier.
5. Magnetochemistry, R.L.Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G.Wilkison, R.D.Gillars and J.A.McCleverty, Pergamon.
7. Elements of Magneto Chemistry, R. L. Dutta, A. Syamal; 2nd Ed. East West Press Pvt Ltd (2009).
8. Fundamental Concepts of Inorganic Chemistry, Vol. 5; Asim K. Das, CBS Publisher, (2015).
9. Fundamental Concepts of Inorganic Chemistry, Vol. 6; Asim K. Das, CBS Publisher, 2nd Ed., (2013).
10. Organometallic Chemistry, R.C. Mehrotra & A. Singh, New Age International, 2nd Ed (2013).
11. Inorganic Chemistry, C. L. Miessler, D. A. Tarr, Pearson, 3rd Ed., (2004).

CH 407: ORGANIC CHEMISTRY - II

Mid Sem : 30 marks

End Sem: 70 marks

Objective:

To impart knowledge of substitution reactions of aromatic compounds, addition reactions to carbon-carbon and carbon-heteroatom multiple bonds, and rearrangement of reactive intermediates.

Outcome: Upon completion of this course students will be able to understand the basic principle of substitution reaction in aromatic compounds along with reaction mechanism, Understand the mechanism of addition reactions of carbon-carbon (C=C C≡C, etc.) multiple bonds and carbon-heteroatom (C=O, C=N, etc.) multiple bonds, and the structure and reactivity of various reactive intermediates.

UNIT I

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmer reaction, Gattermann-Koch reaction.

Aromatic Nucleohilic Substitution

The S_NAr, S_N1, Benzyne and $S_{RN}1$ mechanisms. Reactivity- effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-hauser, and Smiles rearrangements.

UNIT-II

Free Radical Reactions.

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.

Allylic halogenatin (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer

reaction. Free radical rearrangement. Hunsdiecker reaction.

UNIT III

Addition to Carbon-Carbon Multiple Bonds

Mechanistic and stereochemical aspects of addition reactions Hydrogenation, Halogenation, Hydrohalogenation, Hydroboration, Oxymercuration, Sulfenylation, Seleneylation, 1, 3-dipolar species addition, Hydoxylation: Prevost & Woodward hydroxylation, Using $KMnO_4$ and OsO_4, Epoxidation, Sharpless asymmetric epoxidation, Michael reaction, Prins reaction, Addition to cyclopropane ring, Addition to conjugated system.

Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinic and organolithium regents to carbonyl and unsaturated carbonyl compounds. Witting reaction.

Mechanism of condensation reactions involving enolates – Aldol, Konevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

UNIT IV

Rearrangements

Generation, structure, stability and reactivity of Classical and nonclassical carbocations, phenonium ions, norbornyl system, carbanions, free radicals, benzyne, carbenes and nitrenes. General mechanistic considerations – nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements

Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Schmidt, Baeyer-villiger, Shapiro reaction.

Elimination Reactions

The E_2, E_1 and E_1cB mechanisms and their spectrum. Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

Books Recommended

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley, 6th Ed., (2006).
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Part A and B Springer, 5th Ed., (2005).
3. A Guide Book of Mechanism in Organic Chemistry, Peter Sykes, Longman.6th Ed., (1999).
4. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press, 3rd Ed., (1957).
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H. O. House, W.A. Benjamin. 2nd Ed., (1972).
7. Principles of Organic Synthesis, R.O.C. Norman and J. M. Cox, CRC Press 3rd Ed., (2014).
8. Reaction Mechanism in Organic Chemistry, S. M. Mukherjee and S. P. Singh, Macmillan.3rd Ed., (2009).

CH 408: PHYSICAL CHEMISTRY - II

Mid Sem : 30 marks

End Sem: 70 marks

Objective:

Chemical kinetics is the study of the rates of chemical reactions, factors which are influential in the rates and the explanation of the rates with respect to the reaction mechanisms of chemical processes. The course content is designed to provide a fundamental understanding

of basic surface properties such as surface tension, capillarity and adsorption etc. Also the content describes the importance and application of surfactants, starting from basic definition to micelle formation and factors responsible for micelle formation. This course contents have a balance between conventional and modern electrochemistry.

Outcome: Students can follow the concept of rate of change associated with chemical reaction, recognizing that the rate of change and how it can be measured. Learning and discussion of surface chemistry certainly enable a student to solve problems associated with catalysis and nanochemistry, as most of the reactions are observed at the interface. It is believed that after going through the course a student will find its utility in chemistry of batteries, fuel cells, solar cells etc.

UNIT I

Chemical Dynamics

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation; ionic reactions, primary kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions, Lindemann reaction.

Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen- bromine and hydrogen-chlorine reactions) and oscillatory reations (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by stopped flow method, relaxation method, flash photolysis, Diffusion controlled reaction, dynamics of molecular motion.

UNIT II

SurfaceChemistry

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, catalytic activity at surfaces estimation of surface area (BET equation), Surface catalysed oxidation of Co to CO_2 ,surface films on liquids Surface equation of state and its application, Electro-kinetic phenomenon.

Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC)/ Kraft temperature, factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellazation – phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

UNIT III

Electrochemistry-I

Electrochemistry of solutions. Debye-Huckel–Onsager treatment and its extension, ion solvent interactions. Deby-Huckel-Bjerrum model. Solution of Strong electrolytes. Debye-Huckel theory for activity coefficient of electrolytic solutions; determination of activity and

activity coefficients; ionic strength.

UNIT IV

Electrochemistry-II

Thermodynamics of electrified interface equations. Derivation of electro-capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces, Helmltoz-Perrin, Guoy–Champman, Stern models.

Over potentials, exchange current density, derivation of Butler– Volmer equation, Tafel plot. Polarography theory, llkovic equation; half wave potential and its significance, Cyclic voltametry.

Introduction to corrosion, homogenous theory, forms of corrosion, corrosion monitoring and prevention methods.

Books Recommended

1. Physical Chemistry , P.W.Atkins and J. D. Paulo, Oxford, 2013, 10th edition New Delhi.
2. Physical Chemistry, T. Engel and P. Reid, Pearson, 2006, 1st edition, New Delhi.
3. Physical chemistry of the surfaces, A.W. Adamson and A.P. Gast, John Wiley, 6th edition, 1997, New York.
4. Adsorption and Catalysis, D.K. Chakraborty, 1st edition, 1992, Narosa, New Delhi.
5. Surfactants and Polymers in aqueous solution, Krister Holmberg, Bo J¨onsson, Bengt Kronberg and Bj¨orn Lindman, 2002, John Wiley, Sussex.
6. Surfactants and interfacial phenomena, M.J. Rosen,John Wilay, 2nd edition, New Jeresy.
7. Chemical Kinetics, K.J.Laidler, Mcgraw-Hill.
8. Kinetics and Mechanism of Chemical Transformations, J.Rajaraman and J.Kuriacose, McMillan.
9. Modern Electrochemistry Vol.I and Vol.II. J.O.M.Bockris and A.K.N.Reddy, Plenum, 3rd edition, 1997, London.
10. Fast Reaction – D.N.Hague
11. Chemical Kinetics and Dynamics–2nd Edn. , JISteinfild, J.S.Fransis Co, W.L.Hase , Beutic Hall (1999).
12. Physical Chemistry- G. K Vemulapalli
13. Physical Chemistry- George Woodbury, Brooks cole

CH 409: SPECTROSCOPY-II

Mid Sem: 20 marks
End Sem: 50 marks

Objective: The course is designed to understand the nuclear and electron spin resonance spectroscopy in a fundamental way. It also contains vibrational and Raman spectroscopy. A thorough discussion on all basic principles and applications are being included.

Outcome: As it can be seen the spectroscopic techniques discussed are very routine and useful, it is essential every student must have exposure to the course, and by this they will be competent in explaining and solving most of chemical structure analysis.

UNIT I

Symmetry and Group Theory in Chemistry

Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Generators, Point symmetry group.

Representations of group operators, The great orthogonality theorem (without proof) and its explanation. Irreducible and reducible representation. Bases of representation, Character of a representation. Character table and its meaning. Reduction formula.

UNIT II

Electron Spin Resonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

Microwave Spectroscopy

Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor, Stark effect, nuclear and electron spin interaction and effect of external field, Applications.

UNIT III

Vibrational Spectroscopy

Infrared Spectroscopy

Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, P, Q, R branches. Born-Oppenheimer approximation, Breakdown of Oppenheimer approximation; vibrations of polyatomic molecules

Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, normal co-ordinate analysis.

UNIT IV

Raman Spectroscopy

Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, Mutual exclusion principle. Resonance Raman spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).

Books Recommended

1. Modern Spectroscopy, J.M.Hollas, John Wiley, 4th edition, Sussex.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L.Ho, Wiley Inter science.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood, 1st edition, 1990.
4. Physical Methods in Chemistry, R.S.Drago, Sauders College.
5. Chemical Applications of Group Theory, F.A.Cotton.
6. Introduction to Molecular Spectroscopy, G.M.Barrow, McGraw Hill
7. Basic Principles of Spectroscopy, R.Chang, McGraw Hill.
8. Theory and Applications of UV Spectroscopy, H.H.Jaffe and M.Orchin, IBH-Oxford.
9. Introduction to Photoelectron Spectroscopy, P.K.Ghosh, John Wiley.
10. Introduction to Magnetic Resonance, A. Carrington and A.D. Maclachalan, Harper & Row.
11. Inorganic spectroscopic methods, A.K. Brisdon, Oxford Chem. Primers, 1997, New York.
12. Spectroscopy, S. Walker and H. Straw, Chapman and Hall ltd.
13. Energy levels in atom and molecules, W.G. Richards and P.R. Scott, Oxford, Oxford Chemistry Primer vol. 26, 1994, New York.
14. Introduction to Spectroscopy, Pavia, Brooks/Cole Cenage, 4th edition, 2009, Belmont.
15. EPR: Elemental theory and applications, J.A. Well. J.R. Bolton,Wiley, 2nd edition, 2007, New Jeresy.
16. Electron Paramagnetic resonance of transition ions, A. Abraham andB. Bleaney, Clarendon Press, 1970, Oxford.

17. Essentials of Nuclear Chemistry, H.J. Arnikar, John Wiley, 4th edition, 1995, New Delhi.
18. Fundamental of Molecular Spectroscopy, C. N. Banwell and E. McCash, Tata McGraw Hill, 4th edition, 1994, New Delhi.
19. Fundamental concept of Inorganic Chemistry- A.K. Das and Mahua Das, CBS Publisher
20. Symmetry and Spectroscopy of Molecules, , K.V. Reddy, New Age International (P) Ltd., Ist Ed.,, (1998)

CH 410: Practical-2

APPLIED CHEMISTRY PRACTICAL-1

Full Marks-100

Objective:

1. To familiar the student with the chemistry of synthesis of Nylon 6, 6 and other similar polymers,
2. To acquire a minimum practical skill to determine the molecular weight of polymers and thier characterization by other methods
3. To learn the conventional techniques of analysis of different water parameters and specific components in different samples by classical/instrumental methods.

Outcome: After the completion of course students will be able

1. To perform experiment on preparation of polymers and their basic characterizations.
2. To perform the analysis of different water parameters using classical and instrumental methods.
3. To understand the principles behind the experiment performed in the laboratory

Synthesis of polymers

i. Novalac/resole resin using phenol and formaldehyde.
ii. Polyethylene tetrasulphide by emulsion polymerization.
iii. Synthesis of Nylon 6,6

Characterisations of polymers

i. Determination of viscosity average molecular weight of polystyrene (PS), polyninyl alcohol (PVA), polyethyleneglycol (PEG), Polyacrylamide (PA).
ii. Thermal and spectral (IR) analysis of selected polymers

Analysis of water parameters

i. Determination of (i) Dissolved Oxygen (DO), (ii) Chemical Oxygen Demand (COD) and (iii) Biochemical Oxygen Demand (BOD) in water samples.
ii. Analysis of a ground water sample for sulphate by titrimetry (EDTA) and turbidimetry.
iii. Determination of fluoride in drinking water/ground water by spectrophotometry (alizarin red lake method).
iv. phosphate by molybdenum blue method

Miscellaneous

i. Spectrophotometric estimation of phosphate in cola drinks
ii. Analysis of fat in a butter sample
iii. Spectrophotometric estimation of hexavalent chromium in water samples.
iv. Determination of ascorbic acid in vitamin C tablets.
v. Verification of Beer's Lambart law

Flame photometry

Determination of Na^+ / K^+ ions in water sample/soil by flame photometry

Books Recommended.

1. Vogel's Text Book of Quantitative Chemical Analysis By J.Mendham, R.C.Denney, J.D.Barnes, M.J.K. Thomas, Pearson Education Publishers, 6thy Edition.
2. Hand book of Environmental analysis by Pradyot Patnaik, Lewis Publishers, USA (1997).
3. Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WPCF, Washington, DC, USA, 17th Edition.

PHYSICAL CHEMISTRY PRACTICAL-I

Full Marks-50

Objective:

The laboratory course is framed on the basis of instruments such as conductivity meter, pH meter and potentiometer, where a number of experiments based on conductivity measurement, pH measurement and potential measurement can be performed.

Outcome:

It is believed that students performing the experiments will be capable of handling the conductivity meter, pH meter and potentiometer. Also it gives a real feel of the electrochemistry, such a verification of Debye-Huckel-Onsager equation, neutralisation of weak acids, determination of K_{sp} of sparingly soluble salt and conductometric titrations, which are taught in theory.

Error Analysis and Statistical Data Analysis

Errors, types of errors, minimization of errors, error distribution curves, precision, accuracy and combination; statistical treatment for error analysis, student 't' test, null hypothesis, rejection criteria, F & Q test; linear regression analysis, curve fitting.

Calibration of volumetric apparatus, burette, pipette and standard flask.

Adsorption

To study surface tension – concentration relationship for solutions (Gibbs equation)

Chemical Kinetics

(i) Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester / ionic reactions.

(ii) Determination of the velocity constant of hydrolysis of an ester / ionic reaction in micellar media.

(iii) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

Solutions

(i) Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

Electrochemistry

A. Conductometry:

(i) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.

(ii) Determination of solubility and solubility product of sparingly soluble (e.g., $PbSO_4$, $BaSO_4$) conductometrically.

(iii) Determination of the strength of strong and weak acids in a given mixture conductometrically.

(iv) Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

B. Potentiometry / pH metry:

(i) Determination of strengths of halides in a mixture potentionmetrically.
(ii) Determination of the valency of mercurous ions potentiometerically.
(iii) Determination of the strength of strong and weak acids in a given mixture using a potentiometer / pH meter.
(iv) Acid-base titration in a non-aqueous media using a pH meter.
(v) Determination of the dissociation constant of acetic acid in acetone by titrating it with KOH in what medium.
(vi) Determine the PK's of a dibasic acid by pH titration using a pH meter.

C. Polarimetry

(i) Determination of rate constant for hydrolysis / inversion of sugar using a polarimeter.
(ii) Enzyme kinetics – inversion of sucrose.

Books Recommended

1. Practical Physical Chemistry, A. M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B. P. Levitt, Longman.
3. Experimental Physical Chemistry, R. C. Das and B. Behera, Tata McGraw Hill, 1983, New Delhi.
4. Vogel's Text book of Quantitative Analysis, revised, J.Bassett, R.C.Denney, G.H. Jeffery and J.Mendham, ELBS.
5. Fundamentals of Analytical Chemistry, D.A.Skoog, D.M.West and F.J.Hollar. 7th Edition, Harcourt College Publishers, 1996.

SEMESTER-III

CH 501: PERICYCLIC REACTIONS AND PHOTOCHEMISTRY

MidSem: 20 marks
End Sem: 50 marks

Objective: To impart knowledge of pericyclic reactions, photochemistry of alkene, carbonyl compounds and aromatic compounds.
Outcome: Upon completion of this course students will be able to understand the molecular origin of pericyclic reactions, understand the concept of interaction of organic compounds with light and subsequently trigger the reaction, understand the mechanism photochemistry of alkene, carbonyl compounds and aromatic compounds.

UNIT I
Pericyclic Reactions.

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3 – butadiene, 1,3,5 – hexatriene and allyl system. Classification of pericyclic reactions. Woodward – Hoffmann correelation diagrams. FMO and PMO approach. Electrocyclic reactions – conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions – antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions.
Sigmatropic rearrangements – suprafacial and antarafacial shifts of H, sigmatroic shifts involving carbon moieties, 3,3 – and 5,5 – sigmatropic rearrangements. Some variants of Claisen rearrangement (Johnson, Ireland, Abnormal, Asymmetric aromatic), Cope, and Aza-cope, Oxy-cope rearrangements. Fluxional tautomerism, Ene reaction

UNIT II
Photochemical Reactions

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule (singlet, triplet state), Jablonski diagram (fluorescence, phosphorescence, delayed fluorescence), Excimer, Exciplex, quantum yield/quantum efficiency, transfer of excitation energy (Sensitization & quenching), Actinometry. Types of photochemical reactions – photo-dissociation, gas-phase photolysis.

Photochemistry of alkenes

Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1,4 – and 1,5 – dienes, Di-π methane rearrangement.

UNIT III
Photochemistry of Carbonyl Compounds

Intramolecular reactions of carbonyl compounds – saturated, cyclic and acylic, β,γ- unsaturated and α,β- unsaturated compounds, Norrish type I and II reaction, Paterno-Buechi Reaction, Cyclohexadienones, Photodimerisation of carbonyl compounds.

Photochemistry of Aromatic Compounds

Ring Isomerisations, additions, & substitutions, Cyclization reaction.

Miscellaneous Photochemical Reactions

Photo-Fries rearrangement, Photo-Fries reactions of anilides, Barton reaction. Singlet molecular oxygen reactions, Photochemical formation of smog, Photodegradation of polymers, Photochemistry of vision.

UNIT-IV
RETRO SYNTHESIS

Synthetic design: Introduction, Retrosynthetic approach, Terminology in Retro synthetic analysis, One group disconnection, (alcohol, carbonyl compound, olefins and acids), Two group disconnections (β-hydroxy compounds,α, β-unsubstituted carbonyl compounds, 1,3-dicarbonyl compounds, 1,5 dicarbonyl compounds), Synthesis of some organic molecules by disconnection approach.

Book recommended:

1. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
2. Conversion of Orbital Symmetry, R.B. Woodward and R. Hoffman
3. Organic Reactions and Orbital Symmetry,R. C. Storr, T. L Gilchrist
4. Mechanism and Theory in Organic Chemistry by Lowry & Richardson
5. Basic Principles of Organic Chemistry by Roberts & Casserio
6. Photochemistry and Pericyclic Reactions by Jagdamba Singh
7. Organic Synthesis: The Disconnection Approach by Stuart Warren, Paul Wyatt

CH 502: BIOINORGANIC & SUPRAMOLECULAR CHEMISTRY

Mid Sem:20 Marks
End Sem: 50 marks

Objective:

1. To study the role on the role of metals in biological systems and medicine.
2. To introduce the student on structure, stereochemistry and biological functions of different metalloenzymes.
3. To study the structure and function of biomolecules in nitrogen fixation and photosynthesis.
4. To introduce concept molecular recognition, interactions in supramolecular systems and their applications

Outcome: On completion of the course the student will

1. Understand and acquire knowledge of effect of deficiency and toxicity of metals in both human and plant systems.
2. Describe the structural and functional relationships, mechanisms and importance of metaloenzymes.
3. Understand the fundamentals of supramolecules, supramolecular reactions and catalysis, devises.

UNIT I
Metal ions in biological systems and its storage transport and biomineralization

Essential and trace elements, Ferritin, transferrin, and siderophores.

Calcium in Biology

Transported regulation, Intracellular Ca^{2+} transport, Ca^{2+}ATpase, Na^{+}/Ca^{2+} exchange, mitochondrial influx and efflux. Inositol triphosphate, Ca^{2+} regulated intracellular processes: Calmodulin, Troponin C,

UNIT II
Metalloenzymes

Zinc enzymes: Carboxypeptidase and carbonic anhydrase; Iron enzymes: catalase peroxidase and cytochromes, Cyt-P450; Copper enzymes: Superoxide dismutase; Molybdenum oxatransferase enzymes: xanthine oxidase. **Coenzyme** vitamin B_{12}. sulphur proteins

Nitrogen fixation

Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model systems.

UNIT III

Photosynthesis

Chlorophylls, photo system I and photo system II in cleavage of water

Transport and storage of dioxygen

Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerthrin, model synthetic complexes of iron, cobalt and copper

UNIT IV

Supramolecular Chemistry.

Concepts and language

(A) Molecular recognition: Molecular receptors for different types of molecules including anionic substrates, design and synthesis of coreceptor molecules and multiple recognition.
(B) Supramolecular reactivity and catalysis.
(C) Transport processes and carrier design.
(D) Supramolecular devices, supramolecular photochemistry, ~~supramolecular electronic~~, ionic and switching devices.
Some example of self-assembly in supramolecular chemistry

Books Recommended

1. Principles of Bioinorganic Chemistry, S .J. Lippard and J. M. Berg., University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valenting, University Science Books.
3. Inorganic Biochemistry vols I and II ed. G. L.Eichhom, Elsevier.
4. Progress in Inorganic Chemistry, Vols 18 and 38 ed, by J. J. Lippard, Wiley.
5. Bioinorganic Chemistry, Asim K. Das, Books and Allied, 2nd Ed., (2007).
6. Supramolecular Chemistry, J. W. Steed and J. L. Atwood, Willey, 2nd Ed., (2009).
7. Bioorganic, Bioinorganic and Supramolecular Chemistry, P. S. Kalsi, J. P. Kalsi, New Age International, 2nd Ed., (2012).
8. An Introduction of Supramolecular Chemistry, Asim K. Das, Books and Allied, 1st Ed., (2017).

CH 503: POLYMER CHEMISTRY

Mid Sem: 30 marks
End Sem: 70 marks

Objective: To study the fundamental concepts of polymer chemistry, structure of monomers, functionality, and classification of polymers on the basis of source, composition, conditions, molecular weight, geometry, industrial polymer fabrication process, and nomenclature of polymers.

Outcome: After the completion of course students will able to understand about the basics of polymer and the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both, develop specific skills, competencies, and thought processes sufficient to support further study or work in this field of polymer chemistry, evaluate the effect of factors such as polymer structure, molecular weight, branching and diluents on crystallinity, and apply knowledge to build up small scale industry for developing endogenous plastic product.

UNIT I

Basics

Importance of Polymers Basic concepts: Monomers, repeat units, degree of polymerization, Linear, branched and network polymers. Classification of Polymers. Polymerization Process-Condensation, Addition, Radical chain, Ionic and Co-ordination and Co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Polymer Characterization methods

Polydispersion-average molecular weight concept. Number, weight and viscocity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights-End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods: IR, UV, X-ray diffraction. Microscopic analysis: optical, SEM, and TEM. Thermal analysis- TGA, DSC, DTA, DMA and Physical testing-Tensile strength, Flexural strength, Fatigue, Impact strength, Tear resistance, Hardness and Abrasion resistance.

UNIT II

Structure, morphology and properties of polymer

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers- Crystalline, Amorphous structure. Factors affecting crystallinity, degree of crystallinity, techniques to determine the degree of crystallinity, morphology of crystalline polymer, strain induced morphology, properties affected by crystallinity, Glass transition temperature: effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking on glass transition temperature. Tm-melting points of

homogeneous services: effect of chain flexibility, steric factor, entropy, and heat of fusion on Tm. Relation between Tg and Tm, Property requirements and polymer utilization.

UNIT III

Polymer Processing

Plastics, elastomers, and fibers. Resin, Compounding, Additives (crosslinking agent, UV stabilizer, fire retardant, coloring agent, plasticizer, and others). Processing techniques: Calendaring, die casting, rotational casting, film casting, injection molding, blow molding, extrusion molding, reinforcing, pultrusion and fiber spinning.

UNIT IV

Properties of Commercial Polymers

Polythylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers – Fire retarding polymers and electrically conducting polymers (PANI, Polyacetylene). Polymer in Biomedical applications: contact lens, dental polymers, artificial heart, kidney, skin, and blood cells.

Books Recommended

1. Text book of Polymer Science, F.W. Billmeyer, Jr.Wiley.
2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.

CH 504: Practical-3

INORGANIC CHEMISTRY PRACTICAL-II

Full Marks-50

Objective: To introduce multistep inorganic synthesis, separation and estimation of different metals from mixture.

Outcome: Ensures the students to understand and have hands on experience to preparer inorganic (coordination) compounds in multi steps and acquire knowledge of separation of metals from mixture.

(a) Separation and estimation of metal ions in following binary mixture (Cu-Ni, Ni-Zn, Cu-Fe etc.) involving volumetric and/or gravimetric methods.

(b) Preparations

Preparation of following compounds and their studies by elemental, IR and electronic spectra measurements.

i. *cis*-$K[Cr(C_2O_4)_2(H_2O)_2]$
ii. *cis and trans*-$\{Co(en)_2Cl_2\}Cl$
iii. $Mn(acac)_3$
iv. $K_3[Fe(C_2O_4)_3]$
v. $[Ni(NH_3)_6]Cl_2$
vi. $Ni(dmg)_2$
vii. Tris(thiourea) copper(I) complex
viii. Potassium tris-(oxalato)aluminate(III)
ix. Tetraaminecopper(II) sulphate
x. Preparation of N,N-bis-(salicyldehyde)ethylenediamine, $salenH_2$ and Co(Salen) complex and determination of O_2 absorption by $Co(salen)^6$.
xi. Preparation of copper glycine complex-cis and trans-bis(glycinato)copper(II)[7].

(c) Spectrophotometric Determinations

i. Manganese / Chromium / Vanadium in steel sample
ii. Iron-phenanthroline complex: Job's Method of continuous variations.
iii. Copper-ethylene diamine complex: Slope-ratio method.

(d) Flame Photometric Determinations

i. Sodium and potassium when present together

(e) Nephelometric determinations

i. Sulphate/Phosphate.

Books Recommended

1. Inorganic Experiments, J. Derck Woollins., VCH.
2. Microscale Inorganic Chemistry, Z. Szafran, R. M. Pike and M. M. Singh, Wiley.
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrand.
4. An Advanced Course of Practical Chemistry, Nad, Ghosal & Mahapatra, Central Publisher (2000).
5. Vogel's Qualitative Inorganic Analysis, 7th Ed, Revised by G. Svehela, 4th Ed., Person (2007). 6. J. Chem. Educ., 1977, 54, 443, 1973, 50,670; Acc. Chem. Res., 1975, 8, 384.
7. J. Chem. Soc Dalton, 1979, 1901. J. Chem. Edu.,1982, 59, 1052.

ORGANIC CHEMISTRY PRACTICAL-II

Full Marks-50

Objective: To impart knowledge of art of organic synthesis.
Outcome: Upon completion of this course students will be able to understand the different reactivity pattern of different reagents, and understand how to synthesize different organic compounds.

Organic Synthesis

(a) Preparation of Anthranilic acid
(b) Preparation of Methyl Orange
(c) Preparation of Adipic acid by chromic acid oxidation of cyclohexanol.
(d) p-chloro toluene from p-toluidine (Sandmeyer reaction)
(e) Synthesis of p-nitroaniline & p-bromo aniline (Aromatic electrophilic substitution)
(f) Synthesis of triphenyl methanol from benzoic acid (Grignard reaction)

Quantitative Analysis

(a) Estimation of Anilines / Phenols using hromate bromide solution.
(b) Determination of Iodine and Saponification values of an oil sample.
(c) Determination of DO, COD & BOD of Water samples.

Books Recommended

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C.Johnson, & M.Miller, Prantice Hall.
2. Systemetic Qualitative Organic Analysis, H.Middleton, Edward Arnold (Publisher).
3. Hand Book of Organic Analysis, Qualitative & Quantitative, M.T.Clarke, Edward Arnold (Publisher).
4. Vogel's Text Book of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
5. Macroscale and Microscale Organic Experiments, K.L.Williamson, D.C.Heath.
6. A Text Book of Practical Organic Chemistry (Qualitative). Arthur I.Vogel.

CH 505: SEMINAR PRESENTATION

Compulsory for all students. Topic- related to course, some recent advancement in chemistry or application of chemistry.

- Topic selection- 20 mark
- Content and preparation of presentation- 30 marks
- Presentation skill and body language-30
- Knowledge on the topic- 20 (through discussion)

SEMESTER-IV

CH 506: BIOORGANIC CHEMISTRY

Mid Sem: 20 marks
End Sem: 50 marks

Objective: To impart knowledge of biological catalysts, mechanism of enzyme action and reactions catalyzed by enzymes and co-enzyme.

Outcome: Upon completion of this course students will be able to understand how enzyme catalyzes the reaction with outmost efficiency, acid-base catalysis and covalent catalysis of enzyme, strain and distortion during enzyme catalysis, structure and biological functions of various coenzymes, and the origin of mechanism of enzyme action.

UNIT I

Introduction

Basic considerations Proximity effects and molecular Adaptation.

Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomeclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis.

UNIT II

Mechanism of Enzyme Action

Kinetics of enzyme action, Michealis Menten and Lineweaver-Burk plots, revcersible and irreversible inhibition. Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanism for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.

UNIT III

Reactions Catalyzed by Enzymes and Co-Enzyme Chemistry

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerization reactions, β-cleavage and condensation, some isomerization and rearrangement reactions.

UNIT IV

Enzyme catalyzed carboxylation and decarboxylation. Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme. A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, lipoic acid, vitamin B_{12} Mechanisms of reactions catalyzed by the above cofactors.

Books Recommended

1. Biorganic Chemistry, A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed, M.I.Page and A. Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms C. Walsh, W.H.Freemain.
8. Enzyme Structure and Mechanism, A Fersht. W.H.Freeman.

9. Biochemistry: The Chemical Reactions of Living Cells, D.F.Metzler, Academic Press.

CH 507: ORGANIC SYNTHESIS

Mid Sem: 20 marks
End Sem: 50 marks

Objective: To impart knowledge of oxidation and reduction, protection of alcohol, amine, carbonyl and carboxyl compounds and disconnection approach in synthesis of various natural products.

Outcome: Upon completion of this course students will be able to understand the philosophy of synthesis of various natural products, understand the reactivity pattern and underlying reaction mechanism of different oxidizing and reducing reagents, and understand the art of selective protection and deprotection of alcohol, amine, carbonyl and carboxyl groups in organic compounds.

UNIT I

Oxidation

Oxidation of organic molecules using Ruthenium tetraoxide, Hypervalent iodine, thallium(III)nitrate, Dichlorodicyano benzoquinone (DDQ), Selenium dioxide, Dimethyl sulfoxide, Peracids, Oxone, Dioxiranes, Tetramethyl piperidine nitroxide, Singlet oxygen, Ozone, N-sulfonyl oxaziridine, Chromium Manganese, Silver, Ruthenium, Osmium, Molybdenum, Lead, Mercury based reagents. Suzuki coupling, Negishi coupling, Stille coupling, Heck Reaction

UNIT II

Reduction

Reduction of organic molecules using Boron based reagents, Aluminum-based reagents, Free radical reagent, Silane based reagents, Dissolving metal reduction, Diimide reduction, Wolff-Kishner reduction, Hydrogenation using Pd, Pt, Rh, Ni on solid support.

Protecting Groups

Principle of protection of alcohol, amine, carbonyl and carboxyl groups.

UNIT III

Disconnection Approach

An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis.

One Group C-C Disconnection

Alcohols and carbonyl compounds, regioselectivity, Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

Two Group C-C Disconnections

Diels-Alder reaction, 1,3-difunctionalised compounds, α,β- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation.

Ring Synthesis

Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings, aromatic heterocycles in organic synthesis

UNIT IV

Synthesis of some Complex Molecules

Application of the above in the synthesis of following compounds. Camphor, Longifoline, Cortisone, Reserpine, prostaglandin, Juvabione, Aphidicolin and Fredericamycin A.

Books Recommended

1. Designing Organic Synthesis, A programmed introduction to synthon approach, S. Warren, Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J.Fuhrhop and G.Penzillin, VCH, Weinheim, Germany.
3. Some Modern Methods of Organic synthesis. W. Carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions, H.O. House, W.A. Benjamin
5. Advanced Organic Chemistry: Reactions, Mechanisms and Streucture, J.March, Wiley.
6. Principles of Organic synthesis, R. Norman and J.M. Coxon, Blackie Academic & Professional.
7. Advanced Organic Chemistry Part B, F.A. Carey and R.J.Sundberg, Plenum Press

CH 508: practical-4

PHYSICAL CHEMISTRY PRACTICAL-II

Full Mark-50

Objective: The laboratory course is designed based on UV Visible spectrophotometer. Experiments such as determination of indicator constant, stoichiometry of a metal complex by Job's method are included.

Outcome: The conduct of these experiments will enable a student to understand Beer-Lambert's law in a better manner also the handling of an instrument will be learnt.

1. Thermodynamics

(i) Determination of partial molar volume of solute (e.g.,KCL) and solvent in a binary mixture.

(ii) Determination of the temperature dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

2. Spectroscopy

(i) Determination of pKa of an indicator (e.g., methyl red) in (a) aqueous and (b) micellar media.

(ii) Determination of stoichiometry and stability constant of inorganic (e.g. ferric – salicyclic acid) and organic (e.g. amine-iodine) complexes.

3. Polarography

(i) Estimation of Pb^{2+} and Cd^{2+} / Zn^{+} and Ni^{2+} ions in a mixture of Pb^{2+} and Cd^{2+} / Zn^{+} and Ni^{2+} by polarography.

(ii) Determination of dissolved oxygen in aqueous solution of organic solvents.

4. Electronics

This lab course will have theory as well as practicals and the lectures shall be delivered during lab hours.

5. Basic Electronics

Notations used in an electric circuit, study of electronic components and colour codes, conversion of chemical quantities into electrical quantities. Transducer, illustration with electrodes, thermocouples and thermistors.

6. Active Components

Introduction to ordinary diodes and Zener diodes with some emphasis on p-n juction as a solid state property. Use of diodes as rectifiers, clipping and clamping circuits. Power supplies.

Books Recommended

1. Experimental Physical Chemistry, B.P. Levitt, Longman.
2. Findlay's Practical Physical Chemistry, revised B.P. Levitt, Longman.
3. Experiments in Physical Chemistry, J.C.Ghosh, Bharati Bhavan.
4. Experimental Physical Chemistry, R.C. Behera and B. Behera, Tata McGraw Hill, 1983. New Delhi.

CH 509: PROJECT WORK

Full Mark-200

Objective: Students will research or review articles in a particular topic

1. To train the student to design experiment oriented project on particular context
2. To search literature on the selected topic of project work
3. To conduct the experiments scientifically as per selected topic and analyse the data
4. To develop the art of wiring the project report with proper citation of literature, data analysis, and presentation

Outcome: After completion of the project work the students will

1. Learn the design the experimental set up and perform the experimental as per specific problem selected for project
2. Gain the knowledge and competency to search literature and write the dissertation
3. Learn the skill for presentation of the project work.

Each student is required to submit a dissertation of project work before theory examination for evaluation.

- Topic selection-30 marks
- Literature review- 30 marks
- Research methodology- 20 marks
- Result and discussion- 30 marks
- Conclusion-20 marks
- Reference- 20 marks
- Viva- 50 marks

COURSE STRUCTURE OF UG- ACCOUNTING HONOURS

Paper	Subject	Paper Code	Full Marks	End-term Marks	Mid-term Marks	Credit Points
SEMESTER I						
1.1	Environmental Science	AECC -1	100	80	20	4
1.2	Financial Accounting	CORE-1	100	80	20	6
1.3	Business Law	CORE-2	100	80	20	6
1.4	Micro Economics	GE-1	100	80	20	6
	Total		**400**			**22**
SEMESTER II						
2.1	MIL	AECC-2	100	80	20	4
2.2	Cost Accounting	CORE-3	100	80	20	6
2.3	Corporate Law	CORE-4	100	80	20	6
2.4	Macro & Indian Economy	GE-2	100	80	20	6
	Total		**400**			**22**
SEMESTER III						
3.1	Corporate Accounting	CORE-5	100	80	20	6
3.2	Income-tax Law and Practice	CORE-6	100	80	20	6
3.3	Management Principles and Application	CORE-7	100	80	20	6
3.4	Business Statistics	GE-3	100	80	20	6
3.5	Communicative English	SEC-1	100	80	20	4
	Total		**500**			**28**
SEMESTER IV						
4.1	GST and Indirect Taxes	CORE-8	100	80	20	6
4.2	Fundamentals of Data Management (End Term Exam = 60, Practical = 25, Mid-term=15	CORE-9	100	60 25 Practical	15	6
4.3	Management Accounting	CORE-10	100	80	20	6
4.4	Principles of Marketing	GE-4	100	80	20	6
4.5	Quantitative and Logical Thinking	SEC-2	100	80	20	4
	Total		**500**			**28**
SEMESTER V						
5.1	Computerized Accounting & E-filling of Tax Returns (End Term Exam = 60, Practical = 25, Mid-term = 15	CORE-11	100	60 25 Practical	15	6
5.2	Fundamentals of Financial Management	CORE-12	100	80	20	6
5.3	Elective I (Any *one* of the following)	DSE-1	100	80	20	6
	A. Accounting and Finance	Financial Markets, Institutions &Services				

	B. Banking and Insurance	Indian Banking and Insurance System				
	C. Management	Human Resource Management				
5.4	Elective II (Any *one* of the following)	DSE-2	100	80	20	6
	A. Accounting and Finance	Financial Statement Analysis and Reporting				
	B. Banking and Insurance	Merchant Banking and Financial Services				
	C. Management	International Business				
	Total			**400**		
6.1	Auditing and Corporate Governance	CORE-13	100	80	20	6
6.2	Business Mathematics	CORE-14	100	80	20	6
6.3	Elective III (Any *one* of the following)	DSE-3	100	80	20	6
	A. Accounting and Finance	Fundamentals of Corporate Tax Planning				
	B. Banking and Insurance	Fundamentals of Investment				
	C. Management	Consumer Affairs and Customer Care				
6.4	Business Research Methods and Project work	End Term Exam = 50 Project = 30 Viva-voce = 20	DSE-4	100	50 30 Project 20 Viva-voce	
	Total			**400**		
	Grand Total		**2600**			148

(Core-6) -INCOME TAX LAW AND PRACTICE

Objective: To provide basic knowledge and equip students with the application of principles and provisions of Income Tax Act 1961.

Contents:

Unit I :

- **Basic Concepts and Definitions under IT Act**: Assessee, Previous year, Assessment year, Person, Income, Sources of income, Heads of income, Gross total income, Total income, Maximum marginal rate of tax, Tax Evasion, Tax avoidance and Tax planning
- Residential Status and Incidence of Tax, Residential status of all persons except company
- Incomes which do not form part of Total Income Except section 10AA.
- Agricultural Income Definition, determination of agricultural and non-agricultural Income, assessment of tax liability when there is both agricultural and non-agricultural income

Unit II:

Heads of Income and Provisions governing Heads of Income

- Income from Salary
- Income from House property

Unit III:Heads of Income and Provisions governing Heads of Income

- Profits and Gains of Business and Profession Special emphasis on sec. 32, 32AC, 32AD, 35, 35D, 36(i)(ib), (ii), (iii), (iv), (vii), 37, 37(2B), 40A(2), 40A(3), 43B, (Excluding presumptive taxation)
- Capital Gains
  Meaning and types of capital assets, basic concept of transfer, cost of acquisition, cost of improvement and indexation, computation of STCG and LTCG, exemptions u/s 54, 54B, 54EC and 54F, capital gain on transfer of bonus shares, right entitlement and right shares, taxability of STCG and LTCG.
- Income from Other Sources Basis of charge excluding deemed dividend

Unit IV:

- **Income of other Persons** included in Assessee's Total Income Remuneration of spouse, income from assets transferred to spouse and Son's wife, income of minor.
- Set off and Carry Forward of Losses Mode of set off and carry forward, inter source and inter head set off, carry forward and set off of losses u/s 71B, 72, 73, 74, 74A.
- Deductions from Gross Total Income Basic concepts, deductions u/s 80C, 80CCC, 80CCD, 80CCE, 80D, 80DD, 80DDB, 80E, 80G, 80GG, 80GGC, 80TTA, 80U
- Rebate u/s 87A

Computation of Total Income and Tax Payable

- Rate of tax applicable to individual assessee
- Computation of tax liability of an individual
- Provision for Filing of Return Date of filing of return, relevant forms of return, different types of returns, return by whom to be signed, PAN, TAN
- Assessment of Return Self assessment u/s140A, Summary assessment u/s 143(1), Scrutiny assessment u/s 143(3) and Best judgement assessment u/s 144.
- Advance Tax Who is liable to pay, due dates and computation of advance tax (excluding corporate assessees)
- Interest & Fees Section 234A, 234B, 234C, 234F
- TDS Provisions regarding TDS from salary, interest on securities, horse racing, lottery.

- R. K . Singhal, Management Principle and application, V.K. Global Pub. Pvt. Ltd, New Delhi.
- Management Principles and Applications-Jhunjhunwala J Mohanty-Himalaya Publishing House
- Principles of Management: Mitra, Oxford University Press.
- Griffin, R.W. – Management :Principles& Practices, Cengage Learning
- Gupta R.N - Principles & Practice of Management – S. Chand
- A K Jha, Management Principles and Application - Vrinda Publications (P) Ltd.
- Chandan J.S – Management Concepts of Strategy – Vikash Publication
- B.P. Singh and A.K.Singh, Essentials of Management, Excel Books
- TN Chhabra, Management Concepts and Practice, DhanpatRai& Co. (Pvt. Ltd.), New Delhi
- Peter F Drucker, Practice of Management, Mercury Books, London

(Core-8) GST & INDIRECT TAX

OBJECTIVE:

The objective is to equip students with the principles and provisions of Goods and Services Tax (GST), which is, implemented from 2017 under the notion of One Nation, One Tax and One Market and to acquaint students with basic provisions of GST Law and basic working knowledge.

Unit I- INTRODUCTION TO GOODS AND SERVICES TAX (GST)

Introduction to GST : Introduction, Constitutional provisions regarding Taxation In India, Pre-GST Indirect Taxation Structure in India, What is GST, Need for GST in India, Overview and Genesis of GST IN INDIA, GST objectives, Scope of GST, Salient features of GST, GST and Centre-State Financial Relations, The Constitution (122nd Amendment) Bill, Constitutional Amendments required for introduction of GST Indirect Taxes subsumed Post- GST : Principles for subsuming taxes under Goods & Services Tax (GST) in India, Indirect Taxes and Levies subsumed in GST, Events that have led to the introduction of GST, DUAL GST : Benefits of Dual GST, Structure Of Dual Model of GST , Key Features of Dual Model of GST, Benefits of implementing GST, CENTRAL GST – STATE / UNION TERRITORY GST – INTEGRATED GST and GST Cess, Pre-GST Regime Vs. GST Regime, Indirect Taxes

Unit II- GST ACTS: (Structure & Terminology)

Salient features of CGST Act, SGST Act (Odisha State), IGST Act, Meaning and Definition of various terms used under GST

(Coverage- Provisions and Illustration)

PROCEDURE RELATING TO LEVY OF, COLLECTION AND EXEMPTION FROM, TAX

PROCEDURE RELATING TO LEVY OF, COLLECTION AND EXEMPTION FROM, TAX: (CGST & SGST)- Meaning and Scope of 'Supply' under GST Law, Taxable Person, Time of supply, Place of supply and Value of supply. Computation of Taxable Value and Tax Liability, Composition scheme; INPUT TAX CREDIT; PROCEDURE RELATING TO LEVY, COLLECTION AND EXEMPTION OF IGST; PAYMENT OF TAX, TCS, TDS; PRACTICAL PROBLEMS. (Coverage-Provisions and Illustration)

Unit III- REGISTRATION, RETURNS AND ASSESSEMENT

REGISTRATION - Persons liable for registration, Persons not liable for registration, Types: Compulsory registration, Voluntary registration, Deemed registration - Procedure for registration, Special provisions for Casual taxable persons and Non-resident taxable persons;

CLASSIFICATION OF GOODS & SERVICES- HSN, SAC; TAX INVOICE AND OTHER SUCH INSTRUMENTS IN GST - Debit Note, Credit Note, Vouchers, Invoice; ACCOUNTS AND RECORDS; RETURN- Process of Return Filing, Furnishing details of outward supplies and inward supplies, First return, Claim of input tax credit, Matching reversal and reclaim of input tax credit, Annual return and Final return; REFUND; OFFENCES AND PENALTIES; ASSESSMENT; AUDIT; APPEALS AND REVISION.

Unit IV- GST Council AND REGULATORY FRAMEWORK

GST COUNCIL: Structure, Powers and Functions. Provisions for amendments; ROLE OF CBEC: Division of Administrative Powers; GST AND TECHNOLOGY- GST Network, GST ECO SYSTEM, GSP, ASP; NATIONAL ANTI-PROFITEERING AUTHORITY IN GST; COMPLIANCE RATING.

Text Books Recommended

- Swain AK & Agrawal – GST: Concepts and Applications, Himalayan Publishing House.
- GST Manual:Taxman's Publication Ltd., New Delhi.

Suggested Books:

- GST and Indirect Taxes,Sanjeet Sharma, V.K. Global Pub. Pvt. Ltd, New Delhi.
- Mishra, Padhi and Bera – Text Books on GST & Practice, Vikash Publishing House Pvt. Ltd. New Delhi.

(Core-9) FUNDAMENTALS OF DATA MANAGEMENT

Unit I: Word Processing

Working with word document- Editing text, Find and Replace text, Formatting, Spell check, Autocorrect, Auto text; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, Macros, Drop cap; Tables: Inserting, Filling and formatting a Table, Inserting Pictures and Video; Mail Merge- including linking with Database, Printing documents. Creating Business Documents using the above facilities

Preparing Presentations

Basics of presentations: Slides, Fonts, Drawing, Editing; Inserting: Tables, Images, texts, Symbols, Media; Design; Transition; Animation, Hyperlink and Slideshow. Creating Business Presentations using above facilities

Unit II: Spreadsheet and its Business Applications

Managing worksheets- Formatting, Entering data, Editing, and Printing a worksheet; handling operators in formula, Project involving multiple spreadsheets, Organizing Charts and graphs, Pivot Table Spreadsheet Functions: Mathematical [SUMIF, SQRT, SUBTOTAL, SUMPRODUCT
etc.], Statistical [AVERAGE, STDEV, VAR, CORRELATION, REGRESSION etc.], Financial [PMT, RATE, PV, FV, NPER, IRR, NPV, Data Table Etc.] Logical [AND, OR, IF etc.], Date and Time, lookup and reference, Database and Text functions. Creating Spreadsheet in the area of : Loan and Lease statement; Ratio Analysis; Payroll Statements; Capital Budgeting; Depreciation Accounting; Graphical Representation of Data; Frequency Distribution and its Statistical Parameters; Correlation and Regression

Unit III: Database Management System

Creation of Tables, Multiple Table Handling-Defining Relationship [Foreign Key], Simple and Conditional Queries, Types of Queries [Update, Delete, Append], Forms, Reports, Introduction to SQL through Basic Commands.

Applying DBMS in the areas of Accounting, Inventory, HRM and its accounting, managing the data records of Employees, Suppliers and Customers

Unit IV: Website Designing

Introduction to HTML: Tags and Attributes: Text Formatting, Fonts, Hypertext Links, Tables, Images, Lists, Forms, Frames, Cascading Style Sheets

Text Books Recommended

- Coronel and Rob, Database Principles, Cengage Learning
- Fundamentals of Data Managemnet -Saha RG- Himalaya Publishing House

Suggested Readings

- Thareja, IT & Application, Oxford
- Aurora, Computer Fundamentals, Vikash
- Sinha & Sinha, Fundamentals of Computers, BPB Publications
- Dhar, P., Fundamental of IT and Its Application in Business, APH

(Core-10) MANAGEMENT ACCOUNTING

Objective: To acquaint the students with basic concepts of management accounting, and basic understanding of tools and techniques used for managerial decision making.

CONTENTS:

Unit – I:

Management Accounting: Meaning, nature, scope, and importance of management accounting; Role of management accounting; management accounting vs. financial accounting; Role of management accounting in modern business; Tools and techniques of management accounting.

Unit – II: Ratio Analysis & Cash flow statement Ratio Analysis:

Meaning and utility of ratios; significance of Ratio analysis; Classification of Ratios – Profitability ratios, Efficiency Ratios, Liquidity Ratios, Solvency Ratios; Advantages and limitations of Ratio Analysis.

Cash flow Statements:

Cash Flow Statements: Meaning and utility of Cash flow statements; Preparation of Cash flow statements – Indirect method; Limitations of Cash flow statements; Cash flow statements vs. Funds flow statements. (Reference to Revised AS-3 and Ind AS-7)

Unit – III:

Absorption & Marginal Costing: P/V Ratio, Break-even analysis, Margin of safety, angle of incidence; Marginal and differential costing as a tool for decision making – make or buy, change of product mix, exploring new markets, shut down decisions.

Unit – IV:

Budgeting & Standard Costing: Concept of budget and budgetary control; objectives, merits and limitations of budgetary system; Master budget, Functional budget, Fixed and Flexible budgets; Zero based budgeting. Standard Costing & Variance Analysis: Meaning of standard cost and standard costing, Advantages and disadvantages of standard costing & variance analysis: Material, Labour, & Overhead.

Learning Outcome: After the completion of this paper, the students will be able to have confidence in managing cost issues and also to keep a check on cost control and taking managerial decisions.

Text Books Recommended

- Management Accounting, S swain/ S.P. Gupta/ A Sharma, V.K. Global Pub. Pvt. Ltd.,
- Horngreen, Charles T., Gary L. Sundem. Introduction to Management Accounting.
- Prentice Hall.

Suggested Reading:

- Jain & Narang, Management Accounting, Kalyani Publications
- Management Accounting-M Wilson- Cost Accounting-Jena B,Bal S and Das A- Himalaya Publishing House
- Narasimhan M.S. , Management Accounting, Cengage Learning
- Cost & Management Accouning, Taxmann Publications
- Arora, M.N. Cost Accounting – Principles and Practice. Vikas Publishing House, New Delhi.
- Maheshwari, S.N. and S.N. Mittal. Cost Accounting: Theory and Problems. Shri Mahabir Book Depot, New Delhi.
- Lal, Jawahar. Advanced Management Accounting Text and Cases. S. Chand & Co., New Delhi.
- Khan, M.Y. and P.K. Jain. Management Accounting. Tata McGraw Hill, Publishing

(Core-11) COMPUTERIZED ACCOUNTING & E-FILING OF TAX RETURNS

Unit – I: Computerized Accounting Package: Using Generic Software

- Company creation, ledger creation, order processing, accounting voucher, inventory voucher, memorandum voucher, invoicing, multiple godown handling, Transfer of materials across godowns, Bank Reconciliation
- Cost Centre, Cost Category, Bill of Material (BoM), Budget and Controls
- Payroll Accounting
- TDS, GST
- Back up & Restore, Export and Import data

Unit II: Designing Computerized Accounting System

- Introduction to DBMS Package – Table, Query, Form and Report
- Designing Computerized Accounting System using DBMS Package Creating a voucher entry Form, Preparing ledgers, trial balance, profit & loss a/c, and Balance Sheet with Form wizard and Report
- Designing Payroll System for Accounting using Form, Query, and Report

Unit-III: E-filing of Tax return

- Preparation and submission of the Income Tax Return (ITR) offline/online for individual Taxpayer [e-filing without using DSC and with using DSC, EVC]
- View form 26AS, Upload return, View e-file returns, e-verification
- Use of e-tax calculator (including interest calculation u/s 234A, 234B, 234C)
- E-Pay tax (Challan No./ITNS 280, ITNS 281)
- Preparation and submission online form 10E [Relief u/s 89(1)]

Text Books Recommended

- Software: Singhania, V.K., E-Filing of Income Tax Returns and Computations of Tax, Taxmann

- Book of Computerized Accoounting and E Filling of Tax Returns-Mohanty R, Dash ALN- Cost Accounting-Jena B,Bal S and Das A- Himalaya Publishing House

Suggested Readings

1. Software: "Excel Utility", incometaxindiaefiling.gov.in

- House, Delhi, or latest edition.
- Girimaji, Pushpa (2002) Consumer Right for Everyone Penguin Books.
- Nader, Ralph (1973) The Consumer and Corporate Accountability, USA, Harcourt Brace
- Jovanovich, Inc.
- Sharma, Deepa (2011) Consumer Protection and Grievance-Redress in India; A Study of
- Insurance Industry (LAP LAMBERT Academic Publishing GmbH & Co.KG, Saarbrucken, Germany. 263 pp.
- Empowering Consumers e-book, www.consumeraffairs.nic.in
- ebook, www.bis.org
- Nair Suja – Consumer Behaviour – Himalaya Publishing House

DSE-4
B.COM. (HONS.): SEMESTER – VI
BUSINESS RESEARCH METHODS AND PROJECT WORK

Objective: This course aims at providing the general understanding of business research and the methods of business research. The course will impart learning about how to collect, analyze, present and interpret data.

Section A: Business Research Methods 50 Marks Unit-I

Introduction: Meaning of research; Scope of Business Research; Purpose of Research – Exploration, Description, Explanation; Unit of Analysis – Individual, Organization, Groups, and Data Series; Conception, Construct, Attributes, Variables, and Hypotheses.

Unit-II

Research Process: An Overview; Problem Identification and Definition; Selection of Basic Research Methods- Field Study, Laboratory Study, Survey Method, Observational Method Existing Data Based Research, Longitudinal Studies, Panel Studies

Unit-III

Measurement: Definition; Designing and writing items; Uni-dimensional and Multi-dimensional scales; Measurement Scales- Nominal, Ordinal, Interval, Ratio; Ratings and Ranking Scale, Thurst one, Likert and Semantic Differential scaling, Paired Comparison; Sampling –Steps, Types, Sample Size Decision; Secondary data sources

Hypothesis Testing: Tests concerning means and proportions; ANOVA, Chi-square test and other Non-parametric tests; testing the assumptions of Classical Normal Linear Regression.

Section B – Project Report Marks (30 + 20)

Unit-IV Report Preparation: Meaning, types and layout of research report; Steps in report writing; Citations, Bibliography and Annexure in report; JEL Classification

Note:

- There shall be a written examination of 50% Marks on the basis of Unit I to III.

project report under... on field work. The ... examiners. ...ble to assess

The board recommended the following changes in the PG 3rd Semester Syllabus from academic session 2022-23 onwards:

Change recommended

Project Report (Report-100, presentation & Viva-voce-100), Paper MCC-301 to be changed as:

a. PROJECT & DISSERTATION: MCC-301 (A) - 100 Marks
b. SEMINAR PRESENTATION: MCC-301 (B)-100 Marks

The break-up of the mark distribution is given as below:

PROJECT & DISSERTATION

Mark Distribution Head	Distribution of Marks	Total Mark
Topic Selection (Project Proposal preparation)	10	100
Literature Review and Reference	20	
Research Methodology	20	
Result and Discussion	20	
Viva-Voce	30	

SEMINAR PRESENTATION

Mark Distribution Head	Distribution of Marks	Total Mark
Topic Selection	20	100
Content Preparation	30	
Presentation Skills	30	
Discussion	20	

24/11/2022

STATE MODEL SYLLABUS FOR UNDER GRADUATE COURSE IN ECONOMICS (Bachelor of Arts Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

Course structure of UG Economics Honours

Semester	Course	Course Name	Credits	Total marks
I	AECC-I	AECC-I	04	100
	C-I	Introductory Microeconomics	06	100
	C-II	Mathematical Methods for Economics I	06	100
	GE-I	Indian Economy	06	100
			22	
II	AECC-II	AECC-II	04	100
	C-III	Introductory Macroeconomics	06	100
	C-IV	Mathematical Methods for Economics II	06	100
	GE-II	Indian Economy II	06	100
			22	
III	C-V	Microeconomics I	06	100
	C-VI	Macroeconomics I	06	100
	C-VII	Statistical Methods for Economics	06	100
	GE-III	Introductory Microeconomics	06	100
	SEC-I	SEC-I	04	100
			28	
IV	C-VIII	Microeconomics II	06	100
	C-IX	Macroeconomics II	06	100
	C-X	Research Methodology	06	100

	GE-IV	Introductory Macroeconomics	06	100
	SECC-II	SECC-II	04	100
			28	
Semester	Course	Course Name	Credits	Total marks
V	C-XI	Indian Economy I	06	100
	C-XII	Development Economics I	06	100
	DSE-I	1. Economic History of India (1857-1947) or 2. Public Economics	06	100
	DSE-II	1. Introductory Econometrics or 2. Odisha Economy or 3. Money and Banking	06	100
			24	
VI	C-XIII	Indian Economy II	06	100
	C-XIV	Development Economics II	06	100
	DSE-III	1. Environmental Economics or 2. History of Economic Thought	06	100
	DSE-IV	1. International Economics or 2. Agricultural Economics or 3. Project/Dissertation	06	100

			24	

ECONOMICS

HONOURS PAPERS:

Core course – 14 papers
Discipline Specific Elective – 4 papers (out of the 9 papers suggested)
Generic Elective for non Public Administration students – 4 papers. Incase University offers 2 subjects as GE, then papers 1 and 2 will be the GE paper.

Marks per paper - Midterm : 20 marks, End term : 80 marks, Total – 100 marks
Credit per paper – 6
Teaching hours per paper – 50 hours + 10 hours tutorial
Dissertation : (content : 50; Seminar : 30; Viva Voce : 20)l

Core Paper I

INTRODUCTORY MICROECONOMICS

Introduction:
This course is designed to expose the students to the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situations.

Unit I: Exploring the Subject Matter of Economics, Markets and Welfare
The Ten Principles of Economics: How people make decisions; Working of the economy as a whole; Thinking Like an Economist: The economist as Scientist – The scientific method: Observation, Theory and more observation; Role of Assumptions; Economic Models; Why economists disagree; Graphs in Economics

The Market Forces; Markets and Competition; The Demand and Supply curves – Market vs Individual curves, Shifts in Demand and Supply Curves; Market Equilibrium and changes there in; Price Elasticity of Demand – determinants and computation; Income and Cross Elasticity of Demand; The Price Elasticity of Supply – determinants and computation; Consumer and Producer Surplus.

Unit II: Theory of Consumer Choice
The Budget Constraint; Preferences – representing preferences with indifference curves; Properties of Indifference Curves; Two extreme examples of indifference curves; Optimization – Equilibrium; Change in equilibrium due to changes in income, changes in price; Income and Substitution Effect; Derivation of Demand Curve; Three applications – Demand for Giffen goods, Wages and Labour Supply, Interest rate and Household saving.

Unit III: The Firm and Market Structures

Cost concepts; Production and Costs; The various measures of cost – Fixed and Variable cost, Average and Marginal cost; Cost curves and their shapes; Costs in the short run and in the long run; Economies and diseconomies of scale. Firms in Competitive Markets – What is a competitive market; Profit maximization and the competitive firm's supply curve; The marginal cost curve and the firm's supply decision; Firm's short-run decision to shut down; Firm's long-run decision to exit or enter a market; The supply curve in a competitive market – short run and long run.

Unit IV: The Input Markets

The Demand for Labour – The production function and the marginal product of labour; Value of the marginal product of labour and demand for labour; Shifts in labour demand curve; The supply of labour – the trade-off between work and leisure; Shifts in the labour supply curve; Equilibrium in the Labour Market; Other factors of production: Land and Capital; Linkages among factors of production.

Text Book:

- Principles of Economics, Gregory N Mankiw, 6e Cengage Learning India Private Limited, New Delhi

Reference Book:

- Karl E. Case and Ray C. Fair (2007): *Principles of Economics*, 8th Edition, Pearson Education Inc.
  Pindyck, Robert and Daniel Rubinfeld (2018): Microeconomics, 9th Edition, Pearson Education Inc

Core Paper II

MATHEMATICAL METHODS FOR ECONOMICS I

Introduction:

This is the first of a compulsory two-course sequence. The objective of this sequence is to transmit the body of basic mathematics that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomic theory, statistics and econometrics set out in this syllabus. In this course, particular economic models are not the ends, but the means for illustrating the method of applying mathematical techniques to economic theory in general. The level of sophistication at which the material is to be taught is indicated by the contents of the prescribed textbook.

Unit I: **Preliminaries and Functions of one Real Variable**

Sets and set operations; Cartesian product; relations; functions and their properties; Number systems

Types of Functions- constant, polynomial, rational, exponential, logarithmic; Graphs and graphs of functions; Limit and Continuity of functions; Limit theorems.

Unit II: Derivative of a Function

Rate of change and derivative; Derivative and slope of a curve; Continuity and differentiability of a function; Rules of differentiation for a function of one variable; Application- Relationship between total, average and marginal functions.

Unit III: Functions of two or more Independent Variables
Partial differentiation techniques; Geometric interpretation of partial derivatives; Partial derivatives in Economics; Elasticity of a function – demand and cost elasticity, cross and partial elasticity.

Unit IV: **Matrices and Determinants**
Matrices: concept, types, matrix algebra, transpose, inverse, rank; Determinants: concept, properties, solving problems using properties of determinants, solution to a system of equations - Crammer's rule and matrix inversion method.

Text Book:

- A. C. Chiang and K. Wainwright (2005): *Fundamental Methods of Mathematical Economics*, McGraw Hill International Edition.

Reference Book:

- K. Sydsaeter and P. J. Hammond (2002): *Mathematics for Economic Analysis*. Pearson Educational Asia

Core Paper III

INTRODUCTORY MACROECONOMICS

Introduction:
This course aims to introduce the students to the basic concepts of Macroeconomics. Macroeconomics deals with the aggregate economy. This course discusses the preliminary concepts associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments.

Unit I: Basic Concepts in Macroeconomics
Macro vs. Micro Economics; Limitations of Macroeconomics; Stock and Flow variables, Equilibrium and Disequilibrium, Partial and General Equilibrium Statics – Comparative Statics and Dynamics; National Income Concepts – GDP, GNP, NDP and NNP at market price, factor cost, real and nominal; Disposable personal Income.

Unit II: Measurement of Macroeconomic Variables
Output, Income and Expenditure Approaches; Difficulties of Estimating National Income; National Income Identities in a simple 2-sector economy and with government and foreign trade sectors; Circular Flows of Income in 2, 3 and 4-sector economies; National Income and Economic Welfare; Green Accounting.

Unit III: Money and Changes in its Value

Evolution and Functions of Money, Quantity Theory of Money – Cash Transactions, Cash Balances and Keynesian Approaches, Value of Money and Index Number of Prices
Inflation – Meaning, Causes, and Anti-Inflationary Measures; Classical, Keynesian, Monetarist and Modern Theories of Inflation, Inflationary Gap, Deflation- Meaning, Causes, and Anti-Deflationary Measures, Depression and Stagflation; Inflation vs. Deflation.

Unit IV: Determination of National Income
The Classical Approach - Say's Law, Theory of Determination of Income and Employment with and without saving and Investment; Basics of Aggregate Demand and Aggregate Supply and Consumption-Saving– Investment Functions, The Keynesian Approach– Basics of Aggregate Demand and Aggregate Supply and Consumption, Saving, Investment Functions; The Principle of Effective Demand; Income Determination in a Simple 2-Sector Model; Changes in Aggregate Demand and Income- The Simple Investment Multiplier

Text Book:

- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:

- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Core Paper IV

MATHEMATICAL METHODS FOR ECONOMICS II

Introduction:
This course is the second part of a compulsory two-course sequence. This part is to be taught in Semester II following the first part in Semester I. The objective of this sequence is to transmit the body of basic mathematics that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomic theory, statistics and econometrics set out in this Syllabus. In this course, particular economic models are not the ends, but the means for illustrating the method of applying mathematical techniques to economic theory in general. The level of sophistication at which the material is to be taught is indicated by the contents of the prescribed textbook.

Unit I: **Linear models:**
Input- Output Model: Basic concepts and structure of Leontief's open and static Input-Output model; Solution for equilibrium output in a three industry model; The closed model.

Unit II: Second and Higher Order Derivatives and Integration:

Technique of higher order differentiation; Interpretation of second derivative; Second order derivative and curvature of a function; Concavity and convexity of functions; Points of inflection, Derivative of Implicit Function; Higher Order Partial Derivative.

Indefinite Integrals; Rules of Integration; Techniques of Integration: Substitution Rule, Integration by parts, and Partial Fractions; Definite Integral – Area Interpretation.

Unit III: Single and Multivariable Optimization:
Optimum values and extreme values; Relative maximum and minimum; Necessary versus sufficient conditions - First and Second derivative tests (using Hessian Determinants); Economic applications thereof, First and second order condition for extrema of multivariable functions; Convex functions and convex sets.

Unit IV: Optimization with Equality Constraints:
Effects of a constraint; Finding stationary value – Lagrange-Multiplier method (Two variable single constraint case only): First and second order condition; The Bordered Hessian determinant.

Text Book:

- A. C. Chiang and K. Wainwright (2005): *Fundamental Methods of Mathematical Economics*, McGraw Hill International Edition.

Reference Book:

- K. Sydsaeter and P. J. Hammond (2002): *Mathematics for Economic Analysis*. Pearson Educational Asia

Core Paper V

MICROECONOMICS I

Introduction:
The course is designed to provide a sound training in microeconomic theory to formally analyze the behavior of individual agents. Since students are already familiar with the quantitative techniques in the previous semesters, mathematical tools are used to facilitate understanding of the basic concepts; this course looks at the behavior of the consumer and the producer and also covers the behavior of a competitive firm.

Unit I: Consumer Theory I
Preferences and Utility, Axioms of Rational Choice, Utility, Trades and Substitutions, Indifference curves; Mathematics of Indifference curves, Utility functions for specific preferences, the many good case; Utility Maximization and choice: the 2-good case (graphical analysis), the n-good case,

Indirect utility function, the Lump sum principle, Expenditure minimization, properties of expenditure function.

Unit II: Consumer Theory II

The Income and Substitution Effects: Demand function, changes in income, changes in a goods price- Direct and Indirect Approaches (Slutsky), the Individual's Demand Curve, Compensated (Hicksian) demand curves and functions, demand elasticity, Consumer Surplus, Demand relationships among goods, the 2-good case, substitutes and complements, Net (Hicksian) substitutes, and Complements, Substitutability with many goods.

Unit III: Production Theory and Costs

Production Functions: Marginal productivity, Production with One Variable Input (labour) and with Two-Variable Inputs, Isoquant Maps and the Rate of Technical Substitution, Returns to Scale, Elasticity of Substitution, Some Simple Production Functions: Linear, Fixed Proportions, Cobb-Douglas; Technical Progress.

Definition of Cost and its properties, Cost minimizing input choices (Optimization principles, Expansion Path), Cost Functions and Shift in Cost Curves, Long-Run versus Short-Run Cost Curves.

Unit IV: Profit Maximization

The Nature and Behavior of Firms, Marginal Revenue – Relationship between Average and marginal revenue, Short-Run Supply by a Price-Taking Firm, Profit Functions and its Properties, Profit maximization – General conditions, Input demands.

Text Book:

- C. Snyder and W. Nicholson (2012): Microeconomic Theory: Basic Principles and Extensions, 11th Edition, Cengage Learning, Delhi, India.

Reference Books:

- H. R. Varian (2010): Intermediate Microeconomics: A Modern Approach, 8th Edition, W.W. Norton and Company/Affiliated East-West Press (India). The workbook by Varian and Bergstrom may be used for problems.

Core Paper VI

MACROECONOMICS I

Introduction:

This course introduces the students to formal modeling of a macro-economy in terms of analytical tools. It discusses various alternative theories of output and employment determination in a closed economy in the short run as well as medium run, and the role of policy in this context. It also introduces the students to various theoretical issues related to an open economy.

Unit I: Consumption and Investment

Consumption – Income Relationship, Propensities to Consume and the Fundamental Psychological Law of Consumption; Implications of Keynesian Consumption Function; Factors Influencing

Consumption Function; Measures to Raise Consumption Function; Absolute, Relative, Permanent and Life – Cycle Hypotheses
Autonomous and Induced Investment, Residential and Inventory Investment, Determinants of Business Fixed Investment, Decision to Invest and MEC, Accelerator and MEI, Theories of Investment.

Unit II: Demand for and Supply of Money
Demand for Money – Classical, Neoclassical and Keynesian Approaches, The Keynesian Liquidity Trap and its Implications, Supply of Money, The Theory of Money Supply Determination and Money Multiplier, Measures of Money Supply in India.

Unit III: Aggregate Demand and Aggregate Supply
Derivation of Aggregate Demand and Aggregate Supply Curves in the IS-LM Framework; Nature and Shape of IS and LM curves; Interaction of IS and LM curves and Determination of Employment, Output, Prices and Investment; Changes in IS and LM curves and their Implications for Equilibrium.

Unit IV: Inflation, Unemployment and Expectations, and Trade Cycles
Inflation – Unemployment Trade off and the Phillips Curve – Short run and Long run Analysis; Adaptive and Rational Expectations; The Policy Ineffectiveness Debate; Meaning and Characteristics of Trade Cycles; Hawtrey's Monetary Theory, Hayek's Over-investment Theory and Keynes' views on Trade Cycles.

Text Book:

- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi.

Reference Book:

- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Core Paper VII

STATISTICAL METHODS FOR ECONOMICS

Introduction:
This is a course on statistical methods for economics. It begins with some basic concepts and terminology that are fundamental to statistical analysis and inference. It is followed by a study and measure of relationship between variables, which are the core of economic analysis. This is followed by a basic discussion on index numbers and time series. The paper finally develops the notion of probability, followed by probability distributions of discrete and continuous random variables and introduces the most frequently used theoretical distribution, the Normal distribution.

Unit I: **Data Collection and Measures of Central Tendency and Dispersion**

Basic concepts: population and sample, parameter and statistics; Data Collection: primary and secondary data, methods of collection of primary data; Presentation of Data: frequency distribution; cumulative frequency; graphic and diagrammatic representation of data; Measures of Central Tendency: mean, median, mode, geometric mean, harmonic mean, their relative merits and demerits; Measures of Dispersion: absolute and relative - range, mean deviation, standard deviation, coefficient of variation, quartile deviation, their merits and demerits; Measures of skewness and kurtosis.

Unit II: Correlation and Regression Analysis

Correlation: scatter diagram, sample correlation coefficient - Karl Pearson's correlation coefficient and its properties, probable error of correlation coefficient, Spearman's rank correlation coefficient. Two variable linear regression analysis - estimation of regression lines (Least square method) and regression coefficients - their interpretation and properties, standard error of estimate.

Unit III: Time Series and Index Number

Time Series: definition and components, measurement of trend- free hand method, methods of semi-average, moving average and method of least squares (equations of first and second degree only), measurement of seasonal component; Index Numbers: Concept, price relative, quantity relative and value relative; Laspeyer's and Fisher's index, family budget method, problems in construction and limitations of index numbers, test for ideal index number.

Unit IV: Probability Theory and Sampling

Probability: Basic concepts, addition and multiplication rules, conditional probability; Meaning of Sampling, Types of Sampling: Probability Sampling versus Non-Probability Sampling; Simple Random Sampling and its selection, Systematic Sampling, Multi-stage Sampling, Quota Sampling; Error: Sampling and Non-sampling.

Text books:

- S. C. Gupta (2017): *Fundamentals of Statistics*, Himalaya Publishing House, Delhi

Reference Book:

- Murray R. Speigel (2017): *Theory & Problems of Statistics*, Schaum's publishing Series.

Core Paper VIII

MICROECONOMICS II

Introduction:

This course is a sequel to Microeconomics I. The emphasis will be on giving conceptual clarity to the student coupled with the use of mathematical tools and reasoning. It covers Market, general equilibrium and welfare, imperfect markets and topics under information economics.

Unit I: Firm Supply and Equilibrium

Market Environments; Pure competition; Supply decision of a competitive firm and Exceptions; Inverse Supply Function; Profits and Producer's Surplus; Long Run Supply Curve of a Firm; Long Run Average Costs; Short Run and Long Run Industry Supply; Industry Equilibrium in Short and Long Run; Meaning of Zero Profits; Economic Rent.

Unit II: General Equilibrium, Efficiency and Welfare

The Edge worth Box; Trade; Pareto Efficient Allocations; Existence of equilibrium and efficiency; The Welfare Theorems and their implications; The Firm; Production and the Welfare Theorems ; Production possibilities, comparative advantage and Pareto efficiency.

Unit III: Market Imperfections: Monopoly and Oligopoly

Barriers to Entry, Profit Maximization and Output Choice, Monopoly and resource Allocation, Monopoly, Product Quality and Durability, Price Discrimination, Second Degree Price Discrimination through Price Schedules, Regulation of Monopoly, Dynamic Views of Monopoly. Monopolistic competition; Price output determination; excess capacity under monopoliostic competition .

Unit IV: Game Theory

The Payoff Matrix of a Game; Nash Equilibrium; Mixed Strategies ;The Prisoner's Dilemma; Repeated Games; Enforcing a cartel; Sequential Games; A Game of entry deterrence.

Oligopoly – Choosing a strategy; Quantity and price leadership; Simultaneous Quantity Setting; Example of Cournot Equilibrium; Simultaneous Price Setting; Collusion.

Text Book:

- H. R. Varian (2010): Intermediate Microeconomics: A Modern Approach, 8th Edition, W.W. Norton and Company/Affiliated East-West Press (India). The workbook by Varian and Bergstrom may be used for problems.

Reference Book:

- C. Snyder and W. Nicholson (2012): Microeconomic Theory: Basic Principles and Extensions, 11th Edition, Cengage Learning, Delhi, India.
- Pindyck, Robert and Daniel Rubinfeld (2018): Microeconomics, 9th Edition, Pearson Education Inc.

Core Paper IX

MACROECONOMICS II

Introduction:
This course is a sequel to Macroeconomics I. In this course, the students are introduced to the long run dynamic issues like growth and technical progress. It also provides the micro-foundations to the various aggregative concepts used in the previous course.

Unit I: Modeling Economic Growth
Accumulation of Capital in the basic Solow Model; supply and demand for goods, growth in the capital stock and the steady state, Golden rule level of capital: Comparing steady states, transition to the golden rule steady state with too much and too little capital, Population Growth, Technological Progress- Solow version, Beyond Solow Model and Endogenous Growth.

Unit II: Open Economy and Macroeconomic Policy
Balance of payments- concept; meaning of equilibrium and disequilibrium in balance of payments; Determination of foreign exchange rate- the balance of payments theory; Fixed versus flexible exchange rates; Short-run open economy model- the basic Mundell-Fleming model;
Macroeconomic Policies – Fiscal policy, Crowding –out and Crowding – in; Monetary policy and instruments, the Transmission Mechanism; Effectiveness of macroeconomic policies in open and closed economies.

Unit III: Classical and Keynesian Macroeconomics Thoughts
Keynes verses classics: Classical macroeconomics, Employment and output determination, Say's law, the quantity theory of money, Keynes's General theory: Keynes's main propositions; analysis of the labour market, Keynes's critique of Say's law and Quantity theory of money, the orthodox Keynesian school, underemployment equilibrium in the Keynesian model, the Phillips curve and orthodox Keynesian school.

Unit IV: Monetarist and New Classical Macroeconomic Thoughts
The orthodox monetarist school, the Quantity Theory of Money approach, the expectations augmented Phillips curve analysis, the orthodox monetarist school and stabilization policy.
New Classical Economics: The influence of Robert e Lucas Jr, the structure of new classical models: the Rational Expectations hypothesis; and policy implications.

Text Book:

- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:

- Brian Snowdon and Howard R Vane (2005): Modern Macroeconomics: Its Origins, Development and Current State, Edward Elgar

Core Paper X

Research Methodology

Introduction:
The course is to develop a research orientation among the students and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis.

Unit I: Basics of Research
Introduction to Research: Meaning, Objectives, Motivation, Types, Approaches, Significance, Research Process, Criteria of Good Research; Qualities of a Good Researcher, Research as a Career.

Unit II: Research Problem
Defining the Research Problem: What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem; Research Design: Meaning, Need, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.

Unit III: Issues in Research
Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Techniques of Measurement Tools, Scaling and Important Scaling Technique
Research Ethics: codes and ethics, permissions to research, responsibilities, confidentiality, feedback, participatory research; Research Proposal and literature review: research proposal, review of literature, levels of analysis, using the library and internet, abstracting, word processing, plagiarism, Concept of IPR.

Unit IV: Actions in Research
English in report writing: words, sentences, paragraph, writing style; The Report: improving quality, sections, drawing conclusions, evaluation checklists, persistence; Common Citation Styles

Text Book:
- Kothari, C. R. (2004): Research Methodology: Methods and Techniques, New Age International Private Limited Publishers, New Delhi.

Reference Books:
- Guthrie, G. (2010): Basic Research Methods, Sage Publications India Private Limited, New Delhi.

Core Paper XI

INDIAN ECONOMY I

Introduction:

Using appropriate analytical frameworks, this course reviews major trends in economic indicators and policy debates in India in the post-Independence period, with particular emphasis on paradigm shifts and turning points. Given the rapid changes taking place in India, the reading list will have to be updated annually.

Unit I: Basic Characteristics of Indian Economy as a Developing Economy

Indian Economy in the Pre-British Period; The Structure and Organization of Villages and Towns; Industries and Handicrafts in Pre-British India; Colonialism; Economic Consequences of British Rule; Decline of Handicrafts and Progressive Ruralization; The Land System and Commercialization of Agriculture; Industrial Transition; Colonial Exploitation and Impacts – Underdevelopment; Colonization and Modernization; State Policies and Economic Underdevelopment; The Current State of Indian Economy

Unit II: Population and Human Development

Population Growth and Economic Development – size, growth and future of population; Causes of rapid population growth; Population and economic development; Population policy; Demographic issues– Sex and Age Composition of population; Demographic Dividend; Urbanization and Migration; Human Resource Development – Indicators and importance of Human Resource Development; Education policy; Health and nutrition.

Unit III: National Income in India – The Growth Story and Current Challenges

Trends in national and per capita income; Changes in sectoral composition of national income; Regional disparities in Growth and Income; Savings and Investment and Economic Growth – The Linkage; Poverty – Estimation and Trends, Poverty Alleviation Programs– MGNREGA, NRLM, SJSRY; Inequality –Measures and trends in India; Unemployment– Nature, Estimates, Trends, Causes and Employment Policy.

Unit IV: Economic Planning in India

Rationale, Features, Objectives, Strategies, Achievements and Assessment of Planning in India; Eleventh Five Year Plan– Objectives, Targets and Achievements; Twelfth Five Year Plan – Vision and Strategy; From Planning to NITI– Transforming India's Development Agenda.

Text Book:

- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Books:

- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.
- Indian Economy Datt and Sundharam, GauravDatt and AshwaniMahajan, S Chand Publications, 7th Revised Edition
- Indian Economy Since Independence, ed by Uma Kapila, Academic Foundation, Revised Nineteenth Edition 2008-09
- Government of India (Current Year): Economic Survey, Ministry of Finance, New Delhi

Core Paper XII

DEVELOPMENT ECONOMICS I

Introduction:

This is the first part of a two-part course on economic development. The course begins with a discussion of alternative conceptions of development and their justification. It then proceeds to aggregate models of growth and cross-national comparisons of the growth experience that can help evaluate these models. The axiomatic basis for inequality measurement is used to develop measures of inequality and connections between growth and inequality are explored. The course ends by linking political institutions to growth and inequality by discussing the role of the state in economic development and the informational and incentive problems that affect state governance.

Unit I: Study of Economic Development

Development Economics as subject; economic growth and economic development; Characteristics of underdeveloped countries – vicious cycle of poverty and cumulative causation; obstacles to economic development; measures of economic development – national and per capita income, basic needs approach, capabilities approach, three core values of development, PQLI, HDI, HPI, MDPI, GDI; capital formation and economic development.

Unit II: Theories of Economic Growth and Development

Classical theory, Marxian theory; Schumpeterian theory; Rostow's stages of economic growth; Solow model and convergence with population growth and technical progress.

Unit III: Poverty, Inequality, Agriculture, Industry and Development

Measuring poverty: Head Count Ratio, Poverty Gap Ratio, Squared Poverty Ratio, FGT Ratio; Measuring Inequality – Lorenz curve and Kuznets' inverted U hypothesis; Growth, poverty and inequality; Policy options – some basic considerations.

Agriculture, Industry and Economic Development: Role of agriculture; Transforming traditional agriculture; Barriers to agricultural development; Role of industrialization; Interdependence between agriculture and industries – A model of complementarities between agriculture and industry; terms of trade between agriculture and industry; functioning of markets in agrarian societies; interlinked agrarian markets.

Unit IV: Institutions and Economic Development:

Role of institutions in economic development; Characteristics of good institutions and quality of institutions; The pre-requisites of a sound institutional structure; Different measures of institutions – aggregate governance index, property rights and risk of expropriation; The role of democracy in economic development; Role of markets and market failure; Institutional and cultural requirements for operation of effective private markets; Market facilitating conditions; Limitations of markets in LDCs; Corruption and economic development – tackling the problem of corruption.

Text book:

- Todaro, Michael P and Stephen C Smith (2006): *Economic Development*, 8th Edition, Pearson

Reference Books:

- Debraj Ray (2009): *Development Economics,* Oxford University Press.
- Thirlwall, A P (2011): *Economics of Development*, 9th Edition, Palgrave Macmillan

Core Paper XIII

INDIAN ECONOMY II

Introduction:
This course examines sector-specific polices and their impact in shaping trends in key economic indicators in India. It highlights major policy debates and evaluates the Indian empirical evidence. Given the rapid changes taking place in the country, the reading list will have to be updated annually.

Unit I: Agricultural Development in India
Indian Agriculture: nature, importance, trends in agricultural production and productivity, factors determining production, land reforms, new agricultural strategies and green revolution, rural credit; Agricultural marketing and warehousing.

Unit II: Industrial Development in India
Trends in industrial output and productivities; Industrial Policies of 1948, 1956, 1977 and 1991; Industrial Licensing Policies – MRTP Act, FERA and FEMA; Growth and problems of SSIs, Industrial sickness; Industrial finance; Industrial labour.

Unit III: Tertiary Sector, HRD and the External Sector
Tertiary Sector: growth and contribution of service sector to GDP of India, share of services in employment; Human development – concept, evolution, measurement; HRD: indication, importance, education in India, Indian educational policy; Health and Nutrition.
Foreign Trade: role, composition and direction of India's foreign trade, trends of export and import in India, export promotion verses import substitution; Balance of Payments of India; India's Trade Policies; Foreign Capital – FDI, Aid and MNCs.

Unit IV: Indian Economy and Environment
Environmental Policies in India: The Environment (Protection) Act 1986, The Environment (Protection) Rules 1986, The National Forest Policy 1988, Policy statement for Abatement of Pollution 1992, National Conservation Strategy and Policy Statement on Environment and Development 1992, The National Environment Appellate Authority Act 1997, National Environmental Policy 2006; Global deal with Climate Change: Introduction, Intergovernmental Panel for Climate Change (IPCC), Impact of Climate Change on India, Global Response on Climate Change, Possible Role of India.

Text Book:
- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Books:

- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.
- Indian Economy Datt and Sundharam, GauravDatt and AshwaniMahajan, S Chand Publications, 7th Revised Edition
- Indian Economy Since Independence, ed by Uma Kapila, Academic Foundation, Revised Nineteenth Edition 2008-09
- Government of India (Current Year): Economic Survey, Ministry of Finance, New Delhi

Core Paper XIV

DEVELOPMENT ECONOMICS II

Introduction:

This is the second unit of the economic development sequence. It begins with basic demographic concepts and their evolution during the process of development. The structure of markets and contracts is linked to the particular problems of enforcement experienced in poor countries. The governance of communities and organizations is studied and this is then linked to questions of sustainable growth. The course ends with reflections on the role of globalization and increased international dependence on the process of development.

Unit I: Population and Development

Demographic concepts : birth and death rates, age structure, fertility and its determinants, the Malthusian population trap and the microeconomic household theory of fertility; costs and benefits of population growth and the model of low level equilibrium trap; rural-urban migration – the Harris Todaro migration model and policy implications.

Unit II: Dualism and Economic Development

Dualism – geographic, social and technological; the theory of cumulative causation (Myrdal); the regional inequalities in the context of economic development; the inverted U relationship; international inequality and the centre periphery thesis; dependency, exploitation and unequal exchange; the dualistic development thesis and its implications.

Unit III: Environment and Development

Basic issues of environment and development – Development and environment inter-linkage; Poverty, environmental degradation and externalities; common property resources, renewable and non-renewable resources; concept of sustainable development; basics of climate change.

Unit IV: International Trade and Economic Development and Financing Economic Development

Trade and economic development; export led growth; terms of trade and economic growth – the Prebisch Singer Hypothesis; trade strategies for development – import substitution vs. export promotion; international commodity agreements; trade vs aid.

Saving, capital formation and economic development; financial sector and economic development; taxation, public borrowing and economic development; inflation, foreign finance, investment and foreign aid – controversies and opportunities.

Text Book:

- Todaro, Michael P and Stephen C Smith (2006): *Economic Development*, 8th Edition, Pearson

Reference Book:

- Thirlwall, A P (2011): *Economics of Development*, 9th Edition, Palgrave Macmillan.

DSE Group I
Discipline Specific Elective Paper-1

ECONOMIC HISTORY OF INDIA 1857-1947

Introduction:

This course analyses key aspects of Indian economic development during the second half of British colonial rule. In doing so, it investigates the place of the Indian economy in the wider colonial context, and the mechanisms that linked economic development in India to the compulsions of colonial rule. This course links directly to the course on India's economic development after independence in 1947.

Unit I: Introduction: Colonial India: Background and Introduction and Macro trends;

Overview of colonial economy**,** National Income; population; occupational structure.

Unit II: Agriculture

Agrarian structure and land relations; agricultural markets and institutions – credit, commerce and technology; trends in performance and productivity; famines.

Unit III: Railways and Industry

Railways; the de-industrialization debate; evolution of entrepreneurial and industrial structure; nature of industrialization in the interwar period; constraints to industrial breakthrough; labor relations.

Unit IV: Economy and State in the Imperial Context

The imperial priorities and the Indian economy; drain of wealth; international trade, capital flows and the colonial economy – changes and continuities; government and fiscal policy.

Text Book:

- Tirthankar Roy, *The Economic History of India 1857-1947*, Oxford University Press, 3rd edition, 2011.

Discipline Specific Elective Paper-2

INTRODUCTORY ECONOMETRICS

Introduction:
This course provides a comprehensive introduction to basic econometric concepts and techniques. It covers statistical concepts of hypothesis testing, estimation and diagnostic testing of simple and multiple regression models. The course also covers the consequences of and tests for misspecification of regression models.

Unit I: Introduction
Definition, Nature and scope of econometrics; Theoretical Probability Distributions: Binomial, Poisson and Normal distributions: their properties
Theory of Estimation: Estimation of parameters; properties of estimators – small sample and asymptotic properties; point and interval estimation.

Unit II: Hypothesis Testing
Testing of hypotheses: defining statistical hypotheses; Simple and composite hypotheses; Null and alternative hypothesis; Type I and Type II errors, Critical region; Neyman-Pearson lemma; Power of a test; Test statistics: z, chi square, t and F.

Unit III: Linear Regression Analysis
Two variable linear regression model – Assumptions; Least square estimates, Variance and co-variance between Least square estimates; BLUE properties; Standard errors of estimates; Co-efficient of determination; Inference in a two variable linear regression model; ANOVA; Forecasting. Introduction to multiple regression models.

Unit IV: Violation of Classical Assumptions
Heteroscedasticity, Multicollinearity and Auto-correlation: Meaning, consequences, tests and remedies.

Text Book:
- Gujarati, D & Sangeetha (2007); "Basic Econometrics", McGraw Hill Book Co.

Discipline Specific Elective Paper-3

ODISHA ECONOMY

Introduction:
Using appropriate analytical frameworks, this course reviews major trends in economic indicators and policy debates in Odisha in pre- and post-Independence period, with particular emphasis on

paradigm shifts and turning points. Given the rapid changes taking place in Odisha, the reading list will have to be updated annually.

Unit I: Odisha Economy before 1947

Orissa's Economy in the Nineteenth Century: Benevolence or Exploitation, Forces of Nature, Animal Power, The Company Steps in, Public Works and Public Health, Education, Disintegration of Village Economy, New Social Environment, Changing Position of Social Classes, The Moneylenders, The Borrowers, Money-flows from Village to Metropolis, Pauperization of Peasantry, The Wage Earners, Demographic Changes, Profiting from Rural Adversity; Diarchy in 1919 and Separation of Provincial Finances from Central Government in 1937; Emergence of Federal Finance (Ref.: Das 1976a and 1976b, GoO 2016).

Unit II: Macro Economy of Odisha

A macro glance of Odisha economy: aggregate income, broad sectoral decomposition, performance of districts, employment, child labour and bonded labour, employment programmes, consumption expenditure, cost of living; Odisha State public finances (Chapter 14 and 15 of Ref 1; & Chapter 2 and 9 of Ref 2).

Unit III: Agriculture, Industry, Infrastructure and Environment in Odisha

Agriculture: land ownership and land tenure, agricultural wages and rural unemployment, production and productivity of major crops, agricultural inputs, agricultural policy; Animal Husbandry; Fisheries (Chapter 1 to 3 of Ref 1; & Chapter 3 of Ref 2)

Industry: Investment, industrial policy, and the growth of large industries, mining and quarrying; Construction; tertiary sector: tourism, transport and power; Water Resources, Forest Resources (Chapter 4 to 8 of Ref 1; & Chapter 4 & 5 of Ref 2).

Unit IV: Social Sector in Odisha

Poverty: income poverty and inequality; health sector: outcomes, infrastructure, finance, public health, NRHM; education: Literacy, Primary education, secondary education, higher education, SSA; human development (Chapter 9 to 13 of Ref 1; & Chapter 7 & 8 of Ref 2).

Text Book:

- Nayak, P., Panda, S. C., Pattanaik, P. K. (2016): The Economy of Odisha: A Profile, Oxford University Press, New Delhi.

Reference Book:

- GoO (Latest): Odisha Economic Survey, Planning and Convergence Department, Directorate of Economics and Statistics, Government of Odisha, Bhubaneswar.
- GoO (2004): *Human Development Report 2004 Orissa*, Planning and Coordination Department, Government of Odisha, Bhubaneswar.
- GoO (2018): 80 Years Odisha Budget: Commemorative Volume, Department of Finance, Bhubaneswar.

Discipline Specific Elective Paper-4

MONEY, BANKING AND FINANCIAL MARKET

Introduction:

This course exposes students to the theory and functioning of the monetary and financial sectors of the economy. It highlights the organization, structure and role of financial markets and institutions. It also discusses interest rates, monetary management and instruments of monetary control. Financial and banking sector reforms and monetary policy with special reference to India are also covered.

Unit I: Money

Definition and functions of money; Types of money: legal tender money and bank money, near money; Value of money and index number; construction of index number; WPI, CPI, PPI, GDP deflator, Cost of living index

Demand for money- Classical and Keynesian approaches, Patinkin and the Real Balance Effect; Friedman's Quantity theory of money. Supply of Money- Measures of money supply: M_1,M_2, M_3 and M_4; High powered money and money multiplier.

Unit II: Commercial Banking

Meaning and types; Functions of commercial banks; the process of credit creation and its limitations**;** Balance sheet and portfolio management, Banking sector reforms in India; Lessons from Global Financial Crisis and Policy Response in India.

Unit III: Central Banking

Functions of a central bank; Quantitative and qualitative methods of credit control; Central Bank's Supervision and prudential measures for Financial stability; current monetary policy of India, liquidity adjustment facility (LAF) through Repo and reverse repo operation, MSF.

Unit IV: Financial Markets

Financial Market, Meaning, Types , Money market and Capital Market, Primary and Secondary Market, Stock Exchanges, SEBI; Role of Financial Markets for Economic Development.

Text Book

- L. M. Bhole and J. Mahukud*, Financial Institutions and Markets,* Tata McGraw Hill, 5th edition, 2011.

Discipline Specific Elective Paper-5

PUBLIC ECONOMICS

Introduction:
Public economics is the study of government policy from the points of view of economic efficiency and equity. The paper deals with the nature of government intervention and its implications for allocation, distribution and stabilization. Inherently, this study involves a formal analysis of government taxation and expenditures. The subject encompasses a host of topics including public goods, market failures and externalities.

Unit I: Introduction to Public Finance and Public Budgets
Public Finance: meaning and scope, distinction between public and private finance; public good verses private good; Principle of maximum social advantage; Market failure and role of government; Public Budget: kinds of budget, economic and functional classification of the budget; Balanced and unbalanced budget; Balanced budget multiplier; Budget as an instrument of economic policy.

Unit II: Public Expenditure
Meaning, classification, principles, cannons and effects, causes of growth of public expenditure, Wagner's law of increasing state activities, Peacock-Wiseman hypotheses.

Unit III: Public Revenue
Sources of Public Revenue; Taxation - meaning, cannons and classification of taxes, impact and incidence of taxes, division of tax burden, the benefit and ability to pay approaches, taxable capacity, effects of taxation, characteristics of a good tax system, major trends in tax revenue of central and state governments in India.

Unit IV: Public Debt
Sources, effects, debt burden – Classical/ Ricardian views, Keynesian and post-Keynesian views; shifting - intergenerational equity, methods of debt redemption, debt management, tax verses debt.

Text Books:

- J. Hindriks and G. Myles (2006): *Intermediate Public Economics*, MIT Press.

Reference Book:

- R. A. Musgrave and P. B. Musgave(1989): *Public Finance in Theory and Practices.* McGraw Hill
- Bhatia H L (2018): *Public Finance.* Vikas Publishing House.

DSE Group II
Discipline Specific Elective Paper- 1

Environmental Economics

Introduction:
This course introduces the students to the basics of environmental economics to understand the fundamentals of environmental concerns and develop insights into valuation of environment.

Unit I: Economy and Environment
Nature and Scope of Environmental Economics- Environment and Economy interaction; Environment as a public good- Serious environmental problems of Developing Countries – Air pollution, water pollution and deforestation.
Global environmental problems, trade and environment, International Cooperation for Environmental Protections, Montreal and other protocols.

Unit II: The Economics of Pollution and Climate change
Pollution as externality, The market Approach to optimal pollution, Property rights and market bargain theorems, Coase theorem; Pigouvian Taxation, Subsidies and optimal pollution; Climate change – concept, causes, effects and management.

Unit III: Valuation of Environmental Damage
Methods and difficulties of environmental valuation, Economic value, Use value, Option value, Existence value; Direct and Indirect Valuation of Environmental Goods: The hedonic price approach, Contingent valuation, Travel cost approach.

Unit IV: Natural Resources and Sustainable Development
Natural resources- Renewable and exhaustible; Tragedy of commons, People's Participation in the management of common property resources; Sustainable Development Concepts, Sustainability rules, Indicators of sustainability, Solow/Hartwick, Natural capital stock, Safe Minimum Standard.

Text Book:
- Bhattacharya, R. N. (2002): Environmental Economics: An Indian Perspectives, OUP, New Delhi

Reference Book:
- Kolstad, C.D (1999); Environmental Economics Oxford University Press, New Delhi

Discipline Specific Elective Paper-2

INTERNATIONAL ECONOMICS

Introduction:

This course introduces the students to international trade and finance to understand the theories of international trade and develop insights into trade policy and balance of payments. The course also develops insight into international financial system and the trade policy of India.

UNIT I: Importance of Trade and Trade Theories

Importance of the study of International Economics; Inter-regional and international trade; Theories of Trade-absolute advantage (Adam Smith), comparative advantage (David Ricardo) and opportunity cost (Haberler); Heckscher-Ohlin theory of trade — its main features, assumptions and limitations (Leontief Paradox) Factor Price Equalization theorem.

UNIT II: Trade Policy and International Economic Institutions

Concepts of terms of trade and their importance; Doctrine of reciprocal demand – Offer curve technique; Gains from trade ;Trade as an Engine of Growth and Concept of immiserizing growth, Tariffs and quotas – their impact in partial equilibrium analysis; General Equilibrium analysis of tariff and the concept of optimum tariff, Functions of IMF (Conditional Clause), Role of IMF in international liquidity, Reforms for the emergence of international monetary system; World Bank and WTO; Their achievements and failures; Their Role from the point of view of India.

UNIT III: Exchange Rate

Concept and Types of Exchange Rate (bilateral vs. trade-weighted exchange rate, cross exchange rate, spot, forward, futures), Demand for and Supply of foreign exchange, Exchange Rate Determination: Mint Parity Theory, Purchasing-Power Parity Theory, Fixed versus Flexible exchange rate.

UNIT IV: Balance of Trade and Payments

Concepts and components of balance of trade and balance of payments; Disequilibrium in balance of payments; Various measures to correct deficit in BOPs (Expenditure switching and expenditure reducing policies, Direct control), Depreciation Vs. Devaluation; Elasticity approach to devaluation, Foreign trade multiplier- Concept and implications.

Text Book:

- Mannur H. G (Recent Edition) *International Economics*, Vikash Publishing

Reference Books:

- SalvatoreDominick, *InternationalEconomics*,WileIndia.
- SoderstenBo andReedJ, *InternationalEconomics*, McMillanPublisher

Discipline Specific Elective Paper-3

AGRICULTURAL ECONOMICS

Course description

This course introduces students to the significance of agriculture in the Indian economy and helps to understand the role agriculture in economic development. It is designed to develop insights into changing agricultural practices in India and assess the significance of agriculture in the era of liberalization.

UNIT I: Agriculture and Economic Growth

Role of Agriculture in Economic Development, sectoral changes and agriculture, agriculture in rural development, farm and non-farm employment issues, inter-linkages between agriculture and industry; empirical evidence of inter-dependence between agriculture and industry; Schultz's hypothesis on traditional agriculture – its criticisms; Mechanization of Indian Agriculture; Case for and against farm mechanization; Green revolution and trends of mechanization in India.

UNIT II: Agricultural Price and Marketing

Agricultural price policy for a developing economy – objectives and effectiveness of agricultural price policy, elements of agricultural price policy, features of an ideal agricultural price policy, agricultural price policy in India and public distribution system

Agricultural marketing – need and criteria for assessing efficiency, agricultural marketing system in India, development of a national agricultural marketing platform.

UNIT III: Risk and Uncertainty in Agriculture

Difference between risk and uncertainty, types of uncertainty in agriculture, measures for mitigating risk and uncertainty in agriculture, new agricultural insurance scheme of India

Rural credit in India, importance and estimates, agencies for rural credit, review of progress of institutional finance in rural India since independence.

UNIT IV: Agriculture in India

Agriculture in Indian Planning, Globalization and Indian agriculture, Case for and against privatization of agriculture, WTO and India's trade in agricultural commodities.

Text Book

- Sony, R. N. (2006), Leading Issues in Agricultural Economics, Vishal Publishing, Jalandhar.

Reference Book:

- Sadhu, A N and A Singh (2008), Fundamentals of Agricultural Economics, Himalaya Publishing House, Mumbai.

Discipline Specific Elective Paper-4

HISTORY OF ECONOMIC THOUGHT

Introduction:

This course provides a perspective to our intellectual history, development of economic thought and helps relate this thought to the current thinking. It introduces the students to the philosophers and economists who developed economic reasoning and modeling of economic activities. It also helps create critical abilities and attitudes.

UNIT I: Introduction and Early Economic Thought

Mercantilism-main characteristics, Thomas Mur's views ; Physiocracy- main features, Tableau Economique, taxation; Early Classicism: Adam Smith- Theory of Value, Division of labour, capital accumulation, distribution, views on trade and economic progress; David Ricardo-theory of value, theory of rent, distribution, ideas on international trade and development.

UNIT II: Classicism Vs Marxism

Thomas Malthus- population theory, glut theory; Karl Marx-dynamic of social change, theory of value, surplus value, theory of profit, crisis of capitalism, Johns Stuart Mill- ideas on value, distribution, views as a synthesizer.

UNIT III: The Marginalists' Revolution

Economic ideas of Jevons, Walras and Menger, Bohm-Bowerk, Wicksell ; Marshall – Role of time element in price determination, ideas on consumer surplus, Marshal as a synthesizer.

UNIT IV: Indian Economic Thought

Main themes of Kautilya's Arthasashtra; Modern Economic Ideas: Dada Bhai Naoroji, M.K. Gandhi, village swaraj, non-violence, machines and labour, cottage industries; Comparison of Indian Economic thought with western Economic thought.

Text Book

- Gide, Charles and Rist, Charles (1973): A History of Economic Doctrines, Oxford University Press.
- Dasgupta, A K (1986): Epochs of Economic Theory, Oxford University Press, New Delhi.

Reference Book:

- O'Brien, D P (1975): Classical Economists, Oxford, Clarendon Press.
- Ekelund, Robert B. and Robert F. Hebert (1990): A History of Economic Theory and Method, third edition, New York: McGraw Hill.
- Henry W. Spiegel (1991): The Growth of Economic Thought, 3rd ed. Durham: Duke University Press.
- Tom Bottomore (1980): Dictionary of Marxist Thought, Basic Blackwell Publishers.
- Roll, Eric, History of Economic Thought, Faber and Faber Ltd.
- L N Rangarajan (1992): Kautilya: The Arthasastra, edited, rearranged, translated and introduced; Penguine books, New Delhi.

DSE Paper –4
DISSERTATION / RESEARCH PROJECT
(College can give this choice only for students with above 60% aggregate marks)

Introduction : The project is intended to establish the connection between Economics as confined to the text books and class rooms and Economics at play in the ground. It is expected to give an empirical content to the subject. Economics is defined as the study of mankind in the ordinary business of life. It studies individual as well as group behavior.

Project work at the undergraduate level is an in-depth study on a topic chosen by the student. The objective of the project work for the students at undergraduate level is to expose students to the social and real world contexts in which the subjects taught in the classroom have applications. Therefore, the topic must be related to the field of study the student is enrolled. It is undertaken with the guidance of a faculty supervisor, and involves a prolonged period of investigation and writing. The supervisor is supposed to help the student and mentor him/her throughout, from selection of the topic to submission of the project report.
The project output will be a project report written on the topic, chosen by the student and approved by the guide, in about 10000 words.

The process of project preparation typically comprises of an investigation of a particular topic, based on the application of philosophical and theoretical knowledge available in the already existing scientific literature and other published sources of information. The student may use already available data (texts, documents, artworks or existing data sets) or she may go for collection of data from the field. The final report should ideally have the following sections.
(1) Abstract (in about 500 words) containing a summary of the entire report.
(2) Introduction of the topic, arguments for choosing such a topic and the key investigation propositions.
(3) A review of the existing knowledge on the topic
(4) Information on the data and data treatment tools used in the study
(5) An analysis of data and findings
(6) Conclusions
(7) References

A good research project requires sincere efforts and honest dedication from students. Moreover, it requires an engagement of the student with an issue under probe for a fairly long period of time compared to their preparations of subjects for the examination.

A successful completion of the project report has several positive learning outcomes for the student. It empowers the student with the life skill of patience and persistence. It also helps the student to locate her theoretical understandings in the context of socio-economic and political realities.

Generic Elective Paper I

INDIAN ECONOMY

Introduction: This paper introduces the students to the essentials of Indian economy with an intention of understanding the basic feature of the Indian economy and its planning process. It also aids in developing an insight into the agricultural and industrial development of India. The students will understand the problems and policies relating to the agricultural and industrial sectors of India and current challenges of Indian economy.

Unit I: Introduction to Indian Economy and Current Challenges

Colonialism & British Rule: Exploitation and under-development in India; Basic features of India Economy; Indian Economy as a developing economy; Demographic trends in India - Size and growth of population, Occupational structure, Sex composition, Age structure and demographic dividend; Causes of population growth and population policy; The problem of unemployment and recent policies for employment generation; The problem of inequality in income distribution and its causes, Policies to address inequality.

Unit II: Indian Agriculture

Role of Agriculture in Indian Economy; Cause of low productivity, Green Revolution and Land Reforms, Agricultural Finance-Sources and Problems; Agricultural Marketing in India.

Unit III: Industrial Development in India

Role of Industrialization in Indian Economy; Small Scale & Cottage Industries: Meaning, Role, Problems and Remedies; Industrial Policies of 1948, 1956, 1977 and1991; Problems of Industrial Development in India; Industrial Sickness.

Unit IV: Service Sector in India

Growth & Contribution to GDP; Composition and relative importance of service sector; Factors determining growth of the sector; ICT and IT – Spread and Policy; Sustainability of services led growth.

Text Book:

- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Book

- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.

Generic Elective Paper II

INDIAN ECONOMY II

Introduction: : This paper is the part II of Indian economy deals with the external sector, financial markets in India, Indian Public Finances and Economic Reforms. This paper also throws some light on current challenges of Indian Economy.

Unit I: External Sector in India

Trends, Composition & Direction in exports from and imports of India; Problems of Balance of Payment: Causes of deficit in BOP & measures to correct it; Trade Policy- Export Promotion Vs Import Substitution; Foreign Trade Policy of India; WTO and India.

Unit II: Financial Markets in India

Commercial Banking in India- Nationalization of Banks; Lead bank scheme and branch expansion; RBI - Functions, Monetary Policy; Development Banking- IFCI,IDBI, SIDBI and NABARD

Unit III: Indian Public Finance

Public Expenditure-Growth and Composition, Causes of Growth of Public Expenditure in India: Tax Revenue of Central and State Governments; Concept of VAT; Deficit Financing in India-Revenue, Budget, Fiscal and Primary Deficits; Purpose and Effects of Deficit Financing; India's Fiscal Policy-Objectives.

Unit IV: Current Challenges Facing Indian Economy

Inflation – Causes, Consequences and Anti-inflationary Policy; Poverty – Poverty line and Estimates, Major Poverty Alleviation Programmes; Environmental Degradation – Growth and Environment; Population Growth and Environment; Environment Policy; Economic Reforms-Globalization, Macroeconomic Stabilization, Structural Reforms, and their impact on the Indian Economy; Foreign capital and MNCs-Role and consequences.

Text Book:

- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai.

Reference Book

- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.
- Basu, Kaushik (2016): An Economist in the Real World: The Art of Policy Making in India, enguin.

Generic Elective Paper III

INTRODUCTORY MICROECONOMICS

Introduction:

This course is designed to expose the students to the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situation.

Unit I: Exploring the Subject Matter of Economics, Markets and Welfare

The Ten Principles of Economics: How people make decisions; Working of the economy as a whole; Thinking Like an Economist: The economist as Scientist – The scientific method: Observation, Theory and more observation; Role of assumptions; Economic Models; Why economists disagree; Graphs in Economics.

The market forces; Markets and competition; The demand and supply curves – Market vs. individual curves, Shifts in demand and supply curves; Market equilibrium and changes there in; Price elasticity of demand – determinants and computation; Income and cross elasticity of demand; The price elasticity of supply – determinants and Computation; Consumer and Producer Surplus.

Unit II: Theory of Consumer Choice

The Budget Constraint; Preferences – representing preferences with indifference curves; Properties of indifference curves; Two extreme examples of indifference curves; Optimization – Equilibrium; Change in equilibrium due to changes in income, changes in price; Income and substitution effect; Derivation of demand curve; Three applications – Demand for Giffen goods, Wages and Labour Supply, Interest rate and Household saving.

Unit III: The Firm and Market Structures

Cost concepts; Production and costs; The various measures of cost – Fixed and variable cost, average and marginal cost; Cost curves and their shapes; Costs in the short run and in the long run; Economies and diseconomies of scale. Firms in competitive markets – What is a competitive market; Profit maximization and the competitive firm's supply curve; The marginal cost curve and the firm's supply decision; Firm's short-run decision to shut down; Firm's long-run decision to exit or enter a market; The supply curve in a competitive market – short run and long run.

Unit IV: The Input Markets

The demand for labour – The production function and the marginal product of labour; Value of the marginal product of labour and demand for labour; Shifts in labour demand curve; The supply of labour – the trade-off between work and leisure; Shifts in the labour supply curve; Equilibrium in the labour market; Other factors of production: Land and capital; Linkages among factors of production.

Text Book:

- Principles of Economics, Gregory N Mankiw, 6e Cengage Learning India Private Limited, New Delhi.

Reference Book:

- Karl E. Case and Ray C. Fair (2007): *Principles of Economics*, 8th Edition, Pearson Education Inc.
- Pindyck, Robert and Daniel Rubinfeld (2018): Microeconomics, 9th Edition, Pearson Education Inc.

Generic Elective Paper IV

INTRODUCTORY MACROECONOMICS

Introduction:

This course aims to introduce the students to the basic concepts of Macroeconomics. Macroeconomics deals with the aggregate economy. This course discusses the preliminary concepts

associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments.

Unit I: Basic Concepts in Macroeconomics

Macro vs. Micro Economics; Limitations of Macroeconomics ; Stock and Flow variables, Equilibrium and Disequilibrium, Partial and General Equilibrium Statics – Comparative Statics and Dynamics ; National Income Concepts – GDP, GNP, NDP and NNP at market price, factor cost, real and nominal; Disposable personal Income.

Unit II: Measurement of Macroeconomic Variables

Output, Income and Expenditure Approaches ; Difficulties of Estimating National Income; National Income Identities in a simple 2- sector economy and with government and foreign trade sectors; Circular Flows of Income in 2, 3 and 4-sector; economies; National Income and Economic Welfare; Green Accounting.

Unit III: Money and Changes in its Value

Evolution and Functions of Money, Quantity Theory of Money – Cash Transactions, Cash Balances and Keynesian Approaches, Value of Money and Index Number of Prices. Inflation – Meaning, Causes, and Anti-Inflationary Measures; Classical, Keynesian, Monetarist and Modern Theories of Inflation, Inflationary Gap, Deflation- Meaning, Causes, and Anti-Deflationary Measurers, Depression and Stagflation; Inflation vs. Deflation.

Unit IV: Determination of National Income

The Classical Approach - Say's Law, Theory of Determination of Income and Employment with and without saving and Investment; Basics of Aggregate Demand and Aggregate Supply and Consumption- Saving – Investment Functions, The Keynesian Approach – Basics of Aggregate Demand and Aggregate Supply and Consumption, Saving, Investment Functions; The Principle of Effective Demand; Income Determination in a Simple 2-Sector Model; Changes in Aggregate Demand and Income- The Simple Investment Multiplier.

Text Book:

- N. Gregory Mankiw (2010):*Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:

- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Course structure of UG Economics Pass

Semester	Course	Course Name	Credits	Total marks
I	DSC-I	Principles of Microeconomics I	06	100
II	DSC-II	Principles of Microeconomics II	06	100
III	DSC-III	Principles of Macroeconomics I	06	100
IV	DSC-IV	Principles of Macroeconomics II	06	100
V	DSE-I	1. Economic Development and Policy in India 2. Economic History of India 1857-1947	06	100
VI	DSE-II	1. Odisha Economy 2. Money and Banking	06	100
			30	**600**

ECONOMICS Papers for PASS students

Discipline Specific Core – 4 papers
Discipline Specific Elective – 2 papers

Marks per paper – Mid term: 20 marks, End term: 80 marks, Total– 100 marks
Credit per paper– 6
Teaching hours per paper– 50 hours + 10 hours tutorial

Discipline Specific Core Paper I

PRINCIPLES OF MICROECONOMICS- I

Introduction:
This course is designed to expose the students to the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situations.

Unit I: Exploring the subject matter of Economics, Markets and Welfare
The Ten Principles of Economics: How people make decisions; Working of the economy as a whole; Thinking Like an Economist: The economist as Scientist – The scientific method: Observation, Theory and more observation; Role of assumptions; Economic Models; Why economists disagree; Graphs in Economics.

The market forces; Markets and competition; The demand and supply curves – Market vs individual curves, Shifts in demand and supply curves; Market equilibrium and changes there in; Price elasticity of demand – determinants and computation; Income and cross elasticity of demand; The price elasticity of supply – determinants and Computation; Consumer and Producer Surplus.

Unit II: Theory of Consumer Choice
The Budget Constraint; Preferences – representing preferences with indifference curves; Properties of indifference curves; Two extreme examples of indifference curves; Optimization – Equilibrium; Change in equilibrium due to changes in income, changes in price; Income and substitution effect; Derivation of demand curve; Three applications – Demand for Giffen goods, wages and labour supply, Interest rate and household saving.

Unit III: The Firm and Market Structures
Cost concepts; Production and costs; The various measures of cost – Fixed and variable cost, average and marginal cost; Cost curves and their shapes; Costs in the short run and in the long run; Economies and diseconomies of scale. Firms in competitive markets – What is a competitive market; Profit maximization and the competitive firm's supply curve; The marginal cost curve and the firm's supply decision; Firm's short-run decision to shut down; Firm's long-run decision to exit or enter a market; The supply curve in a competitive market – short run and long run.

Unit IV: The Input Markets

The demand for labour – The production function and the marginal product of labour; Value of the marginal product of labour and demand for labour; Shifts in labour demand curve; The supply of labour – the trade-off between work and leisure; Shifts in the labour supply curve; Equilibrium in the labour market; Other factors of production: Land and capital; Linkages among factors of production.

Text Book:

- Principles of Economics, Gregory N Mankiw, 6e Cengage Learning India Private Limited, New Delhi

Reference Book:

- Karl E. Case and Ray C. Fair (2007): *Principles of Economics*, 8th Edition, Pearson Education Inc.

Discipline Specific Core Paper II

PRINCIPLES OF MICROECONOMICS II

Introduction:

The course is designed to provide a sound training in microeconomic theory to formally analyze the behavior of individual agents. Since students are already familiar with the quantitative techniques in the previous semesters, mathematical tools are used to facilitate understanding of the basic concepts; this course looks at the behavior of the consumer and the producer and also covers the behavior of a competitive firm.

Unit I: Consumer Theory I

Preferences and Utility, Axioms of Rational Choice, Utility, Trades and Substitutions, Indifference curves; Mathematics of Indifference curves, Utility functions for specific preferences, the many good case; Utility Maximization and choice: the 2-good case (graphical analysis), the n-good case, Indirect utility function, the Lump sum principle, Expenditure minimization, properties of expenditure function.

Unit II: Consumer Theory II

The income and substitution effects: Demand function, changes in income, changes in a goods price- Direct and Indirect Approaches (Slutsky), the Individual's Demand Curve, Compensated (Hicksian) demand curves and functions, demand elasticity, Consumer Surplus, Demand relationships among goods, the 2-good case, substitutes and complements, Net (Hicksian) substitutes, and Complements, Substitutability with many goods.

Unit III: Production Theory and Costs

Production Functions: Marginal productivity, Production with One Variable Input (labour) and with Two-Variable Inputs, Isoquant Maps and the Rate of Technical Substitution, Returns to Scale, Elasticity of Substitution, Some Simple Production Functions: Linear, Fixed Proportions, Cobb-Duglas; Technical Progress.

Definition of Cost and its properties, Cost minimizing input choices (Optimisation principles, expansion path), Cost Functions and Shift in Cost Curves, Long-Run versus Short-Run Cost Curves.

Unit IV: Profit Maximization

The Nature and Behavior of Firms, Marginal Revenue – Relationship between Average and marginal revenue, Short-Run Supply by a Price-Taking Firm, Profit Functions and its Properties, Profit maximization – General conditions, Input demands.

Text Book:

- C. Snyder and W. Nicholson (2012): Microeconomic Theory: Basic Principles and Extensions, 11th Edition, Cengage Learning, Delhi, India.

Reference Books:

- H. R. Varian (2010): Intermediate Microeconomics: A Modern Approach, 8th Edition, W.W. Norton and Company/Affiliated East-West Press (India). The workbook by Varian and Bergstrom may be used for problems.

Discipline Specific Core Paper III

PRINCIPLES OF MACROECONOMICS I

Introduction:

This course aims to introduce the students to the basic concepts of Macroeconomics. Macroeconomics deals with the aggregate economy. This course discusses the preliminary concepts associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments.

Unit I: Basic Concepts in Macroeconomics

Macro vs. Micro Economics; Limitations of Macroeconomics ; Stock and Flow variables, Equilibrium and Disequilibrium, Partial and General Equilibrium Statics – Comparative Statics and Dynamics ; National Income Concepts – GDP, GNP, NDP and NNP at market price, factor cost, real and nominal; Disposable personal Income.

Unit II: Measurement of Macroeconomic Variables

Output, Income and Expenditure Approaches ; Difficulties of Estimating National Income; National Income Identities in a simple 2- sector economy and with government and foreign trade sectors; Circular Flows of Income in 2, 3 and 4-sector; economies; National Income and Economic Welfare; Green Accounting.

Unit III: Money and Changes in its Value

Evolution and Functions of Money, Quantity Theory of Money – Cash Transactions, Cash Balances and Keynesian Approaches, Value of Money and Index Number of Prices

Inflation – Meaning, Causes, and Anti-Inflationary Measures; Classical, Keynesian, Monetarist and Modern Theories of Inflation, Inflationary Gap, Deflation- Meaning, Causes, and Anti-Deflationary Measurers, Depression and Stagflation; Inflation vs. Deflation.

Unit IV: Determination of National Income

The Classical Approach - Say's Law, Theory of Determination of Income and Employment with and without saving and Investment; Basics of Aggregate Demand and Aggregate Supply and Consumption- Saving – Investment Functions, The Keynesian Approach – Basics of Aggregate Demand and Aggregate Supply and Consumption, Saving, Investment Functions; The Principle of Effective Demand; Income Determination in a Simple 2-Sector Model; Changes in Aggregate Demand and Income- The Simple Investment Multiplier.

Text Book:

N. Gregory Mankiw (2010):*Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:

Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Discipline Specific Core Paper IV

PRINCIPLES OF MACROECONOMICS II

Introduction:

This course introduces the students to formal modeling of a macro-economy in terms of analytical tools. It discusses various alternative theories of output and employment determination in a closed economy in the short run as well as medium run, and the role of policy in this context. It also introduces the students to various theoretical issues related to an open economy.

Unit I: Consumption and Investment

Consumption – Income Relationship, Propensities to Consume and the Fundamental Psychological Law of Consumption; Implications of Keynesian Consumption Function; Factors Influencing Consumption Function; Measures to Raise Consumption Function; Absolute, Relative, Permanent and Life – Cycle Hypotheses

Autonomous and Induced Investment, Residential and Inventory Investment, Determinants of Business Fixed Investment, Decision to Invest and MEC, Accelerator and MEI, Theories of Investment.

Unit II: Demand for and Supply of Money

Demand for Money – Classical, Neoclassical and Keynesian Approaches, The Keynesian Liquidity Trap and its Implications, Supply of Money – Classical and Keynesian Approaches, The Theory of Money Supply Determination and Money Multiplier, Measures of Money Supply in India.

Unit III: Aggregate Demand and Aggregate Supply
Derivation of Aggregate Demand and Aggregate Supply Curves in the IS-LM Framework; Nature and Shape of IS and LM curves; Interaction of IS and LM curves and Determination of Employment, Output, Prices and Investment; Changes in IS and LM curves and their Implications for Equilibrium.

Unit IV: Inflation, Unemployment and Expectations, and Trade Cycles
Inflation – Unemployment Trade off and the Phillips Curve – Short run and Long run Analysis; Adaptive and Rational Expectations; The Policy Ineffectiveness Debate; Meaning and Characteristics of Trade Cycles; Hawtrey's Monetary Theory, Hayek's Over-investment Theory and Keynes' views on Trade Cycles.

Text Book:

- N. Gregory Mankiw (2010): *Macroeconomics*, 7th edition, Cengage Learning India Private Limited, New Delhi

Reference Book:

- Richard T. Froyen (2005): *Macroeconomics*, 2nd Edition, Pearson Education Asia, New Delhi.

Discipline Specific Elective Paper I
DSE Group I
(A student has to choose any one from group I under DSE-1)

1. ECONOMIC DEVELOPMENT AND POLICY IN INDIA

Introduction: : This paper introduces the students to the essentials of Indian economy with an intention of understanding the basic feature of the Indian economy and its planning process. It also aids in developing an insight into the agricultural and industrial development of India. The students will understand the problems and policies relating to the agricultural and industrial sectors of India and current challenges of Indian economy.

Unit I: Introduction to Indian Economy and Current Challenges
Colonialism & British Rule: Exploitation and under-development in India; Basic features of India Economy; Indian Economy as a developing economy; Demographic trends in India - Size and growth of population, Occupational structure, Sex composition, Age structure and demographic dividend; Causes of population growth and population policy; The problem of unemployment and recent policies for employment generation; the problem of inequality in income distribution and its causes, Policies to address inequality.

Unit II: Indian Agriculture
Role of agriculture in Indian Economy; Cause of low productivity, Green Revolution and Land Reforms, Agricultural Finance-Sources and Problems; Agricultural Marketing in India

Unit III: Industrial Development in India

Role of Industrialization in Indian Economy; Small Scale & Cottage Industries: Meaning, Role, Problems and Remedies; Industrial Policies of 1948,1956,1977 and1991; Problems of Industrial Development in India; Industrial Sickness.

Unit IV: Service Sector in India

Growth & Contribution to GDP; Composition and relative importance of service sector; Factors determining growth of the sector; ICT and IT – Spread and Policy; Sustainability of services led growth.

Text Book:

- Misra, S. K. and Puri V. K. Indian Economy — Its Development Experience. Himalaya Publishing House, Mumbai

Reference Book

- Dutt R. and Sundharam K. P. M. *Indian Economy*. S. Chand & Company Ltd., New Delhi.

Discipline Specific Elective Paper I

2. ECONOMIC HISTORY OF INDIA 1857-1947

Introduction:

This course analyses key aspects of Indian economic development during the second half of British colonial rule. In doing so, it investigates the place of the Indian economy in the wider colonial context, and the mechanisms that linked economic development in India to the compulsions of colonial rule. This course links directly to the course on India‘s economic development after independence in 1947.

Unit I: Colonial India: Background and Introduction

Overview of colonial economy, Macro trends in national Income; population; occupational structure.

Unit II: Agriculture

Agrarian structure and land relations; agricultural markets and institutions – credit, commerce and technology; trends in performance and productivity; famines.

Unit III: Railways and Industry

Railways; the de-industrialization debate; evolution of entrepreneurial and industrial structure; nature of industrialization in the interwar period; constraints to industrial breakthrough; labor relations.

Unit IV: Economy and State in the Imperial Context

The imperial priorities and the Indian economy; drain of wealth; international trade, capital flows and the colonial economy – changes and continuities; government and fiscal policy.

Text Book:

- Tirthankar Roy, *The Economic History of India 1857-1947*, Oxford University Press, 3rd edition, 2011.

Discipline Specific Elective Paper II
DSE Group II
(A student has to choose any one from group II under DSE - 2)

1. ODISHA ECONOMY

Introduction
Using appropriate analytical frameworks, this course reviews major trends in economic indicators and policy debates in Odisha in pre- and post-Independence period, with particular emphasis on paradigm shifts and turning points. Given the rapid changes taking place in Odisha, the reading list will have to be updated annually.

Unit I: Odisha Economy before 1947
Orissa's Economy in the Nineteenth Century: Benevolence or Exploitation, Forces of Nature, Animal Power, The Company Steps in, Public Works and Public Health, Education, Disintegration of Village Economy, New Social Environment, Changing Position of Social Classes, The Moneylenders, The Borrowers, Money-flows from Village to Metropolis, Pauperization of Peasantry, The Wage Earners, Demographic Changes, Profiting from Rural Adversity; Diarchy in 1919 and Separation of Provincial Finances from Central Government in 1937; Emergence of Federal Finance (Ref.: Das 1976a and 1976b, GoO 2016).

Unit II: Macro Economy of Odisha
A macro glance of Odisha economy: aggregate income, broad sectoral decomposition, performance of districts, employment, child labour and bonded labour, employment programmes, consumption expenditure, cost of living; Odisha State public finances (Chapter 14 and 15 of Ref 1; & Chapter 2 and 9 of Ref 2).

Unit III: Agriculture, Industry, Infrastructure and Environment in Odisha
Agriculture: land ownership and land tenure, agricultural wages and rural unemployment, production and productivity of major crops, agricultural inputs, agricultural policy; Animal Husbandry; Fisheries (Chapter 1 to 3 of Ref 1; & Chapter 3 of Ref 2)
Industry: Investment, industrial policy, and the growth of large industries, mining and quarrying; Construction; tertiary sector: tourism, transport and power; Water Resources, Forest Resources (Chapter 4 to 8 of Ref 1; & Chapter 4 & 5 of Ref 2).

Unit IV: Social Sector in Odisha

Poverty: income poverty and inequality; health sector: outcomes, infrastructure, finance, public health, NRHM; education: Literacy, Primary education, secondary education, higher education, SSA; human development (Chapter 9 to 13 of Ref 1; & Chapter 7 & 8 of Ref 2)

Text Book:

- Nayak, P., Panda, S. C., Pattanaik, P. K. (2016): The Economy of Odisha: A Profile, Oxford University Press, New Delhi

Reference Book:

1. GoO (Latest): Odisha Economic Survey, Planning and Convergence Department, Directorate of Economics and Statistics, Government of Odisha, Bhubaneswar
2. GoO (2004): *Human Development Report 2004 Orissa*, Planning and Coordination Department, Government of Odisha, Bhubaneswar
3. GoO (2018): 80 Years Odisha Budget: Commemorative Volume, Department of Finance, Bhubaneswar

Discipline Specific Elective Paper II

2. MONEY AND BANKING

Introduction: This paper intends to explain the ideas and institutions concerning money and banking. It will help the students to understand the meaning, functions and theories of money the working of different types of banks in an economy.

Unit I: Money

Money: Meaning, functions and classification; Gresham's law; Monetary standards: Metallic and paper systems of note issue; Value of money: (Uses and limitations of index number); Construction of price index number – its limitations.

Unit II: Quantity theory of money

Quantity theory of money - Cash transaction approach, cash balance approach, Keynesian approach; Inflation: meaning, types, causes – demand pull and cost push, effects, measures to control inflation, Trade-off between inflation and unemployment; Stagflation and deflation: meaning; Phillip's curve.

Unit III: Banking

Banking: meaning and types; Commercial banks: evolution, functions, the process of credit creation and its limitations, liabilities and assets of banks; A critical appraisal of the progress of commercial banking in India after nationalization; Recent reforms in banking sector in India.

Unit IV: Central Bank

Central Bank: Functions, Quantitative and qualitative methods of credit control - bank rate policy, open market operations, variable reserve ratio and selective methods; Relative efficacy of quantitative and qualitative methods of credit control.

Reserve Bank of India: Role and functions; Repo rate and reverse repo rate; Components of money supply in India; Objectives and limitations of monetary policy with special reference to India

Text Book:

- Paul R.R. (2017) Money Banking and Public Finance, Kalyani Publishers

Reference Book:

- Reserve Bank of India – The Reserve Bank of India, functions and working, Bombay, 1983.

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SKILL ENHANCEMENT COURSES (SECC II)

Optional for SECC II paper

Total Marks- 100

Skill Enhancement Courses (SECC II Option-I)

DATA ANALYSIS AND COMPUTER APPLICATION

Introduction:

The purpose of this course is to introduce basic computer skills to students at UG level in non-technical subjects. After completion of this course, the students are expected to acquire some basic knowledge about computers and to develop some basic skills in using computers for data storage, compilation, analysis and presentation.

Unit I: Introduction to Computers and Networks

Introduction to computer- Components of Computer System, concepts of Hardware and Software, Classifications of computers; Concepts of data processing, Basic data types, Storage of data/Information as files, operating system and The User Interface (windows, Linux), Windows Setting- Control Panels, Accessories (windows)

Basic of Computer networks- LAN and WAN, Internet, Service on Internet; WWW and Web Browsers, Web Browsing software, Surfing the Internet, Chatting on Internet, Email-Basic of electronic mail, Using Emails, Document handling in Email.

Unit II: Basic Word Processing

Introduction to Word Processing, Opening Word Processing Package, Opening and closing documents, Using a Document/Help Wizard, Text Creation and Manipulation, Formatting the Text,

Handling Multiple Documents, Table Manipulation, Printing, saving documents in different formats.

Unit III: Spreadsheets and Basic Data Analysis

Spread Sheet, Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Manipulation of cells, Formulas and functions; Spread sheets for Small accountings- maintaining invoices/budgets, basic practical data analysis works (Maintaining daily and monthly sales reports).

Unit IV: Basic Presentations

Basics- Difference between presentation and document, Using Power Point, Creation of Presentation, Preparation of Slides, Selection of type of Slides, Importing text from word documents, Providing aesthetics- Slide Designs, Slide Manipulation and Slide Show, Presentation of the Slides.

Text Book:

- C.S. French "Data Processing and Information Technology", BPB Publications 1998

Reference Books:

- P.K Sinha, Computer Fundamentals, BPB Publications, 1992

Skill Enhancement Courses (SECC II)

FINANCIAL ECONOMICS

Introduction:

This course intends to explain the ideas on financial system in India. It will help the students to enhance their knowledge on concepts like financial institutions, instruments and markets, their functioning and usage in real world.

Unit I: Financial System

The structure of the financial system- Functions of the financial sector-Indicators of financial development; Financial System and Economic Development; financial inclusion: concept and its evolution; policy initiatives on financial inclusion.

Unit II: Interest Rate Policy

Theories of interest rate determination-Level of interest rates-Long period and short period rates-Administered interest rates; Deregulation of interest rates; financial sector reforms in India.

Unit III: Money and Capital Market

Money Market: features; objectives; and importance of money market; composition of money market; money market institutions and instruments; features and problems of Indian money market. Capital market: composition; Primary and secondary market for securities. Functions of new issue and secondary market; organizations of stock exchanges in India; defects in Indian stock exchange; SEBI; its objectives and functions.

Unit IV: Non-Banking Financial Companies

Non-Banking Financial Companies: Hire purchase Companies-Venture Capital Companies. Insurance Sector: objectives, functions, life insurance and general insurance; IRDA and its role and functions in financial markets.

Text Book:

- L.M.Bhole: Financial institutions and Market, Tata McGraw hill, New Delhi.

Reference Books:

- Gorden & Natrajan: Financial Market and institutions, Himalaya Publishing house.

SYLLABUS FOR M.A. IN ECONOMICS (2022-23)

PG DEPARTMENT OF ECONOMICS

DHENKANAL AUTONOMOUS COLLEGE DHENKANAL,

ODISHA.

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1st Semester

HCE-101	Microeconomics Analysis-I
HCE-102	Macroeconomics Analysis -I
HCE-103	Quantitative Methods-I
HCE-104	Public Economics
HCE-105	Indian Economy

2nd Semester

HCE-201	Microeconomics Analysis -II
HCE-202	Macroeconomics Analysis -II
HCE-203	Quantitative Methods-II
HCE-204	Economics of Growth and Development
CEE-201	Economics of Education

3rd Semester

HCE-301	Basic Econometrics
CEE-301	International Economics
AEE-301	Agricultural Economics
FEE-301	International Finance
FEE-302	Seminar

4th Semester

CEE-401	Economics of Environment
CEE-402	Financial Institutions and Market
AEE-401	Economics of Gender and Development
AEE-402	Financial Inclusion and Economic Development
AEE-403	Project and Dissertation

Semester I
Paper HCE101
Microeconomic Analysis I

Course Objectives

1. To have a theoretical understanding of consumer behavior and decision-making
2. To get acquainted with recent advances in microeconomic theory and acquire the skills to apply the theoretical knowledge in research
3. To learn about theory of demand, Utility Functions - types and properties; Consumers' choice involving risk and uncertainty; Production function – types and properties; Theories of Cost and general equilibrium theory – An overview.

Course Outcomes:

On successful completion of this course students will be able to:

1. have an understanding of the basic reasoning of Economics and understand the consumption; production and cost concepts in an analytical way;
2. apply mathematical tools and techniques to study behavior of economic agents;
3. understand the basic principles of General equilibrium theory

Module I

Theory of demand, Utility function Ordinary and Compensated Demand Functions, Lexicographic Ordering, Slutsky Theorem, Revealed Preference Theory.

Module II

Consumers' choice involving Risk and Uncertainty: N – M Utility Function, Utility – Expenditure duality, Indirect Utility function, Inter-temporal consumption, Consumer's surplus.

Module III

The production function, Elasticity of substitution, C-D and CES Production function and their properties, Multiproduct firm and it's equilibrium.

Module IV

Theories of cost and pricing: various types of short-run and long-run costs; full cost, average cost and Marginal cost pricing theories. Limit pricing theory of Bain

Module V

Partial and General Equilibrium – Walrarian System, Excess Demand Approach, Existence, Stability and Uniqueness of equilibrium

Basic Reading List

1. Henderson, J. M. & Quandt, R.E. (1980), Micro Economic Theory – A Mathematical Approach, Mc Graw Hill Co.
2. Varian, H. R. (1992), Micro Economic Analysis, WW Norton & Co., New York.
3. Gravelle, H & Rees, R (1992) Micro Economics, Pearson Education U.K.
4. Snyder, C & Nicholson, W (2008), Fundamentals of Micro Economics, Cengage learning, New Delhi.
5. Maddala, G.S. & Miller, E (2004), Micro Economics: Theory and Application, Tata Mc Graw Hill, New Delhi.

Paper HCE102
Macroeconomic Analysis I

Learning Objectives:

1. To analyse and establish the functional relationship between economy level/aggregates.
2. To have a proper understanding of macroeconomic theoretical structure
3. To educate the students on different terms and concepts in macroeconomics like national income accounting, Circular flows, consumption function, investment function, supply and demand for money etc

Learning Outcomes:

On successful completion of this course students will be able to:

1. Apply the subject knowledge in understanding the working of the economy as well as the macroeconomic issues and policies.
2. Understand systemic facts and theoretical developments

Module I

Circular Flow of Income in two, three and four sector economy; National Income and different forms of national income accounts –social accounting, input-output accounting, flow of funds accounting and balance of payments accounting.

Module II

Theory of Income determination: Classical and Keynes, consumption function, Keynes' psychological law – implications of the law; short-run and long-run consumption function; empirical evidence on consumption function; income-consumption relationship – absolute income, relative income, life cycle and permanent income hypotheses.

Module III

Investment behavior, Marginal efficiency of capital and investment – long run and short run; the accelerator and investment behavior – impact of inflation; Influence of policy measures on investment.

Module IV

Financial intermediation – a mechanistic model of bank deposit determination; A behavioral model of money supply determination, a demand determined money supply process; RBI approach to money supply; money supply and open economy; control of money supply.

Module V

Classical approach to demand for money–Quantity theory approach, Fisher's equation, Cambridge quantity theory, Keynes's liquidity preference approach, Derivation of LM curve. Post-Keynesian approaches to demand for money–Patinkin and the Real Balance Effect. Approaches of Baumol and Tobin; Friedman and the modern quantity theory.

Basic Reading List:

1. Macro Economics - An Introduction to Keynesian-Neo-Classical Controversies: R. Levacic and A Rebmann.
2. Macroeconomics: Dorn Busch, Fisher
3. Macroeconomics: Theory and Policies: Richard, T. Froyen
4. Macroeconomics Analysis: E. Shapiro
5. Macroeconomics: N.G. Manikiw

Paper HCE103
Quantitative Methods I

Course Objectives

1. To train the students to use the techniques of mathematical and statistical analysis, which are commonly applied to understand and analyze economic problems
2. To emphasize the mathematical methods rather than learning mathematics itself, which are usually used for understanding economic concepts
3. To learn about the classical techniques involving functions and calculus
4. To gain knowledge about the elements of Game Theory as applicable to real life economic analysis.

Course Outcome

On completion of this course, a student should be able to

1. express relationship between economic variables mathematically, analyze, optimize and interpret them;
2. use appropriate techniques to solve problems with calculus and linear algebra.
3. understand the basics of Game theory to resolve economic issues.

Module I

Functions: Types of functions, Limit, Continuity and derivates- Rules of differentiation: Revenue, Cost demand and Supply functions; Elasticities, Multivariable functions – Production functions; Partial derivatives; Total differential; Total derivatives; Jacobian and functional dependence.

Module II

Matrix – Types of matrices, Algebra of matrices- Transposition, Inversion, Rank of a matrix; Determinants – their properties; Solution of a system of equations; Vector space and linear independence of vectors; Eigen values and eigen vectors; Introduction to Input – output Analysis.

Module III

Quadratic forms; Optimization – Hessian and constrained optimization – bordered hessian- Economic applications; Linear programming – Graphical solution to a linear programming

Module IV

Integration – Rules of integration; Application to consumer's surplus and producer's surplus; growth rates; Difference equations – Solution of first and second order difference equations; Domar's growth model and Lagged market equilibrium models; Differential equations – Solution to first order linear differential equation, Dynamics of market price; Non-linear differential equation of first order & first degree.

Module V

Game theory - Concept of Game, Types of Game, Two-persons-zero sum game, Nash Equilibrium, Prisoner's dilemma. Maximin - minimax principle; Saddle point solution, Dominant Strategy, Mixed Strategies; Graphical solution of 2 x n and m x 2 Games

Basic Reading List

1. Chiang, A. C. (1986): Fundamental Methods of Mathematical Economics, McGraw Hill.
2. Gupta, S. C. (1993): Fundamental Methods of Applied Statistics, S. Chand & Sons.
3. Speigel, M. R. (1992): Theory & Problems of Statistics, McGraw Hill Book Co
4. Yamane, Taro (1975): Mathematics for Economists, Prentice Hall of India, New Delhi.
5. Mukherji & Guha (2011): Mathematical Methods & Economic Theory, Oxford University Press

Paper HCE104
Public Economics

Course Objectives:

1. To provide the students with thorough analytical understanding to analyze public goods, externalities, market failures; economics of government expenditure, taxation and public borrowing;
2. To critically analyze fiscal policies/finance and its implication in Indian Economy.

Course Outcomes

On successful completion of this course, the students will be able to

1. have conceptual clarity on the theories of public goods, public expenditure, public revenue and public borrowing
2. apply the principles of public economics in analyzing various government policies

Module I: Role of Government

Role of government and fiscal functions-Allocation, Distribution and Stabilization branch; Private goods, public goods and merit goods; Externalities, Market failure and public goods, Private and public mechanism for allocating resources; Problems for allocating resources. Arrow's impossibility theorem; Theory of club goods, Tiebout model

Module II Public Revenue

Sources and classification of public revenue- tax and non-tax revenue, direct and indirect taxes, effects of tax on production, distribution and economic activities; Principles of tax equity– Benefit principle of taxation, Ability to pay principle, Efficiency of taxation- Excess burden and deadweight loss, Incidence of taxation- incidence under perfect competition- partial and general equilibrium analysis, incidence under monopoly.

Module III Public Expenditure

Growth of public expenditure, Wagner's law of increasing state activities; Wiseman–Peacock hypothesis; effects of public expenditure on production, distribution and economic activities; public sector pricing policy-average cost and marginal cost pricing, Criteria for public investment- Social cost benefit analysis

Module IV Public Debt and Budget

Sources of public borrowing, effects of public debt, burden of public debt-classical, Ricardian and others, shifting of debt burden, intergenerational shifting, methods of debt redemption; Budget: Basic concepts, balanced vs. unbalanced budget, budgetary deficits and their limitations, budget as an instrument of Economic policy

Module V: Fiscal federalism

Principles of multi-unit finance; Fiscal federalism in India- Vertical and horizontal fiscal imbalances, corrective measures; Constitutional provisions; Finance Commission, Devolution of resources and grants; Resource transfer from Union to States – Criteria for transfer of resources; Theory of Grants- matching vs non matching grant, general vs earmarked grants

Basic Reading List

1. Cullis, J. & Jones, P. (2009): Public Finance and Public Choice. Oxford University Press.
2. Musgrave, R. A. & Musgrave, P. B. (2004): Public Finance in Theory and Practice. Fifth edition, TATA McGraw-Hill
3. Herber, B. P. (1967): Modern Public Finance. Richard D. Irwin, Homewood.
4. Stiglitz, J. E (2000) Economics of the Public Sector. W W Norton
5. Rangarajan, C. and D. K. Srivastava (2011) 'Federalism and Fiscal Transfers in India'. Oxford University Press, New Delhi.

Paper HCE105
Indian Economy

Course Objectives

1. To critically understand the economic growth trajectory, economic policies, and institutional reforms of modern India
2. To understand four major economics challenges of Indian Economy, i.e. Poverty, Inequality, Unemployment and inflation
3. To have an in-depth analysis of the sectoral contributions of agriculture, industry and service sector in India
4. To examine the operation and implementation of fiscal and monetary policy in India

Course Outcomes

On successful completion of this course students will be able to:

1. have a clear picture of the economic growth trajectory, economic policies, and institutional reforms in India;
2. understand four major economics challenges of Indian Economy, i.e. Poverty, Inequality, Unemployment and inflation;
3. have an in-depth analysis of the sectoral contributions of agriculture, industry and service sector in India and
4. understand the nitty-gritty of fiscal and monetary policy.

Module I: Growth and Economic Reforms I

Phase I (1951–65)-Takeoff under a Liberal Regime: era of liberal trade and foreign investment policies, a restrictive industrial policy regime, agriculture; Phase II (1965–81)-Socialism Strikes with a Vengeance: the political context, the crisis and failed liberalization episode, strangulation of industry, foreign trade, factor market regulation-land and labour, nationalization of banks, agriculture, insurance, savings and investment

Module II: Growth and Economic Reforms I

Phase III (1981–88) - Liberalization by Stealth: Political Context, Deregulation of Industry, Trade Liberalization, and other Reforms; Phase III (1988 onwards) - Triumph of Liberalization: Political Context, Shifting of Consensus, Growth and BOP Crisis, New Industrial Policy, Trade Liberalization

Module III: Major Economic Problems

Poverty: estimations – old and new method, phase I and II – good intentions but poor performance, phase III and IV – liberalizing reforms and significant decline in poverty, expenditure growth - the NAS and NSS, farmers suicide; Inequality: forms, inequality at national level, regional inequality, urban – rural inequality; Unemployment: measurement, trends and patterns, rural and urban, gender aspect of unemployment, jobless growth, green jobs and growth; Inflation: trend and pattern, inflation and growth debate, sources of inflationary pressure, food price inflation

Module IV: Sectoral Growth in India

Agricultural Sector: performance, food security, input market, public investment in agriculture, agriculture and environment; Secondary Sector: output and employment pattern, productivity, privatization, regional aspects; Tertiary Sector: what explains rapid service growth, is it sustainable, Education – infrastructure and outcome, Health – infrastructure and outcome

Module V: Fiscal and Monetary Policies in India

Fiscal Policy of India: fiscal consolidation in India, tax reform, FRBM Act 2003; Monetary Policy: role of financial sector in economic growth, financial sector reform, money and banking in pre- and post-1991, capital market

Basic Reading List

1. Panagariya, Arvind (2008): India: The Emerging Giant, Oxford University Press, New York
2. Acharya, S. and Mohan, R. (Eds.) (2010): India's Economy: Performance and Challenges, Oxford University Press, New Delhi.
3. Ahluwalia, I. J. and Little, I. M. D. (Eds.) (1998): India's Economic Reforms and Development: Essays for Manmohan Singh, Oxford University Press, New Delhi.
4. Rakshit, M. (2009): Macroeconomics of Post-reform India, Oxford University Press, New Delhi

Semester II
Paper HCE201
Microeconomic Analysis II

Course Objectives:

1. To impart theoretical knowledge on decision making under market imperfections
2. To impart theoretical knowledge on distribution.

Course Outcomes:

After completing the course, the students are expected to have;

1. Deeper knowledge on decision making under different market imperfections including oligopoly.
2. Deeper knowledge about the broad paradigm of neo-classical economics.
3. Deeper knowledge about distributional and welfare aspects of economic activities.

Module I

Price and output determination under Monopoly; Price discrimination and dumping aspects, Bilateral monopoly. Monopolistic competition – product differentiation, Selling costs and excess capacity – effects of free entry and price competition.

Module II

Non-collusive oligopoly models: Cournot, Bertrand, Stackelberg, Sweezy, Chamberlin, Collusive oligopoly models: Cartels, price leadership and basing point price systems.

Module III

Critical evaluation of marginal Analysis: Baumol's sales Revenue maximization, Williamson's model of managerial discretion, Marris model of managerial enterprise.

Module IV

Neo-classical Approach, Product exhaustion theorem, Euler's theorem, distribution theories in imperfect product and Factor markets.

Module V

Pareto optimal conditions; B-S Social welfare function, Compensation criteria, optimum welfare under market imperfections and externality.

Basic Reading List

1. Henderson, J. M. & Quandt, R.E. (1980): Micro Economic Theory – A Mathematical Approach, McGraw Hill Co.
2. Mankiw, (2006): Principles of Micro Economics, Cengage Learning India, New Delhi
3. Landsburg, S. E. (2008), Pricing, Cengage Learning India, New Delhi
4. Baumol, W. J. (1977): Economic Theory & Operation Analysis, Prentice – Hall of India, New Delhi.
5. Bilas, R. A. (1985): Micro Economic Theory, McGraw Hill Publishers.

Paper HCE202
Macroeconomic Analysis II

Learning Objectives:

1. To make the students understand the different terms and concepts in macroeconomics like Money market and real market, inflation in developing countries, causes of occurrence of business cycle in a market economy and ways to control them.
2. To expose the students to open economy macroeconomics and the dynamics there in.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Apply the subject knowledge in understanding the macroeconomic dynamics both in a closed and an open economy.
2. Understand the functioning of a market economy and the ways and means to keep such an economy functioning properly.

Module I

Keynesian views on interest. The IS-LM model; Change in general Equilibrium: a change in investment, a change in the money supply, Extension of IS-LM model with government sector (government spending, taxation); Relative effectiveness of monetary and fiscal policies; Extension of IS-LM models with flexible wage and flexible prices, Wage-Price flexible with Pigou Effect and other effects.

Module II

Trade Cycle and its different phases; Theories of Trade cycle: Schumpeter, Kaldor, Samuelson, Hicks, Goodwin's model of Trade Cycle, Control of business cycle.

Module III

Classical, Keynesian and Monetarist approaches to inflation' Structuralist theory of inflation; Philips curve analysis – short run and long run Philips curve; the natural rate of unemployment hypothesis; Solow and Tobin's modified Philips curve.

Module IV

The new classical critique of micro foundations, the new classical approach; Policy implications of new classical approach – empirical evidence

Module V

The open Economy Macro Economics: International Monetary System-Exchange Rate and market for foreign exchange; Current exchange rate system; Experience with floating exchange rates. Monetary and Fiscal Policy in the Open Economy - The Mundell-Fleming Model; Monetary and Fiscal Policy under Imperfect and Perfect Capital Mobility- Under fixed and Flexible Exchange Rate.

Basic Reading List

1. Macro Economics - An Introduction to Keynesian-Neo-Classical Controversies: R. Levacic and A Rebmann.
2. Macroeconomics: Dorn Busch, Fisher
3. Macroeconomics: Theory and Policies: Richard, T. Froyen
4. Macroeconomics Analysis: E. Shapiro
5. Macroeconomics: N.G. Manikiw

Paper HCE203
Quantitative Methods II

Course Objectives

1. To train the students to use the techniques of probability theory and statistical analysis, which are commonly applied to understand and analyze economic problems
2. To deals with simple tools and techniques, which will help in sampling theory and designs, data collection, analysis, theory of estimation and hypothesis testing
3. To initiates the correlation analysis - simple, multiple and partial, and regression analysis - linear and non-linear.

Course Outcomes

On completion of this course, a student should be able to

1. have fair idea about probability theory which forms the foundation of inferential statistics;
2. understand theoretical distributions and their significance;
3. understand sampling and sampling designs, theory of estimation and hypothesis testing procedure and
4. fit a linear and some commonly used non-linear curves.

Module I

Deterministic and non-deterministic experiments; Sample space; Addition rule and complementation rule, Conditional probability, Multiplication rule, Independence of events; Bayes theorem and problems; Random variable and its probability distribution, probability mass function and probability density function, expectation and variance of a random variable, laws of expectation and variance.

Module II

Theoretical probability distributions: Binomial, Poisson and Normal probability distributions and their properties; Normal approximation to Binomial; Joint, marginal and conditional probability distributions, independence of random variables, covariance, results on expectation and variance.

Module III

Basic concepts of sampling, random and non-random sampling; simple random sampling, stratified random sampling and p.p.s. sampling; concept of an estimator and its sampling distribution; desirable properties of an estimator.

Module IV

Interval estimation; statistical hypotheses- null and alternative; Type I and Type II errors; power of a test, confidence intervals and hypothesis testing based on z, t, x^2 (chi-square) and F-distributions.

Module V

Correlation and regression analysis; correlation coefficient and its properties, rank correlation co-efficient, concept of least squares and the lines of regression; standard error of estimates; partial and multiple correlation and regression (applications only)' methods of estimation of non-linear equations: parabolic, exponential, modified exponential, Gompertz and logistic relationships

Basic Reading List

1. Chiang, A. C. (1986): Fundamental Methods of Mathematical Economics", McGraw Hill.
2. Gupta, S. C. (1993): Fundamental Methods of Applied Statistics, S. Chand & Sons.
3. Speigel, M.R. (1992): Theory & Problems of Statistics, McGraw Hill Book Co
4. Yamane, Taro (1975): Mathematics for Economists, Prentice Hall of India, New Delhi.
5. Mukherji & Guha (2011): Mathematical Methods & Economic Theory, Oxford University Press.

Paper HCE 204
Economics of Growth and Development

Course Objectives:

1. To learn neoclassical growth models of Solow; Meade; Robinson; Kaldor and Pasinetti
2. To discuss about Cambridge criticism over measurement of capital
3. To understand the importance of endogenous growth theories which highlight on human capital as an essential component for a country like India
4. To analyse the investment decisions through investment criterion along with its merits and demerits

Course Outcomes:

On completion of this course, a student should be able to

1. to gain knowledge about recent developments in growth and development, and in particular dynamic growth theories focusing, among other issues, on labor market distortions, pollution and the cost benefit of projects to be undertaken.

Module I

Theories of Economic Growth: Neo-Classical Growth Models of Solow and Meade; Mrs. Joan Robinson's Growth Model; Cambridge Criticism of Neo-Classical Analysis of Growth – Controversy on the Measurement of Capital.

Module II

Growth Models of Kaldor and Pasinetti; Technological Progress – Embodied and Disembodied; Hicks- Harrod Neutrality Approach.

Module III

Production Function Approach to Economic Growth; Total Factor Productivity; Growth Accounting; Transitional Dynamics; Convergence Hypothesis; Golden Rule of Capital Accumulation.

Module IV

Endogenous Growth, Intellectual Capital, Role of Learning, Education and Research, Optimal Savings and Ramsay Model, Two Sector Growth Model of Ujawa

Module V

Need for Investment Criteria in Developing Countries, Alternative Investment Criteria; Cost – Benefit Analysis, Shadow Prices, Project Evaluation and UNIDO Guidelines

Basic Reading List

1. Todaro, M. P. (1994): Economic Development, Longman Publishing, New York.
2. Acemoglu, D. (1995): Introduction to Modern Economic Growth, Princeton University Press.
3. Jones, C. I. (2001): Introduction to Economic Growth, W. W. Norton & Company, New York.
4. Thirwal, A.P. (2003): Growth and Development: With special reference to Developing Economies, Palgrave MacMillan, New York.
5. Jones, H. G. (1984): Economic Growth, V. N. Reinhold Company, Ltd. England.
6. Barro, R. J. & Sala – I – Martin, X. (2004): Economic Growth, PHI, New Delhi.
7. Vanden – Burg, H. (2001): Economic Growth and Development, Mc Graw Hill, New York.

Paper CEE201
Economics of Education

Course Objectives:

1. To study the role of economics in evaluating education and education policy
2. To familiarize with educational problems in the context of economic concepts, theories and techniques
3. To develop an understanding of planning, financing and cost of education
4. To find the link between the educational system and economic development
5. To apply standard economic theories to understand how individuals make education choices
6. To explain and predict education markets and their inefficiencies

Course Outcomes:

On successful completion of the course, students will be able to:

1. understanding of key concepts, issues, theories and models relating to economics of education, along with empirical evidence on and policy implications of those theories and models and a deeper understanding of recent research activity;
2. understand methods used by economists to evaluate education policies;
3. understand and Model the Education Production Function;
4. define the return to education and understand its empirical estimates;
5. research and investigative skills such as problem framing and solving and the ability to assemble and evaluate complex evidence and arguments.

Module I: Economics of Education and Demand for Education

Economics of Education: definition, methods, evidence and policy, Classical Economists and Education; The demand for education: Education as creation of minimal capabilities, Education as investment in human capital, The role of individual talent, Imperfect financial markets and the indivisibility of human capital investment

Module II: Supply of Education

The supply of education: Human capital formation, Class formation and peer effects, Integration or segregation, Class size, Resource effectiveness, Resource efficiency, Efficiency versus equity

Module III: Educational Financing

Education financing: Demand for education when agents differ in abilities and family incomes, Collective choice over public or private schooling, Growth and inequality under public and private schooling, Education financing and school stratification, School voucher as a solution, Subsidizing or lending; Financing Education in India

Module IV: Production of Education

Education Production Function: concept, estimation, role in policy analysis; Costs of Education: direct and indirect; Wastage and Stagnation; Benefits of Education: types, measurement; Returns to Education: Productivity of human capital, Effort-enhancing preferences, Education as a signal or as a screening device, On-the-job training, Measuring the return on education, Estimating the return on education

Module V: Educational Planning

Educational planning and economic growth – Cost- benefit analysis; production function models; education and economic growth: dimensions, sources, contributions. Manpower requirements approach programming and input-output models. Economics of educational planning in developing countries with reference to India.

Basic Reading List

1. Checchi, D. (2005): The Economics of Education, Cambridge University Press, New York
2. Psacharopoulos, G. (1987): Economics of Education: Research and Studies, Pergamon Books Ltd, Oxford
3. Lovenheim, M. & Turner, S. (2018): Economics of Education, Worth Publishers, New York

Semester III
Paper HCE301
Basic Econometrics

Course Objectives

1. To introduce the relevant econometric theory and explaining the theory with examples
2. To understand Classical Linear Regression Models and regression diagnostics
3. To develop an intuitive understanding of the material that will allow these econometric tools to be utilized effectively and creatively.

Course Outcomes

On successful completion of this Course, students will be able to:

1. learn various basic econometric methods, estimation methods and related econometric theories
2. apply these methods to data or econometric modeling techniques.

Module I

Meaning and scope of econometrics; Two variable linear regression model – its assumptions, estimation of parameters and properties of estimators; Gauss Markov Theorem, Coefficient of determination; Analysis of Variance of two variable LRM.

Module II

K – Variable LRM: Estimation of parameters, properties of estimators, Gauss – Markov theorem; Testing of significance of single co-efficient, Subset of Coefficients: ANOVA; Adjusted coefficient of determination.

Module III

Prediction in two – variable and K – Variable LRM; Multicollinearity - Nature, detection, consequences and remedy. Specification Errors and Measurement errors.

Module IV

Heteroscedasticity - Meaning, Consequences, detection and remedy; Generalized Least square and weighted least square estimation; Auto-correlation: Meaning, Detection, Consequences and remedy.

Module V

Dummy variable models: Estimation; Testing the structural stability of regression models; Interaction effects; Seasonal analysis; Piecewise Linear regression

Basic Reading List:

1. Johnston (1991): Econometric Methods, Mc Graw Hill Book Co
2. Koutsoyiarnis, A. (1992): Introduction to Econometrics, OUP
3. Dougherty, C. (1992): Introduction to Econometrics, OUP.
4. Kmenta, J. (1997): Elements of Econometrics, University of Michigan Press
5. Gujarati, D & Sangeetha (2007): Basic Econometrics, Mc Graw Hill Book Co.

Paper CEE301
International Economics

Course Objectives:

The objectives of this course are to provide the students with thorough analytical understanding of

1. the theories of international trade, gains from trade and its distribution;
2. effects of trade policy and regional trading blocs;
3. BOPs and its adjustments.

Course Outcomes

On successful completion of this course, the students will be able to

1. analyse and apply the trade theories and theories of tariff; apply and analyze the different policies for BOPs adjustments of developing countries like India
2. comment critically on and participate in current debates on international economic policy.

Module I: Pure Theories of International Trade

Introduction to the International Economics, Trade Based on Absolute Advantage, Comparative Advantage and Opportunity Costs, Modern Trade Theories: Heckscher-Ohlin theory of trade. Factor Price Equalization theory, Stolper-Samuelson Theory, Empirical test of the H-O model: The Leontief paradox, the gains from trade

Module II: New Theories of International Trade:

The Specific factors model, economies of scale, Imperfect Competition and international trade, Intra-Industry Trade, Effect of changes in tastes, per capita income and technology on Trade. Kravis Theory of Availability, Trade based on dynamic technological changes: Technological Gap theory and Product Life Cycle theory

Module III: Economic Growth and International trade

Growth of factors of production: The Rybczynski theorem, Effect of growth on trade, Economic growth and trade in small country and in large country case, Technical Progress and International trade, trade as an engine of growth, the immeserising growth.

Module IV: The Theory of Interventions

Tariffs: Partial and General Equilibrium analysis, Effective Rate of Protection and optimum tariff, Non-tariff trade barriers: Import Quotas, Voluntary Export restraints, Export subsidies; Economic Integration: the Customs Union

Module V: Balance of Payments and its adjustments

The Balance of Payments: components of balance of payments; Equilibrium and disequilibrium, deficit and surplus in the balance of payments, balance of payments adjustments: Automatic process, expenditure–reducing, expenditure-switching policies and direct controls, Elasticity estimates and the J-curve, Policies for achieving internal and external equilibrium

Basic Reading List

1. Chacholiades, M. (1990), The Pure Theory of International Trade, McGraw Hill.
2. Krugman P. R., Obstfeld Maurice and Melitz. International Economics, Pearson Education
3. Batra, R. N. (1975), The Pure Theory of International Trade under Uncertainty, The Macmillan Press.
4. Bhagwati, J. (Ed.) (1981), International Trade: Selected Readings, Cambridge University Press.

5. Dana, M.S. (2000), International Economics: Study, Guide and Work Book, Routledge Publishers.
6. Dunn, R. M. and Mutti, J. H. (2000), International Economics, Routledge Publishers, London.
7. Gandolfo Giancarlo, International Trade Theory and Policy, Springer.
8. Haberler, G. (1937), The Theory of International Trade, Macmillan & Co.
9. Heller, H. R. (1968), International Monetary Economics, Prentice-Hall of India.
10. Kenen, P. B. (1989). The International Economy, Prentice-Hall of India Pvt. Ltd.
11. Kindleberger, C.P. (1977). International Economics, D.B. Taraporevala Sons & Co.
12. Meade, J. E. (1952). A Geometry of International Trade, George Allen and Unwin.
13. Neihans, J. (1984). International Monetary Economics, John Hopkins University Press.
14. Roy, P. N. (1986). International Trade: Theory and Practice, Wiley Eastern.
15. Salvatore, D. (1997). International Economics, Prentice Hall
16. Sodersten, BO (1991). International Economics, The Macmillan Press.

Paper AEE301
Agricultural Economics

Course Objectives:

1. To impart knowledge on applications of economic theories in agricultural sector,
2. To make students understand the linkage between agriculture and other sectors of the economy.
3. To impart knowledge on new developments in the policy paradigms related to agricultural sector.

Course Outcomes:

After completing the course, the students are expected to have:

1. Deeper knowledge on different theories related to economic development and the agricultural sector.
2. Increased interest to undertake research activities related to aspects of agricultural sector in India and Odisha.

Module I

General Models of agricultural development: Frontier model, Conservation model, Urban-industrial Impact model, Diffusion model, High payoff input model.

Module II

Schultz model of Agricultural Development, Mellor Theory of Agricultural development, Boserup model of Agricultural development, Lewis & Ranis-Fei Model. Types of farming & Farm organization

Module III

Agricultural production and productivity – measures of farm efficiency Production function analysis – Factor use and resource substitution, Size of farms and productivity – theoretical and empirical issues. Tenancy & share cropping – Efficiency & equity issues.

Module IV

Labour supply in agriculture & inter-locking of factor markets, Agricultural wage: Determinants & implications, marginalization of rural labour, Role of technology in agriculture – technical efficiency and labour absorption. Agriculture and environment – Sustainability issues in agriculture

Module V

Agriculture price policy – objectives, product price & factor price – issue of subsidies in agriculture, terms of trade between agricultural and industry – implications and Indian experiences.

Agricultural marketing and measures to improve efficiency in agricultural marketing in India.

Instability in agriculture - Price instability & cob-web model.

Agricultural Credit Risk & uncertainty in farming and crop insurance – Indian experience.

Basic Reading List

1. Bhaduri, A. (1984): The Economic Structure of Backward Agriculture, Macmillan, Delhi.
2. Gulati. A. and T. Kelly (1999): Trade Liberalization and Indian Agriculture, Oxford University Press, New Delhi.
3. Rao. C. H. Hanumanatha (1975): Agricultural Growth, Rural Poverty and Environmental Degradation in India, oxford University Press, New Delhi.

Paper FEE301
International Finance

Learning Objectives:

1. To educate the students on different terms and concepts in international finance like exchange rate and interest rate determination and forecasting, different forms of derivatives and its uses, different financial risk in international market,
2. To enhance the skill of the student to understand the activities in international market.

Learning Outcomes:

On successful completion of this Course, students will be able to:

1. appreciate the functioning of the international financial markets and its management and the determination of different exchange rates.
2. understand the way the foreign exchange market and the derivatives markets and the capital markets function using futues, options and swaps

Module I

The International Finance: International Business and its modes, Nature, scope and Importance of International Finance; International Financial Markets and Instruments, Exchange rate mechanism: Exchange rate quotes, Nominal, real and effective exchange rates, factors influencing exchange rates, exchange rate determination in spot and forward market.

Module II

Market for foreign exchange and derivatives: Spot and forward market; Forward Market: Features, Arbitrage, Hedging and Speculation, Futures Market: Features, Hedging and Speculation, Options Market: Features, Hedging and Speculation, Currency swap and interest swap.

Module III

Exchange rate determination: Mint Parity theory, Purchasing Power Parity, Monetary Models of Exchange Rate Determination; the Portfolio Balance Model. International Investment decision: FDI: theories, cost and benefits of FDI and strategy, capital budgeting: Evaluation criteria and computation of the cash flow, political risk: meaning and forms, evaluation and management of political risk, international portfolio investment: benefits, problems and modes.

Module IV

Foreign Exchange Exposure and its management: Exchange rate forecasting: need and techniques, Foreign Exchange Exposure: transaction, real operating and translation, Management of Foreign Exchange Exposure: need, hedging of transaction and real operating exposure;

Module V

Management of short-term funds: working capital policy; managing cash and near cash assets, management of receivables and management of inventory. Financing foreign trade: Foreign trade documentation, modes of payment in international trade, methods of trade financing

Basic Reading List

1. Apte, P.G. (1995): International Finance Management, Tata McGraw-Hill Publishing. Co. Ltd, New Delhi.
2. Levi, M.D. (1990): International Finance, McGraw-Hill Publishing Company.
3. Levi, M.D. (1996): International Finance, McGraw-Hill, Inc, New Delhi.
4. Kevin, S. (2009): Fundamentals of International Financial Management" PHI, Learning Pvt. Ltd, New Delhi.
5. Click, R. W. & Coval, J. D. (): The Theory and Practice of International Financial Management" Pearson Education.
6. Avadhani, V.A. (): International Financial Management" Himalayan Publishing House.
7. Pibeam, K. (1998): International Financial, McMillan Press Ltd. London.
8. Shapiro, A.C. (1995): Multinational Financial Management, Prentice. Hall of India Pvt. Ltd.

Paper FEE-302

Seminar

SEMESTER IV
Paper CEE401
Economics of Environment

Course Objectives:

The objectives of this course are to provide the students with thorough analytical understanding in the

1. application of economic theories for environmental issues; global environmental externalities and climatic change
2. valuation of environmental goods; economics natural resources.

Course Outcomes

On successful completion of the course, students will be able to:

1. apply economic principles for applied environmental issues
2. select and apply appropriate economic techniques to solve environmental problems and measure value of environmental goods.

Module 1: The Theory of Externalities

Pareto optimality and competitive equilibrium; public goods and externalities, public goods and bads, efficient provision of public goods and bads, pricing of public goods and bads; Environmental externalities-Pigouvian taxes and subsidies, property rights and externalities, Coase's bargaining solution and collective action.

Module 2: The Economics Pollution

Pollution charges and abatement costs, Marketable pollution permits, The theory of marketable permits, The advantages of marketable permits, Types of permit system, Permit trading in practice. Tradable pollution permits vs international carbon tax. Informal regulation and the new model of pollution control. Environmental institutions and grass root movements; Cooperative Solution to Common Property resources.

Module 3: Measurement of Environmental Values

The concept of total economic value: Use values; Option values and non-use values; Monetary Valuation techniques – use of market prices, The Hedonic pricing approach, The contingent valuation method, the travel cost methods; the non-monetary valuation techniques;

Module 4: Natural Resource Economics

A resource taxonomy, theories of optimal use of exhaustible and renewable resources; Environmental Kuznet Curve and its critique. Environment and development, The concept of sustainable development; strong and weak sustainability; the concept of green GDP

Module 5: Environment Regulation and Policies

Mechanism for environment regulation in India; environmental laws and their implementation; Policy instruments for controlling water and air pollution and forestry policy; People's participation in the management of common and forest lands. The institutions of joint forest management and the joint protected area management; social forestry-rationale and benefits

Basic Reading List

1. Kolstad, C. D. (2010): Environmental Economics. OUP.
2. Bhatacharya, R. (2001): Environmental Economics: An Indian Perspective. OUP
3. Samuelson, P. A. (1995): Diagrammatic Exposition of a Theory of Public Expenditure. *The Review of Economics and Statistics*, 37(4): 350-356.

4. Bator, F. M. (1958): The Anatomy of Market Failure, *The Quarterly Journal of Economics*, 72(3): 351-379.
5. Buchanan, J. M. & Stubblebine, C. W. (1962): Externality, Economics. New Series, 29(116), November, 371-384.
6. Mishan, J. E. (1971): The Postwar Literature on Externalities: An Interpretative Essay, *Journal of Economic Literature*, 9(1): 1-28.
7. Baumol, W. J. & Oates, W. E. (1988). The Theory of Environmental Policy, Second Edition, Cambridge University Press, Cambridge.
8. Coase, R. H. (1960): The Problem of Social Cost, *Journal of Law and Economics*, 3: 1-44.
9. Markandya, A. & Richardson, J. (ed.) (2005): Environmental Economics, Earthscan Publications, London.
10. Ostrom, E. (1997): Governing the Commons: The Evolution of Institutions for Collective Action, Cambridge University, Cambridge.
11. Shiva, V. et. Al. (1997): The Enclosure and Recovery of the Commons. Research Foundation for Science, Technology and Ecology, New Delhi.
12. Grossman, G. M. & Krueger, A. B. (1994): Economic Growth and the Environment, NBER Working paper 4634.
13. Baland, J. & Platteau, J. (1996): Halting Degradation of Natural Resources: *Is there a Role for Rural Communities?* Published by Food and Agriculture Organization of the United Nations
14. Dasgupta, P. & Maler, K. (1997): The Environment and Emerging Development Issues. Clarendon Press

Paper CEE-402
Financial Institutions and Market

Learning Objectives:

1. To educate the students on different terms and concepts in financial institutions and market like commercial and central bank, monetary policy, money and capital market.
2. To enhance the understanding of the students about organisation, operation and growth of financial systems.

Learning Outcomes:

On successful completion of this Course, students will be able to:

1. understand the financial system: its structure and functions and equilibrium.
2. understand the way the different rates of interests are determined.
3. appreciate the functioning and importance of different banking and non-banking financial institutions and their role in a developing economy.
4. explain the role and structure of money and capital markets

Module I

The structure of the financial system- Functions of the financial sector-Indicators of financial development-Equilibrium in Financial Markets, Financial System and Economic Development. The Concept of Risk and Return - its type, Risk and financial assets, Risk and return on assets, Risk-Return trade off-Valuation of Securities.

Module II

Theories of interest rate determination-Level of interest rates-Long period and short period rates- Term Structure of Interest rates: Administered interest rates- Appropriate interest rate policy. Development banks- role and functions, Merchant banking; financial sector reforms in India.

Module III

Functions of Central Bank- the aims and objectives of the monetary policy in developing countries-Instruments and effectiveness of monetary policy. Proliferation of banking -Credit creation and its control; Balance Sheet Analysis, Profitability and efficiency of banks. Role of commercial banks in money market.

Module IV

Role and structure of money market and capital market, Primary and secondary market for securities. SEBI; its impact on the working of capital market in India; Non-banking financial institutions- Their growth and impact on India's economic development.

Module V

Non-Banking Financial Companies: concept and role in financial market-Regulation and functions of leasing, Hire purchase and Housing Finance Companies-Venture Capital Companies. Insurance Sector: Objectives, functions, changing role, IRDA and its role and functions in financial markets.

Basic Reading List

1. Khan, M. Y. (): Indian Financial System, Tata McGraw Hill, New Delhi.
2. Bhole, L. M. (): Financial institutions and Market, Tata McGraw hill, New Delhi.
3. Gorden & Natrajan (): Financial Market and institutions, Himalaya Publishing house.
4. Gupta, S. B. (): Monetary Economics.
5. Mishkin, F. S. & Eakins S. G (): Financial Market and institutions, PE, New Delhi.

Paper AEE-401
Economics of Gender and Development

Course Objectives

1. To provide a critical overview of economic theories, methods and economic policy-debates from a gender perspective.
2. To cover major debates in gender economics relevant to developed and developing countries.
3. To analyse orthodox economic theory and provides students with a gender-critique.
4. To explore alternative feminist economic theory and apply these different theoretical understandings to concrete examples in the real world.

Course Outcomes

On successful completion of the course, a student should be able to demonstrate the ability to:

1. demonstrate a general understanding of the theoretical debates surrounding the construction of gender and gender relations in the discipline of economics;
2. critically examine and assess mainstream and heterodox economic theories and policies from a gender perspective;
3. evaluate the ways in which current economic realities in developed and developing countries have different effects on men and women; and
4. identify the connections between feminist economic theory and feminist economic reality in developed and developing countries.

Module I

Gender and Development-Concepts, Patriarchy, Caste, Kinship and implications on gender, Gender in mainstream Economics- WID, WAD and GAD approach in development- Basic Needs and Capability Approach. HDI, GDI and GEM, Empowerment of women: concept and implications.

Module II

Demography and female population- Age structure and sex ratio, Mortality and fertility rates and declining sex ratio with special reference to India. Gender in ownership and access to resources, intra household distribution and decision making; Property rights and land rights for women and implications, Historical trends, land reforms and current provisions; Women and environment: WED and Eco feminism, Climate change, women and sustainable development

Module III

Women and work - concepts and valuation: visible and invisible, productive and unproductive, paid and unpaid work; Economic participation of women in pre-industrial and industrial societies. Women in labour market-supply and demand for female labour, female work participation developing countries with special reference to India, agricultural and non-agricultural activities. Women in formal and informal sector; Gender wage differential- Theories of wage discrimination and differentials and use of time- use survey

Module IV

Gender Issues in Poverty - Women and poverty, feminization of poverty, Inclusive growth and development, Gender inequalities: Access to education, health and other public services; Social security and Insurance, entitlements and social justice; Women and access to finance: Micro finance and self help groups; Women empowerment – concept and indicators; Development, Migration and women, Technology and women: ownership, access and implications on gender inequality

Module V

Globalization and Gender in Neo Liberal economics, Smart Economics and Women in Development Institution framework - engendering development, Women and macroeconomic policies, Decentralization of governance and empowerment of women in India; Gender budgeting with special reference to India

Basic Reading List

1. Boserup, E (1970): Women's Role in Economic Development, George Allen and Unwin, London
2. Seth, M. (2000): Women and Development: the Indian Experience, Sage Publications, New Delhi.
3. Venkateswaran, S. (1995): Environment, Development and Gender Gap, Sage Publications, New Delhi.
4. Kabeer, N. (1994): Reversed Realities: Gender Hierarchies in Development Thought, Kali for Women, New Delhi.
5. Nussbaum, M. (2000): Capability Approach and Human Development, Cambridge University Press.
6. Mies, M. (1998): Patriarchy and Accumulation on a World Scale: Women in the International Division of labour, Zed Book, London.
7. Agnihotri, S. B. (2000): Sex ratio in Indian Population: A Fresh Exploration, Sage Publications, New Delhi.
8. Agarwal, B. (1994): A Field of One's Own: Gender and Land Rights in South Asia, Cambridge University Press
9. Sen, A. K. (1990): Gender and Cooperative Conflicts, in Tinker (Ed) 'Persistent Inequalities: Women and World Development', Oxford University Press, New York.
10. Amsden, A. H. (Ed.) (1980): The Economics of Women and Work, Penguin Publications.
11. ILO (1998): Women's Participation in the Economic Activity of Asian Countries, Geneva.
12. Papola, T. S. and A. N. Sharma (Eds.) (1999): Gender and Employment in India, Vikas Publishing House, New Delhi.
13. Schultz, T. P. (1988): Education Investments and Returns, in Chenry, H. B. and T. N. Srinivasan, Handbook of Development Economies North Hollnad, New York.
14. Ahmed. I. (Ed.) (1985): Technology and Rural Women: Conceptual and Empirical Issues, George Allen and Unwin, London.
15. Jhabwala, R. and R. K. Subramanya (Eds) (2000): The Unorganized Sector: Work Security and Social protection, Sage Publications, New Delhi.
16. Narasimhan, S. (1999): Empowering Women: An Alternative Strategy from Rural India, Sage Publications, New Delhi.
17. Purushothaman, S. (1998): The Empowerment of Women in India: Grassroots Women's Network and the State, Sage Publications, New Delhi.
18. Jacobs, Jerry, A. (1995): Gender Inequality at Work, Sage Publications

Paper AEE-402
Financial Inclusion and Economic Development

Course Objectives:

The objectives of this course are to provide the students with thorough understanding of

1. financial inclusion and exclusion, relation between financial inclusion and economic development
2. role of financial institutions, micro finance and micro insurance in financial inclusion.

Course Outcomes

On successful completion of this course, the students will be able to

1. learn and analyse the dimensions of financial inclusion, the progress of financial inclusion in India
2. analyse the complexities associated with financial inclusion in India.

Module I: Financial Inclusion and Inclusive Growth

Inclusive Growth: Concept, Relevance and Salient Features. A Theoretical Model for Inclusive Economic Growth in India, Challenges and prospects of inclusive growth in India. Financial Inclusion: Concepts, Rationale; Financial exclusion, financial inclusion in India

Module II: Strategy for financial Inclusion

Strategies to extend financial services to vulnerable groups, Measurement of the progress of financial inclusion, Financial inclusion Index, Determinants of financial inclusion, Economics of financial inclusion.

Module III: Institutions and Financial Inclusion

Role of Banking System in Financial Inclusion, Financial Inclusion and Social Banking, Regional Rural Banks, Cooperative Credit Institutions, Reserve bank of India, Government in financial inclusion, Technology Applications in Banking Sector.

Module IV: Rural Credit and Micro Finance

Rural Credit, Demand and Supply Side Analysis, Institutional Mechanism in India, Government Policies for Promoting Rural Credit, Micro Finance: Institutions and Mechanisms, Credit to SHGs, Growth, Prospectus and Challenges, Policy Measures; Farm and Non-farm credit

Module V: Insurance

Moral Hazard and Adverse Selection Problem in Insurance Market; Benefits and Costs of Insurance, Micro insurance, The Moral Foundations of Universal Health Insurance, Evolution of Insurance Market in India. Reforms in Indian Insurance Market

Basic Reading List

1. Karmarkar, K. G., Banerjee, G. D. & Mohapatra, N. P. (2011): Towards Financial Inclusion in India, Sage Publication
2. Desai, V. (2005): Rural Development in India, Himalaya Publishing House
3. Rohtagi (2010) Rural Banking & Overdues Management, Cyber Tech Publications
4. Patnaik, U. C. & Mishra, R. N. (1999): Rural Banking in India, Anmol Publications
5. Bhatnagar, A. (2008): Rural Micro finance & Microenterprise, Concept Publishing Co.
6. Sohani, A. K. (2009): Financial Inclusion: Perspectives and Country Experiences, ICFAI
7. Sujatha, B. (2007): Financial Inclusion: Concepts and Strategies, ICFAI
8. Kocchar, S., Chakrabarty, K. C. & Rangarajan, C. (): Speeding Financial Inclusion, Academic Foundation
9. Sundaram, I. S. (2015): Rural Development, Himalaya Publishing House

Paper AEE-403

Project and Dissertation

STATE MODEL SYLLABUS FOR UNDER GRADUATE COURSE IN EDUCATION (Bachelor of Arts Examination)

UNDER

CHOICE BASED CREDIT SYSTEM

Course structure of UG Education Honours

Semester	Course	Course Name	Credits	Total marks
I	AEC-I	AEC-I	04	100
	C-I C-I Practical	Educational Philosophy	04 02	75 25
	C-II C-II Practical	Educational Psychology	04 02	75 25
	GE-I GE-I Practical	GE-I	04 02	75 25
			20	
II	AEC-II	AEC-II	04	100
	C-III C-III Practical	Educational Sociology	04 02	75 25
	C-IV C-IV Practical	Changing Pedagogical Perspective	04 02	75 25
	GE-II GE-II Practical	GE-II	04 02	75 25
			20	
III	C-V C-V Practical	Educational Assessment and Evaluation	04 02	75 25
	C-VI C-VI Practical	Educational Research	04 02	75 25
	C-VII C-VII Practical	Statistics in Education	04 02	75 25
	GE-III GE-III Practical	GE-III	04 02	75 25
	SEC-I	SEC-I	04	100

			26	
IV	C-VIII C-VIII Practical	History of Education in India	04 02	75 25
	C-IX C-IX Practical	Curriculum Development	04 02	75 25
	C-X C-X Practical	Guidance and Counseling	04 02	75 25
	GE-IV GE-IV Practical	GE-IV	04 02	75 25
	SEC-II	SEC-II	04	100
			26	

Semester	Course	Course Name	Credits	Total marks
V	C-XI C-XI Practical	Development of Education in Odisha	04 02	75 25
	C-XII C-XII Practical	Information And Communication Technology in Education	04 02	75 25
	DSE-I DSE-I Practical	A. Pedagogy of language (English) B. Pedagogy of language (Odia)	04 02	75 25
	DSE-II DSE-II Practical	A. Pedagogy of Social Sciences B. Pedagogy of Mathematics	04 02	75 25
			24	
VI	C-XIII C-XIII Practical	Contemporary Trends and Issues in Indian Education	04 02	75 25
	C-XIV C-XIV Practical	Educational Management and Leadership	04 02	75 25
	DSE-III	A. Policy and Practices in School Education in India	04	75

	DSE-III Practical	B. Policy and Practices in Higher Education in India	02	25
	DSE-IV DSE-IV Practical	Inclusive Education (Theory)	04 02	75 25
	OR			
	DSE-IV	Dissertation	06	100*
			24	

EDUCATION

HONOURS PAPERS:

Core course – 14 papers
Discipline Specific Elective – 4 papers
Generic Elective for Non Education students – 4 papers. -

Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical : 25 marks
Total – 100 marks
Credit per paper – 6

Core Paper I

EDUCATIONAL PHILOSOPHY

Learning Objectives:

On completion of this course, the learners shall be able to:

- State and analyze the meaning of education and form own concept on education
- Explain philosophy as the foundation of education
- Analyze aims of education
- Describe the essence of different formal philosophies and draw educational implications
- Compare and contrast Indian and western philosophies of education

UNIT 1: Education in Philosophical Perspective

(i) Etymological meaning of education
(ii) Narrower and broader meaning of education, Lifelong Education
(iii) Aims of Education- Individual and Social Aims of Education
(iv) Meaning and nature of philosophy
(v) Branches of Philosophy- Metaphysics, Epistemology and Axiology, and its educational implications
(vi) Functions of Philosophy in relation to education

UNIT 2: Formal Schools of Philosophy and their Educational Implications

(i) Idealism, Naturalism, Pragmatism with reference to: Aims of Education, Curriculum, Methods of Teaching, Role of Teacher, Discipline

UNIT 3: Indian Schools of Philosophy and their Educational Implications

(i) Common Characteristics of Indian Philosophy

(ii) Sankhya, Vedanta, , Buddhism, Jainism with reference to:

Philosophical tenets, Aims of education, Curriculum, Methods of Teaching, Role of Teacher

UNIT 4: Educational Thought of Western and Indian Thinkers

(i) Plato

(ii)Dewey

(iii)Gopabandhu Das

(iv)Gandhi

(v) Tagore

(vi)Aurobindo

PRACTICAL

- Field visit to a seat of learning in the locality and prepare report.

NB: It will be evaluated by both the of internal core -1 internal and External examiners.

Text Books

- Safaya, R.N. & Shaida, B.D. (2010). *Modern Theory and Principles of Education*. New Delhi: Dhanpatrai Publishing Company Pvt. Ltd. Nayak, B.K. (2018).
- Ravi, Samuel.S. (2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.
- Taneja, V.R. (2000). *Educational thought and practice*. New Delhi: Sterling Publishers Pvt. Limited.

Reference Books

- Aggrawal, J.C. (2013). *Theory and principle of education*. New Delhi: Vikash Publishing House Pvt Ltd.
- Anand, C.L. *et.al*. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT.
- Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
- Dash, B.N. (2011) Foundation of education, New Delhi; Kalyani Publishers.
- Dewey, John (1916/1977). Democracy and education. New York: MacMillan.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.
- Krishnamurthy, J. (1953). Education and significance of life. New Delhi: B.I. Publications
- Kumar Krishna (1996). Learning from conflict. New Delhi: Orient Longman.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson. Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Peters, R.S. (1967). The Concept of education. London: Routledge Kegan & Paul.

Radhakrishnan, S. Indian philosophy Vol. I and Vol. II

- Ross, James S.(1981). Ground work of educational theory.Delhi: Oxford University Press Rusk, Robert R., Philosophical bases of education, London: Oxford University Press.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Wingo, G. Max (1975). Philosophies of education. New Delhi: Sterling Publisher Pvt. Limited.

Core Paper II

EDUCATIONAL PSYCHOLOGY

Learning Objectives:

On completion of this course, the learners shall be able to:

- Explain the concept of educational psychology and its relationship with psychology.
- Understand different methods of educational psychology.
- Describe the theoretical perspectives of educational psychology.
- Explain the concepts of growth and development of child and adolescence, and underlined general principles of growth and development.
- Describe briefly the periods and the typical characteristics ofgrowth and development during childhood and adolescence.
- Specify the contexts and factors influencing development.
- Explain the theory of cognitive development and its educational implications.
- State the different forms and characteristics of individual differences and the ways of meeting the classroom issues arising out of the differences.
- Identify the learning needs during the different stages of development and adopt appropriate strategies in and out of school to meet the learning needs.

UNIT 1: Educational Psychology in Developmental Perspective

(i) Meaning, nature, scope and relevance of educational psychology
(ii) Methods of educational psychology- observation, experimentation, and case study
(iii) Application of educational psychology in understanding learner
(iv) Growth and Development-Concept, difference between growth and development, and principles of growth and development
(v) Characteristics of development during adolescence in different areas: Physical, social, emotional and intellectual (with reference to Piaget)

UNIT 2: Intelligence, Creativity and Individual difference

(i) Individual difference-concept, nature, factors and role of education

(ii) Intelligence- meaning and nature of intelligence, concept of I.Q, theories of intelligence- Two factor theories, Guildford's structure of intelligence (SI) model, Gardner's multiple theory of intelligence.
(iii) Measurement of intelligence- individual and group test, verbal, non-verbal test
(iv) Creativity- meaning, nature and stages of creative thinking, strategies for fostering creativity

UNIT 3: Learning and Motivation

(i) Learning- meaning, nature and factors of learning
(ii) Theories of learning with experiment and educational implications-
(iii) Classical conditioning, operant conditioning, insightful learning and constructivist approach to learning
(iv) Motivation – concepts, types, and techniques of motivation

UNIT 4: Personality and Mental health

(i) Personality- meaning and nature of personality
(ii) Theories- type theory and trait theory
(iii) Assessment of personality- subjective, objective and projective techniques
(iv) Mental health-concept, factors affecting mental health and role of teacher, mental health of teacher.
(v) Adjustment mechanism: Concept and Types

PRACTICAL

- Administration and interpretation of any psychological test relating to intelligence or personality

N.B: It will be evaluated by both the Internal and External examiners.

Text Books

- Woolfolk, A. (2015). *Educational psychology (9th Ed.)*. New Delhi: Pearson Publication
- Chauhan, S.S. (2010). *Advanced educational psychology*. New Delhi: Vikas Publishing House Pvt. Ltd.
- Mangal, S.K. (2002). *Advanced educational psychology*. New Delhi: Prentice Hall of India.

Reference Books

- Arnett, J. (2007). Adolescence and emerging adulthood: A cultural approach. (3rd Edn.). Upper Saddle River, N.J.: Pearson.
- Berk, Laura E. (2011). Child development (9th Edn.). New Delhi: Prentice Hall of India.
- Flavell, J.H. (1963). The developmental psychology of Jean Piaget. New York: Van

Nostrand
- Hurlock, E. B. (1980). Developmental psychology: All span approach. New York: McGraw Hill Book.
- Hurlock, E.B. (1980). Child development (6th Edn.). Tokyo: McGraw-Hill, Kogakusha Ltd.
- Hurlock, E.B. (2007). Child growth and development. New York: McGraw Hill.
- Kail, Robert V (2011). Children and their development (6th Edition). Englewood Cliffs, N.J: Prentice Hall.
- Stephens, J. M.; Evans, E. D.(1973). Development and classroom learning: An introduction to educational psychology. New York: Holt, Rinehart and Winston

Core Paper III

EDUCATIONAL SOCIOLOGY

Learning Objectives:
On completion of this course, the students shall :

- State the relationship between education and society.
- Understand the meaning of Educational Sociology and function of education as a social system.
- State different agencies of education and their functions.
- Justify the importance of education for social change.
- Describe the role of education in modernization and globalization.
- Describe the function of education to ensure equality and equity.

UNIT 1: Education and Society

(i) Relationship between education and society, school as a miniature society
(ii) Educational Sociology- Concept, nature, scope and importance;
(iii) Relationship between education and sociology.
(iv) Education as a process of Socialization.
(v) Education and Politics, Education and Economic Development

UNIT 2: Agencies of Education

(i) Family- Importance, functions and role for education and socialization of the children
(ii) School - Importance, functions and role for education and socialization of the children
(iii) Society- Importance, functions and role for education and socialization of the children
(iv) Mass Media- Importance, functions and role for education and socialization of the children

UNIT 3: Education, Social change and Modernization

(i) Concept of social change and factors affecting Social Change
(ii) Education as an instrument of social change and social control
(iii) Concept and Attributes of modernization

(iv) Education for accelerating the process of modernization
(v) Impact of Globalization on Education

UNIT 4: Equalization of Educational opportunities for ensuring equity and Inclusion

(i) Concept of equality, equity and inclusion: its educational implication
(ii) Ensuring equality in the Education of SC and ST
(iii) Education for Women Empowerment
(iv) Inclusive Education with reference to children with special needs(CWSN)

PRACTICAL

Field Visit: Study of a social unit (Home/School/Village/slum) and reporting.

NB: It will be evaluated by both the internal and external examiners

Text Books

- Mathur, S. S. (2000). *A sociological approach to Indian education.* Agra : Vinod Pustak Mandir.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson.
- Bahttacharya, S. (2006). Sociological Foundation of Education. New Delhi: Atlantic

Reference Books

- Ravi, Samuel.S.(2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.
- Safaya, R.N. & Shaida, B.D. (2010), *Modern theory and principles of education*. New Delhi: Dhanpati Publising Company Pvt. Ltd.
- Aggrawal, J.C.(2013). Theory and principle of education. New Delhi: Vikash Publishing House Pvt Ltd.
- Anand, C.L. et.al. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
- Dewey, John (1916/1977). Democracy and education. New York: MacMillan.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.

  Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.

- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.

  Saraswati, T.S. (Ed.) (1999).Culture, socialization and human development. Theory, research and applications in India. New Delhi: Sage Publication.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling

  Publishers Pvt. Limited.

Core Paper IV

CHANGING PEDAGOGICAL PERSPECTIVE

Learning Objectives:

On completion of this course, the students shall:

- Explain the concept of pedagogy
- Differentiate pedagogy from other allied concepts
- Explain different teaching task with example
- Establish relationship between teaching and learning
- List out different approaches and methods of teaching
- Prepare a lesson plan following different designs

UNIT 1: Concept of Teaching and Learning

(i) Meaning and definition of teaching and learning
(ii) Relationship between teaching and learning
(iii) Variables involved in teaching task: independent, dependent and intervening
(iv) Phases of teaching: Pre- active, inter- active and post- active
(v) Levels of teaching: memory, understanding and reflective
(vi) Lesson plan design- The Herbartian steps, 5 E and ICON design model

UNIT 2: Theories of Teaching

(i) Meaning and nature of teaching theory
(ii) Types of teaching theories:
(iii) Formal theories of teaching- communication theory of teaching
(iv) Descriptive theories of teaching– Gagne's hierarchical theory of instruction and Bruner's cognitive theory of instruction
(v) Normative theories of teaching - Mitra's psychological theory of teaching and Clarke's general theory of teaching

UNIT 3: Principles and maxims of teaching

(i) General principles of teaching
(ii) Psychological principles of teaching
(iii) Maxims of teaching
(iv) Core teaching skills: Introducing the lesson, explaining, illustrating with examples, stimulus variation, and reinforcement, questioning, probing questions, closure.

UNIT 4: Approaches and methods of Teaching

(i) Concept of approach, method, strategy and techniques
(ii) Methods of teaching: inductive-deductive, analytic- synthetic, problem solving and project
(iii) Shift in focus from teaching to learning- constructivist approach to learning

PRACTICAL

- Preparation of rating scale/ checklist /observation schedule to evaluate classroom teaching and reporting.

NB: It will be evaluated by both the internal and external examiners

Text Books

- Kochar, S.K.(2011). *Methods and Techniques of teaching*. Sterling Publisher Pvt. Ltd., New Delhi
- Chauhan, S.S.(1995). *Innovations of teaching learning process*. Vikash Publishing House, New Delhi
- Sharma, R.A.(1986).*Technology of Teaching*. International Publishing House, Meerut.

Reference Books

- Aggarwal, J.C.(1995). *Essentials of Educational Technology*. Vikash Publishing House, New Delhi
- Walia, J.S. (2013). *Educational Technology*. Jalandhar, Punjab: Ahim Publications.
- Mangal, S.K. and Mangal, U.(2010) *Essentials of Educational Technology*, New Delhi, PHI Learning Pvt. Limited
- Mangal, S.K.(1988) *Foundations of Educational Technology,* Ludhiana, Tandan Publications
- Nageswar Rao, S., Sreedhar, P. & Rao, B.(2007). *Methods and techniques of teaching*, Sonali Publications, New Delhi
- Oliver,R.A. (1963) *Effective teaching*, JM Dent & Sons
- Pathak, R.P. & Chaudhary, J. (2012) *Educational Technology*, Pearson, New Delhi
- Ryburn, W.M.(1955) *Principles of Teaching*, Geoffrey Cembridge, OUP
- Sampath,K, Pannir Salvam,A.,& Santhanam, S.(1981) *Introduction to Educational Technology*, Sterling Publisher, New Delhi

Core Paper V

EDUCATIONAL ASSESSMENT AND EVALUATION

Learning Objectives:

On completion of this course, the students will.

- State the nature, purpose and types of educational assessment and evaluation.
- Develop and use different types of tools and techniques for continuous and comprehensive assessment of learning in the school situation.
- Explain the importance of assessment for learning and its processes for enhancing the quality of learning and teaching.
- Describe the characteristic of a good test.
- Analyze the trends and issues in learning and learner assessment.
- Analyze and interpret results of the assessment using standard score.
- Illustrate the principles of test construction in education.

UNIT 1: Assessment and Evaluation in Education

(i) Understanding the meaning and purpose of test, measurement, assessment and evaluation
(ii) Scales of measurement- nominal, ordinal, interval and ratio
(iii) Types of test- teacher made and standardized
(iv) Approaches to evaluation- placement, formative, diagnostic and summative
(v) Types of evaluation- norm referenced and criterion referenced
(vi) Concept and nature of continuous and compressive evaluation

UNIT 2: Instructional Learning Objectives

(i) Taxonomy of instructional Learning Objectives with special reference to cognitive domain
(ii) Criteria of selecting appropriate Learning Objectives, and stating of general and specific instructional Learning Objectives
(iii) Relationship of evaluation procedure with Learning Objectives
(iv) Difference between objective based objective type test and objective based essay type test

UNIT 3: Tools and Techniques of Assessment and construction of Test

(i) Steps of test construction: planning, preparing, trying out and evaluation
(ii) Principles of construction of objective type test items- matching, multiple choice, completion and true – false
(iii) Principles of construction of essay type test
(iv) Non- standardized tools: Observation schedule, interview schedule, rating scale, check list, portfolio and rubrics .

UNIT 4: Characteristics of a good Test

(i) Validity-concept, types and methods of validation
(ii) Reliability- concept and methods of estimating reliability

(iii) Objectivity- concept and methods of estimating objectivity
(iv) Usability- concept and factors ensuring usability

PRACTICAL

- Construction of Unit test on a school subject based on blueprint and reporting.

  NB: It will be evaluated by both Internal and External examiners.

Text Books

- Aggrawal, J.C. (1997). *Essentials of examination system, evaluation, tests and measurement*. New Delhi: Vikas Publishing House Pvt Ltd.
- Goswami, M. (2011). *Measurement and evaluation in psychology and education*. Hyderabad: Neelkamal Publishers
  Gronlund, N.E. (2003). *Assessment of student Achievement*. Boston: Allyn & Bacon
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books

- Anastasi, A.(1976). Psychological testing. New York: Macmillan Publishing Co.
- Anderson, L.W. (2003). Classroom assessment: Enhancing the quality of teacher decision making.
- Banks, S.R. (2005). *Classroom assessment: issues and PRACTICES*. Boston: Allyn & Bacon.
- Blooms, B.S.(1956). *Taxonomy of educational Learning Objectives*. New York: Longman Green and Company
- Cohen, R.J., Swerdlik, M.E., & Phillips, S.M. (1996). *Psychological testing and assessment. an introduction to the tests and measurement*. California: Mayfield Publishing Co.
- Earl, L.M. (2006). *Assessment as learning: using classroom assessment to maximize student learning*. Thousand Oaks, California: Corwin Press
- Hopkins, KD. (1998). *Educational and psychological measurement and evaluation.* Boston: Allyn and Bacon.
- Linn, R.L. & Gronlund, N.E. (2000). *Measurement and assessment in teaching.* London: Merrill Prentice Hall.
  Macmillan, J.H. (1997). *Classroom assessment, principles and practice for effective instruction.* Boston: Allyn and Bacon
- Mohan, R. (2016). *Measurement evaluation and assessment in education*. Delhi: PHI Learning Pvt. Ltd.
- National Council of Educational Research and Training (2006). *Position paper: Examination Reforms.* New Delhi: NCERT
- Noll, N.H. S cannell, D.P. & Craig, RC. (1979). *Introduction to educational measurement.* Boston: Houghton Miffin.

Core Paper VI

EDUCATIONAL RESEARCH

Learning Objectives:

On completion of this course, the student will:

- Describe nature, scope and limitation of educational research.
- Understand different types and methods of educational research.
- Explain sources from where knowledge could be obtained.
- Describe the process of research in education.
- Analyze research design in education.
- Illustrate procedure of collecting and analyzing data.
- Prepare the research report.

UNIT 1: Concept and Types of Educational Research

(i) Concept and nature of research
(ii) Meaning, nature and scope of educational research
(iii) Types of research by purpose- Fundamental, Applied and Action
(iv) Types of research by approach- Quantitative and Qualitative

UNIT 2: Design of Research and preparation of research proposal

(i) Steps of Research
(ii) Review of Related Literature; and identification of problem
(iii) Hypothesis: Meaning, Types, Sources and Characteristics of hypothesis
(iv) Concept of population and sample
(v) Sampling procedures- Probability and Non-Probability
(vi) Tools and techniques for data collection(i.e. questionnaire, interview, observation and Procedure of data collection , Preparation of research proposal

UNIT 3: Methods of Research

Meaning nature and steps of:
(i) Survey method
(ii) Case-study method
(iii) Historical research
(iv) Experimental research

UNIT 4: Writing Research Report

(i) Data analysis and interpretation in research.
(ii) Steps for reporting research
(iii) Reporting style (APA Style)
(iv) Plagiarism checking
(v) Referencing Style (APA Style): Bibliography, Webliography

PRACTICAL

- Preparation of a Research Proposal on any Educational Topic (Issues/ Trends/ Problems/ Psychological Topics)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Best J.W. and Kahn, J. V. (2006). *Research in education (*9th Ed.) New Delhi: Pearson Education Inc.
- Kaul, L. (1984). *Methodology of educational research.* New Delhi: Vikas Publication
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books

- Nanda, G.C. & Khatoi, P.K. (2012). *Fundamentals of Educational Research and Statistics.* New Delhi: Ludhiana.
- Gay, L.R. (1990). *Educational research-competencies for analysis and application* (3rd Ed.), Macmillan Publishing Company, New York Ary, D., Jacobs, L. C., &Razavieh, A. (2002). *Introduction to research in education* (6th Ed.). Belmont, CA: Wadsworth/Thomson Learning.
- Bhandarkar, P.L. and Wilkinson,T.S. (2010). *Methodology and techniques of social research*. Himalaya Publishing House, New Delhi.
- Creswell, J.W. (2014). *Educational research-planning, conducting and evaluating quantitative and qualitative research (4th Ed.).* New Jersey, USA: Pearson Education Inc. (Indian Reprint available at PHI Learning Pvt.Ptd.)
- Kerlinger, F.N. (1973). *Foundation of behavioral research.* New York: Holt Rinehart & Winston.
- Rao, U. (2007). *Action research.* Himalaya Publishing House, New Delhi.
- Borg, W.R. & Gall, M.D. (1989). *Educational research: An introduction*. New York: Longman.
- Corey, S. M. (1953), *Action research to improve school practice*, New York: Teachers College Press
- Johnson, B. & Christensen, L. (2008). *Educational research: quantitative, qualitative, and mixed approaches*. London: Sage Publication
- McMillan, J.H. & Schumacher, S. (1989). *Research in Education- a Conceptual Introduction.* New York: Harper Collins.
- Mertler, C.A. (2006). *Action research: teachers as researchers in the classroom*. London: Sage Publication

Core Paper VII

STATISTICS IN EDUCATION

Learning Objectives:

On completion of this course, the students will:

- Describe the importance of statistics in education.
- Organise and represent educational data in tabular and graphical form.
- Compute and use various statistical measures of average, variation and bi-variate distribution to in analysis and interpretation of educational data.
- Describe the concept and importance of normal probability curve and interpret test scores in using normal probability curve.

- Understand the divergence of data from normality.

UNIT 1: Educational Statistics

(i) Educational Statistics-Meaning, Nature, Scope and Uses
(ii) Organization of Data: Frequency Distribution, Cumulative Frequency Distribution
(iii) Graphical Representation of Data (Histogram, Frequency polygon , Ogive and Pie-Diagram)

UNIT 2: Measures of Central Tendency and Variability

(i) Mean, Median and Mode- concept, computational process, uses and limitations
(ii) Range, Average Deviation, Quartile Deviation and Standard Deviation- Concept, computational process, uses and limitations

UNIT 3: Co-relational Statistics

(i) Meaning and types of Correlation
(ii) Computation of Coefficient of Correlation by Rank Difference Method; Product Moment Method

UNIT 4: Normal Probability Curve and Divergence from Normality

(i) Normal Probability Curve- concept, properties and applications
(ii) Skewness and Kurtosis
(iii) Interpretation of Derived scores: Z- score and T- score

PRACTICAL

- Analysis of Achievement Data of a particular class and Reporting

  NB: It will be evaluated by both Internal and External examiners.

Text Books

- Aggarwal,Y.P.(2009).*Statistical methods: concepts, application and computation*.New Delhi: Sterling Publishers Pvt. Ltd**.**
- Garrett, H.E. (1971). *Statistics in psychology and education.* New Delhi: Paragon International Publisher
- Mangal, S.K. (2008). *Statistics in education and psychology*. New Delhi: Prentice-Hall of India Private Limited

Reference Books

- Ferguson, G.A.(1971). *Statistical analysis in psychology and education.* Kogakusha, Tokyo: McGraw-Hill
- Guilford, J.P. &Fruchter, B. (1981). *Fundamental statistics in psychology and education.* New York: McGraw Hill
- McCall, R. (1993). *Fundamental statistics for the behavioral Science.* New York: Harcourt Brace
- Ravid, Ruth. (2000). *Practical statistics for education*. New York: University Press of America.

- Seigel. S. & Castel Ian N.J. (1988). *Non-parametric statistics for the Behavioral Science.* Singapore: Graw- Hill Book Co.

Core Paper VIII

HISTORY OF EDUCATION IN INDIA

Learning Objectives:

On completion of this course, the student will

- Understand the development of education in India during ancient period, medieval period and pre-independence period.
- Describe the development of education in India during post-independence period.
- Describe major recommendations of different policies and committee reports on education in India.

UNIT 1: Education during Ancient Period

(i) Features of Vedic period with special reference to aims, curriculum and methods of teaching
(ii) Features of Buddhist period with special reference to aims, curriculum and methods of teaching
(iii) Relevance of Gurukul system and Buddhist centers of learning
(iv) Ancient seats of Learning

UNIT 2: Education during Medieval Period

(i) Features of education during Medieval Period with special reference to aims, curriculum and methods of teaching
(ii) Educational institutions during Muslim period, important centers of education.
(iii) Relevance of Islamic period

UNIT 3: Education during pre-independence period

(i) Charter's Act(1813)
(ii) Maculay's Minute(1835)
(iii) Wood's Despatch (1854)
(iv) Indian Education Commission(1882)
(v) Calcutta University Commission(1917)
(vi) Hartog committee(1929)

UNIT 4: Education during post-independence period

Major recommendations of the following commissions and committees relating to the aims of education and curriculum:

(i) University Education Commission (1948)
(ii) Major recommendations of Secondary Education Commission (1954)
(iii) Major recommendations of Education Commission (1966)
(iv) National Policy on Education (1986), revised in 1992

PRACTICAL

- Study on implementation of NPE(1986) in respect of recommendations for elementary level

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Aggrawal, J.C.(2010). *Landmarks in the history of modern Indian education*. New Delhi: Vikash Publishing Pvt Ltd.
- Dash, B.N. (1911). *Development of education in India*. New Delhi: Ajanta Prakashan
- Das, K.K. (1993). *Development of education in India*. New Delhi: Kalyani Publishers.

Reference Books

- Naik, J.P. & Narullah, S. (1996). *A student's history of education in India.*New Delhi: Mc Millan India Ltd
  Rawat, P.L. (1989). *History of Indian education* New Delhi: Ram Prasad & Sons.
- Govt. of India. (1992, 1998). National policy on education, 1986 (As modified in 1992). Retrieved from http://mhrd.gov.in/sites/upload_files/mhrd/files/NPE86-mod92.pdf
- Keay, F.E. & Mitra, Sukumar (1978). A history of education in India. New Delhi: Oxford University Press.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ministry of Human Resource Development (2004).Learning without Burden: Report of the National Advisory Committee. New Delhi: Min. of HRD.
- Mookharjee, R.K. (1989). The Gupta Empire. Delhi: Motilal Banarsi Dass Publishers Pvt Ltd. Mukherji, S.M., (1966). History of education in India. Vadodara: Acharya Book Depot.
- Naik, J.P. and Syed, N., (1974). A student's history of education in India. New Delhi: MacMillan.
- Rawat, P.L.(1989). History of Indian education. New Delhi: Ram Prasad & Sons. Website, www.mhrd.gov.in

Core Paper IX

CURRICULUM DEVELOPMENT

Learning Objectives:

On completion of this course, the students will

- Differentiate curriculum from courses of study, text book.
- Analyse bases and sources of curriculum.
- Describe different types of curriculum.
- Critically examine National curriculum framework- 2000 and 2005.
- Describe process of curriculum development and differentiate different models of curriculum development.
- Evaluate curriculum using different evaluation models.

UNIT 1: Curriculum

(i) Concept of syllabus, courses of study, text book and curriculum
(ii) Bases of curriculum- philosophical, sociological and psychological
(iii) Components of curriculum: Learning Objectives, Contents, Methods and Evaluation
(iv) Concept of Curriculum design

UNIT 2: Types of Curriculum

(i) Subject centered curriculum
(ii) Learner centered curriculum
(iii) Experience centered curriculum
(iv) Core curriculum

UNIT 3: Curriculum Organization

(i) Principles of curriculum construction
(ii) Selection and organization of content
(iii) Selection and Organization of learning experiences
(iv) National curriculum framework- 2005 and its guiding principles

UNIT 4: Curriculum Development and Evaluation

(i) Curriculum development- its process, role of local authority, state level agencies like SCERT, BSE and National Agencies like CBSE, NCERT
(ii) Tyler and Taba Model of curriculum development
(iii) Meaning and nature of curriculum evaluation

PRACTICAL

- Content Analysis of any text book of elementary level

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Ornstein, A.C. & Hunkins, E (1998). *Curriculum. Foundations, Principles and Issues*. Boston: Allyn & Bacon, Boston.
- Oliva, P.F. (2001). *Developing the curriculum* (Fifth Ed.). New York, NY: Longman.
- Talla, M. (2012). *Curriculum Development: Perspectives, Principles and Issues.* New Delhi: Pearson Publications.

Reference Books

- Beane, J.A. ,Conrad, E.P. Jr. and Samuel JA, Jr. (1986). Curriculum planning and development, Boston: Allyn & Bacon.
- Brady, L. (1995). Curriculum development, New Delhi: Prentice Hall.
- Doll, R.C. (1996).Curriculum development: decesion-making and process, Boston: Allyn & Bacon. Krug, E.A.(1956). Curriculum planning. New York: Harper and Row

Publishers.
- Oliva, P.F. (2001). *Developing the curriculum* (Fifth Ed.). New York, NY: Longman.
- Pratt, D.(1980). Curriculum design and development. New York: Macmillan Publishing Co. Inc.
- Popham, W.J. (1993). Modern educational measurement. Englewood Cliffs, N.J.: Prentice Hall.
- Saylor, J.G., Alexander, W.M. and Lewis, A.J.(1981). Curriculum planning for better teaching and learning. New York: Holt Rienehart & Winston.
- Taba, H. (1962). Curriculum development-theory and practice. New York: Harcourt Brace, Jovanoich. Tanner, D. and Tanner, L.(1975) Curriculum development- theory and practice. New York: Macmillan Publishing Co. Inc.
- Tyler, R.W.(1941). Basic principles of curriculum and instruction .Chicago: University of Chicogo Press.

Core Paper X

GUIDANCE AND COUNSELLING

Learning Objectives:

On completion of this course, the students will
- State the concept, need, principles and bases of guidance.
- Use various tools and techniques of guidance in appropriate contexts.
- Explain the role of school in organizing different guidance programmes.
- State the concept, scope and type of counseling.
- Narrate the process, tools and techniques of counseling.
- Explain the qualities and role of a counselor.
- Describe different programmes for with differently abled children.
- Explain the role of teacher and head master in organizing different guidance programmes.

UNIT 1: CONCEPT OF GUIDANCE

(i) Meaning, nature and scope of guidance
(ii) Philosophical, psychological and sociological bases of guidance
(iii) Need, importance, purpose and scope of educational guidance in schools
(iv) Need, importance, purpose and scope of vocational guidance

UNIT 2: EDUCATIONAL GUIDANCE

(i) Basic data necessary for educational guidance
(ii) Basic principles and main types of pupil personnel records
(iii) Cumulative records in a guidance programme
(iv) Case study procedure in guidance

UNIT 3: CONCEPT OF COUNSELLING

(i) Meaning, nature and scope of counseling
(ii) Relationship between Guidance and Counselling
(iii) Different types of counseling
(iv) Steps and techniques of counseling
(v) Necessary qualities of a good counselor
(vi) Role of a counselor in secondary schools

UNIT 4: ORGANISATION OF GUIDANCE SERVICE

(i) Placement Service
(ii) Follow-up service
(iii) Individual inventory service
(iv) Occupational information service
(v) Launching school guidance programme

PRACTICAL-25

- Case Study of a Child with Special Needs or a child coming from socially disadvantaged background

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Goswami, Marami (2016). *Essentials of Guidance and Counselling*. New Delhi: Lakshi Publishers And Distributors.
- Kochhar. S.K. (2017). *Educational and Vocational Guidance in Secondary Schools*. New Delhi: Sterling Publishers
- Siddiqui, M.H. (2009). *Guidance And Counselling*. New Delhi: APH Publishing Corporation

Reference Books

- Sharma, R. N., & Sharma, R. (2013). *Guidance and counselling in India*. New Delhi: Atlantic Publishers and Distributors (P) Ltd.
- Bhatnagar,AshaGupta, Nirmala (Eds) (1999). Guidance and counseling: A theoretical perspective (Vol.I). New Delhi: Vikas
- Bhatnagar, Asha and Gupta, Nirmala (Eds) (1999). Guidance and counseling:A practical approach(Vol.II). New Delhi: Vikas.
- Dave, Indu (1984). The basic essentials of counseling. New Delhi: Sterling Pvt. Ltd.
- Gazda George R.M.(1989). Group counseling: A development approach. London: Allyn and Bacon. Gibson, R.L. & Mitchell, M.H. (1986). Introduction to guidance. New York: McMillan.
- Nugent, Frank A. (1990). An Introduction to the profession of counseling. Columbus: Merrill publishing Co.
- Pietrofesa, J.J., Bernstein, B.,and Stanford,S.(1980). Guidance: An introduction. Chicago: Rand McNally.
- Rao, S.N. (1981). Counseling psychology. New Delhi: Tata McGraw Hill.
- Saraswat, R.K. & Gaur, J.S.(1994). Manual for guidance counselors. New Delhi:

NCERT.

Core Paper XI
DEVELOPMENT OF EDUCATION IN ODISHA

Learning Objectives

On completion of the course the students will:

- Grasp the structure of educational system of Odisha
- State the function of institutions/units at the state and district levels
- Appreciate the contribution of Utkalmani Gopabandhu Das to the thoughts and
- Practices of Indian Education narrate the Learning Objectives and implementation process of the major education
- Schemes of central as well as state government being implemented in the state of Odisha
- Explain the role of various state and district level institutions in education
- Analyze the scenario of higher and technical education of Odisha
- Establish linkage between higher education and development of the state

UNIT 1: Status of Elementary Education

(i) History of primary education in Odisha
(ii) Efforts to Universalize Elementary Education: DPEP, SSA and Right to Education Act, 2009
(iii) Indicator wise position in terms of provision, enrolment, retention and achievement for elementary level programmes: NPEGEL and KGBV
(iv) Problem and issues in elementary education

UNIT 2: Status of Secondary and Higher Secondary Education

(i) History of secondary education in Odisha
(ii) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and its implementation in Odisha.
(iii) Role of BSE, Odisha- Problems and issues
(iv) Status of Higher Secondary Education and Role of CHSE; Problems and Issues
(v) Status of Higher Secondary Vocational Education-Problems and Issues

UNIT 3: Status of Higher Education

(i) History of Collegiate Education
(ii) Organization of higher education at the under graduation level and University level-Present status
(iii) RUSA and its implementation
(iv) Autonomous colleges and their functioning
(v) Problems and issues relating to higher education

UNIT 4: Status of Teacher Education

(i) History of Teacher Education in Odisha
(ii) Pre-service and In-service teacher education for elementary schools teachers
(iii) Pre-service and In-service teacher education for secondary school teachers
(iv) Role of DIET, CTE, IASE and SCERT
(v) Problems and issues in teacher education

Practical: 25 Marks

- Seminar Presentation (Each student has to present minimum two papers during this semester related to themes based on Core-11)

NB: It will be evaluated by both the Internal and External Examiners.

Text & Reference Books

- Govt. of Odisha, Department of S & ME (2011). *School Education at a Glance-2011-12*, Bhubaneswar
- Samal, J.K.(1984). History of Education in Odisha: 1905-1936, Sankar Bhattacharya, Punthi Pustak, 136/4B, Bidhan Sarani, Calcutta -700004 ;p-171
- Samal, J.K.(1989). History of Modern Orissa, Firma KLM private limited, 257B,B.B.Ganguly Street, Calcutta;p-188

Websites to be visited:

- *www.shodhganga.inflibnet.ac.in/bitstream/10603/.../08_chapter%202.pdf*: Education in Odisha- *1850-1900: Retrieved on dt.25.07.2012*
- *www.en.wikipedia.org/wiki/Odisha: Odisha - Wikipedia, the free encyclopedia/Retrieved on dt.25.07.2012*
- *www.newkerala.com/states-of-india/Odisha.php:* Odisha: Info on geography, history, government, districts, business ..: *Retrieved on dt.25.07.2012*
- *www.Odisha.gov.in/e-magazine/Odishareview/2011/Jan/engpdf/57-61.pdf:*
- Gopabandhu Das:The National Education Planner of Odisha*: Retrieved ondt.25.07.2012*
- www.dheOdisha.in/ *Higher Education Department - Online Admission - e-Admission for ...*: Retrieved on dt.25.07.2012
- www.Odisha.gov.in/highereducation/index.htm: *Higher Education Department.... - Government of Odisha*: Retrieved on dt.25.07.2012
- www.Odisha2020.org/home/Odisha-higher-education-task-force:*Odisha Higher Education Vision 2020*: Retrieved on dt.25.07.2012
- http://www.scertodisha.nic.in/
- http://www.chseodisha.nic.in/
- http://bseodisha.nic.in/
- http://mhrd.gov.in/rusa
- http://mhrd.gov.in/rmsa

Core Paper XII

INFORMATION AND COMMUNICATION TECHNOLOGY IN EDUCATION

Learning Objectives

On completion of this course, the student will:

- Explain the concept, nature and scope of ICT in education
- Explore ICT resources for Teaching and learning.
- Differentiate between Web1.0 and Web2.0
- Describe the importance of free and open source software in education
- Demonstrate the use of various application software in education.
- Develop the ability to use various tools connect the world
- Explain the content by using various subject tools.
- Explore tools and techniques of ICT for evaluation.

UNIT 1: Educational technology

(i) Meaning , nature and scope
(ii) Approaches to educational Technology: Hardware, Software and System Approach
(iii) Innovations in Educational Technology: Open Educational Resources (OER), Massive Open Online Course (MOOC) Learning Management System (LMS)
(iv) Importance of Educational Technology for the teacher and the student.

UNIT 2: ICT in Education

(i) Conceptual Understanding: Information Technology; Communication Technology; and Information and Communication Technology (ICT)
(ii) Relevance of ICT in Education
(iii) Nature and Scope of ICT in Education.
(iv) Content, Pedagogy and Technology Integration
(v) Challenges in Integrating ICT in Education
(vi) Use of Computers in Education- Computer Aided Learning

UNIT 3: Application of software and ICT assessment Tools in Education

(i) Word Processing Application
(ii) Spread sheet Application
(iii) Presentation Application
(iv) Free and Open Source Software (FOSS)
(v) Subject Tools: Digital Storytelling, Concept Map Software (C-Map)
(vi) Assessment Tools: Rubistar, Hot potatoes, E- portfolios

UNIT 4: Connecting with the World

(i) Use of browsers and search engines; choosing appropriate sites; search and retrieval of information and resources; Downloading, uploading and sharing information and resources;
(ii) Use and importance of Web 2.0 Tools: E-mail, Wikis, Social networking (WhatsApp, Twitter, Facebook and Blogging)
(iii) Use and importance of e-library, e-books, e-journals, Inflibnet.

PRACTICAL

- Development of an Objective Test using any assessment tool or development of a Rubric using Rubistar.

NB: It will be evaluated by both Internal and External examiners.

Text Books

- UNESCO (2002). *Information and communication technology in education: A curriculum for schools and programme of teacher development.* Paris: UNESCO.
- Kanvaria, V.K. (2014). *A Comprehension on Educational Technology and ICT for Education*. New Delhi: GBO.
- Vanaja and Rajasekar, S. (2016). *Information & Communication Technology (ICT) In Education*. New Delhi: Neelkamal

Reference books

- Senapaty, H.K. (2011). *Pedagogy-Technology Integration for the ProfessionalDevelopment of Teacher Educators.* Bhubaneswar: Regional Institute ofEducation, NCERT (Monograph).
- NCERT (2006). National Curriculum Framework 2005 Position Paper NationalFocus Group on Educational Technology. New Delhi: Author.
- Senapaty, H.K. (2009). *ICT Integrated Learning Materials on Basic School Subjectsfrom Constructivist Perspectives*. Bhubaneswar: Regional Institute ofEducation, NCERT (Monograph).
- Singh, L. C. (Ed.) (2010). *Educational Technology for Teachers and Educators.* NewDelhi: Vasunandi Publication.
  UNESCO(2008).*ICTCompetencyStandardsforTeachers:PolicyFramework.*Retrievedf rom http://portal.unesco.
  UNESCO (2002). Information and Communication Technologies in Teacher Education A Planning Guide. Paris: Author
  UNESCO (2005). How ICT can create new, open learning environments: Information and communication technologies in schools: A handbook for teachers. Paris: UNESCO.Mishra, S. (2008). Developing E-Learning Materials: Some Pedagogical Concerns. *Indian Journal of Open Learning*, 17 (2).

Core Paper XIII

CONTEMPORARY TRENDS AND ISSUES IN INDIAN EDUCATION

Learning Objectives

On completion of this course the students will:

- Understand the importance of pre-school and elementary school education. Analyze various problems and issues for ensuring quality education.
- State the importance of secondary education and analyze various problems and issues forensuring quality in secondary education.
- Enumerate the importance of higher education and analyze various problems and issues forensuring quality in higher education.
- Justify the importance of teacher education and analyze various problems and issues forensuring quality in teacher education.
- Analyze emerging concerns in Indian education.

UNIT 1: Pre-school and Elementary School Education

(i) Meaning, nature and importance of ECCE, problems and issues with regard to ECCE
(ii) Universalisation of Elementary Education: efforts to achieve UEE, SSA
(iii) Problems and issues in implementing Right to Education Act 2009.
(iv) Problems and issues in bringing the community to school, role of SMC
(v) Problems in ensuring equity and quality of elementary education

UNIT 2: Secondary and Higher Secondary Education

(i) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and ensuring secondary education for all.
(ii) Role of School Management and Development Committee (SMDC)
(iii) Shifting the teaching learning process from teacher centered to learner centered and activity based classroom –problems and issues
(iv) Problems and issues with regard to vocationalisation of secondary and higher secondary education
(v) Examination reforms at the secondary level
(vi) Widening the access to secondary education through National Open School

UNIT 3: Higher Education and Teacher Education

(i) Challenges in Higher education- expansion, quality and inclusion
(ii) Role of RUSA and NAAC for quality assurance in Higher education
(iii) Higher education through open and distance learning mode
(iv) Elementary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009
(v) Secondary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009

UNIT 4: Emerging Concerns

(i) Examination system: defects and reforms for making examination system flexible (internal assessment and semester system , grading, open book examination, online examination)

(ii) Choice Based Credits System (CBCS): Concept, Learning Objectives, importance, problems and issues.
(iii) Human Rights Education: Concept, Learning Objectives, importance, problems and issues.
(iv) Life-Skill Education: Concept, Learning Objectives, importance, problems and issues.
(v) Peace Education: Concept, Learning Objectives, importance, problems and issues.

PRACTICAL

- Study of perception of Stakeholder's of Education on any of the current issues based on Pass DSE-1 and concerns, and reporting.

NB: It will be evaluated both by the Internal and External Examiners.

Text Books

- Kumar, Chanchal & Sachedeva, M.S. (2017). *Vision of Secondary Education In India in the context of 21st century*. Twentyfirst Century Publications; First Edition edition (2015)
- Pathak, K. R. (2007). *Education in the Emerging* India. New Delhi: Atlantic Publishers**.**
- Saxena, V. (2011). *Contemporary trends in education: A handbook for educators*. New
- Delhi: Pearson.

Reference Books

- Broudy, H.S. (1977) *Types of knowledge and purposes of education*. In R.C. Anderson, R.J., Spiro and W.E. Montanaque (Eds.) Schooling and the acquisition of knowledge (PP. Hillsdale, NJ: Erlbaum.
- Bruner, J.S. (1996). *The culture of education*. Cambridge, M.A.: Harvard University Press.
- Butchvarov, P. (1970). *The concept of knowledge*. Evanston, Illinois, North Western University Press.
- Dearden R. F. (1984). *Theory and practice in Education*. Routledge K Kegan & Paul.
- Delors, Jacques, et al; (1996). *Learning: the Treasure within report of the international commission on education for 21st century*, UNESCO.
- Illich, I. (1996). *Deschooling society*. Marion Boyers, London.
- Matheson, David (2004). *An Introduction to the study of education* (2 Ed.). David Fulton Publish.
- MHRD (2008). *Framework for implementation of Rashtriya Madhyamik Shiksha Abhiyan: A scheme for universalisation of access to and improvement of quality at the secondary stage.* New Delhi: Department of School Education and Literacy.
- MHRD (2011). *Sarva Shiksha Abhiyan: Framework for implementation based on the Right of Children to Free and Compulsory Education Act, 2009*. New Delhi: Department of School Education and Literacy.
- MHRD, (1992). *Programme of action*. Govt. of India, New Delhi.
- MHRD, Gov. of India (1992). *National policy on education* (revised) New Delhi: MHRD.

- Ministry of Law and Justice (2009). *Right to education Act 2009*. New Delhi: Govt of India.
- Naik, J.P. (1975). *Equality, quality and quantity: The elusive triangle of Indian education.* Allied Publications, Bombay.
- NCERT (2005). *National curriculum framework 2005*. New Delhi: NCERT.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- Slatterry, P. and Dana R. (2002). *Ethics and the foundations of education-Teaching Convictions in a postmodern world*. Allyn & Bacon.
- UN (2015). *The sustainable development goals (SDGs) – UNDP*. United Nations
- UNESCO (1998). *Educating for a sustainable future: A transdisciplinary vision for concerted action*. Paris: UNESCO.
- UNICEF (2000). *Defining quality in education*. New York: Programme Division (Education), Unicef.
- Wall, Edmund (2001). *Educational theory: philosophical and political Perspectives*. Prometheus Books.
- WHO (1991). *Comprehensive school health programme*. New Delhi: World Health Organization Regional Office.
- Winch, C. (1996). *Key concepts in the philosophy of education*. Routledge.
- Yadav, M. S. & Lakshmi, T. K. S. (1995). Education: Its disciplinary identity. *Journal of Indian Education,* XXI (*1*), 01-21.

Core Paper XIV

EDUCATIONAL MANAGEMENT AND LEADERSHIP

Learning Objectives

On completion of this course, the students will

- Describe the concept, types and importance of educational management.
- Spell out the structure of educational management at different levels - from national to institution leve
- Describe different aspects and importance of educational management.
- Describe the concept, theories and style of leadership in educational management.
- Analyze the concept, principles and structures of total quality management approach in education.

UNIT 1: Educational Management

(i) Concept of educational Management- meaning, nature, scope and principles
(ii) Process of educational Management- planning, execution, staffing, control, supervision, monitoring, evaluation and feedback
(iii) Types of Management:
(iv) Centralized and decentralized
(v) Authoritarian, democratic, dynamic/creative and laissez-faire
(vi) Educational Management in Odisha- structure and function with reference to school and mass education, and Higher education

UNIT 2: Aspects of Institutional Management

(i) Human, material and financial resource management
(ii) Management of curricular and co curricular programmes
(iii) Management of students' welfare, auxiliary services including students' health services
(iv) School development plan
(v) Working with SMC and SMDC

UNIT 3: Leadership in Education

(i) Leadership- meaning, nature and importance in education
(ii) Leadership : Functions and skills
(iii) Theories of leadership- Redden's 3-D theory, and Hersey and Blanchard's situational theory
(iv) Styles of leadership-participating style, delegating style, selling style and telling style, Herseyand Blanchard)

UNIT 4: Total Quality Management

(i) Total Quality Management(TQM)- meaning, nature and importance
(ii) Principles of TQM- Demming's and Jurana's
(iii) Planning for TQM in school and higher education
(iv) Quality Assurance in Higher Education

PRACTICAL

- Studying the role of SMC/SMDC in school management and reporting

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Kochar, S.K (2011). *School Administration and Management*. New Delhi: Sterling Publishers Private Limited.
- Bhatnagar, R. P. & Aggrawal V (2015). Educational Administration, Supervision, Planning and financing. Meerut: R Lal Book Depot.
- Mukhopadhyay, M. (2005). i. New Delhi: Sage

Reference Books

- Adolph and Turner Harold, E. *Supervision for change & Innovation*. Houghton Miffin Company.
- Anderson, C.A & Bowman, M.J (1971).*Educational management*, London, U.K: Frankas
- Ashima V, Deshmukh & Naik A.P (2010). *Educational management*. Girgaon, Mumbai: Himalaya Publishing House.
- Bhatnagar, R.P & Verma, I.B (1978). *Educational administration*. Meerut, India: Loyal Book Depot.
- Chau, Ta-Ngoc (2003): *Demographic aspects of educational planning.* Paris: International Institute for Educational Planning.
- Hariss, B. M (1963).*Supervisory behaviour in education*.USA: Englewood Cliffs.

- Kimbrough, S.Ralph, Michall & Nunnery. *Educational administration*. New York: Mc Millan Company.
- Livack, et al (1998).*Rethinking Decentralization in developing countries*. Washington, D.C, USA: World Bank.
- Mukerji, S.N. *Administration of educational planning and financ*e. Baroda, India: Acharya Book Depot.
- Naik, J.P. (1965): *Educational planning in India*. New Delhi, India: Allied.
- Naik, J.P. (1982): *The educational commission & after*. New Delhi, India: Allied.
- Newman and summer. *The process of management: concept, behaviour and practice*. New Delhi, India: Prentice Hall of India Pvt. Ltd.
- Oliva, O (19760. *Supervision for today's school*. New York, USA: Harper & Row.
- Ramani, K.V (2004). *A text book of educational management*. New Delhi, India: Dominant Publisher
- Safya, R & Saida, B.D *(1964). School administration and organisation.* Jalandhar, India: Dhanpat Rai & Sons
- Shukia, P.O (1983). *Administration in India*. New Delhi, India: Vikas Publication.
- Simon, Herbart A. *Administrative behaviour*. New York,USA :McMillan Company.
- Tilak, J.B.G. (1992). *Educational planning at grassroots*. New Delhi: India.
- Waber, Clarence A. *Fundamentals of educational leadership*. New York ,USA: Exposition Press.Buch, T. et al. (1980). Approaches to school management. London: Harper and Row.
- Chalam K.S. (2003): Introduction to Educational Planning and Management: New Delhi, Anmol Publications Pvt. Ltd.
- Chandrasekharan P. (1997): Educational Planning and Management. New Delhi: Sterling Publishers Pvt. Ltd.
- Deshmukh, A.V. & Naik, A.P.(2010). School administration and management. Mumbai.
- Glasser, William(1990). The quality school. New York, NY: Harper Collins Publishers, Inc.
- Government of India (1986/92). National policy on education. New Delhi: MHRD.
- Government of India (1992). Programme of action. New Delhi: MHRD.
- Gupta, S.K. & Gupta, S.91991). Educational administration and management. Indore: Manorama Prakashan.
- Hallak, J.(1990).Investing in the future:Setting educational priorities in the developing world. Paris: UNESCO.
- Kalra, Alka (1977). Efficient school management and role of principals. New Delhi: APH Publishing Corporation.
- Kochar, S.K. (2011). School administration and management. New Delhi: Sterling Mukhopadhyay, M. (2001). Total quality management in education. New Delhi: NIEPA.
- Shaeffer, S. (1991). Collaborating for educational change: The role of parents and the community in school improvement. Paris: UNESCO.
- Tyagi R.S. and Mahapatra P.C. (2000), Educational Administration in Orissa : New Delhi, National Institute of Educational Planning and Administration (NIEPA)
- Vashist, Savita(ed.) (1998). Encyclopaedia of school education and management. New Delhi: Kamal Publishing House.

Discipline Specific Elective Paper-I

(A student has to choose any one from Pedagogy of English and Odia under DSE-1)

A.PEDAGOGY OF LANGUAGE (ENGLISH)

Learning Objectives

On completion of this course, the student will

- Analyze the issues relating to place of English in school curriculum, acquisition of skills in English, realization of aims and Learning Objectives of learning English and language policy as conceived in NPE, 1986 and NCF – 2005
- Use various methods, approaches and strategies for teaching-learning English and transact various types of lesson plans covering all aspects of English language following different approaches
- Develop test items to assess learning in English and provide feedback as well as prepare enrichment materials
- Use the understanding of phonetics for facilitating students' speaking in English
- Plan appropriate pedagogical treatment of the prescribed contents for effective classroom transaction

UNIT 1: English in School Curriculum

(i) Language policy in India with reference to NPE 1986 and NCF 2005
(ii) Place of English as a compulsory subject in school curriculum (both at elementary and secondary levels)
(iii) Learning Objectives of learning English at elementary and secondary levels
(iv) English language skills –components, their independence and interdependence

UNIT 2: Approaches, Methods and Strategies of Teaching English

(i) Understanding of different methods and strategies: Bi-lingual Method, Translation Method, Direct Method, Structural Approach, Communicative Approach.
(ii) Listening Skill: Tasks for developing Listening Comprehension
(iii) Speaking Skill: Tasks for developing Speaking skills
(iv) Reading skill: Types of Reading, Strategies to develop reading comprehension
(v) Writing Skill: Strategies to improve writing skill, Qualities of good writing (simplicity, logicality and organization in writing)

UNIT 3: Transaction of Contents

(i) Teaching of Prose (detailed and non-detailed), poetry, grammar and composition – Approaches, Methods and Strategies
(ii) Pedagogic analysis :Content analysis- analysis of topics of English text book for identification of language items(new vocabulary, structural words, grammar components),learning Learning Objectives, methods and strategies, teaching learning materials including ICT materials
(iii) Preparing Lesson Plan following 5E and Interpretation Construction Design Model(ICON)
(iv) Preparation of Lesson Plans following Herbartian approach.

UNIT 4: Lesson Delivery Strategies and Assessment

(i) Lesson Delivery Strategies: Lecturing, Role play and Dramatization, Collaborative Approach, Ability Grouping, Group Work; Learning through Narratives and Discourses; Concept Mapping and Brain Storming

(ii) Techniques of Assessment in English : Continuous Assessment of Learners performance in English, preparation of different types of objective-based test items (Extended Response Type, Restrictive

PRACTICAL

- School Internship (Delivery of 5 Lessons following Herbatian/5E/ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Kohli, A.L (2010) *Techniques of teaching english.* New Delhi: Dhanpat Rai publishing Company
  Jain, R.K (1994). *Essentials of English teaching*, Agra: Vinod Pustak Mandir
- Sharma, K.L(1970) .*Methods of teaching English in India*. Agra : Laxmi Narayan Agrawal

Reference Books

- Agnihotri R. K. and Khanna A. L. (1994). *Second language acquisition: socio-cultural and linguistic aspects of English in India.* New Delhi: Sage Publications.
- Allen, H.B. (1965). *Teaching English as a second language: A book of readings*. New York: McGraw-Hill.
- Baruah, T.C (1984). *The English teacher's handbook.* New Delhi: Sterling Publishers Pvt.Ltd,
- Billows, F. L. (1975). *The techniques of language teaching.* London: Longman
- Bista, A.R(1965). *Teaching of English (Sixth Edition)*. Agra: Vinod Pustak Mandir
- Bright, J.A(1976). *Teaching English as second language.* London: Long Man Group
- Catarby, E. V (1986) *Teaching English as a foreign language in school curriculum India*, New Delhi: NCERT
- Hudelson, Sarah. (1995). *English as a second language teacher resource handbook. A practical guide for K-12 ESL programs.* California.: Corwin Press, Inc.
- Joyce , Bruce and Weil, Marsha (2003). *Models of teaching*. New Delhi: Prentice Hall of India Pvt. Ltd.
- Krishna Swamy, N. and Sri Raman, T. (1994). English teaching in India. Madras : T.R. Publication.
- Mukalel, Joseph C. (2009). *Approaches to English language teaching.* New Delhi: Discovery Publishing House Pvt Ltd.
- Pal, H.R and Pal, R(2006). *Curriculum – yesterday, today and tomorrow*, New Delhi: Shipra Publications
- Sachdeva, M.S. (1973). A new approach to teaching of english in India. Ludhiana : Prakash Brothers
- Shrivastava, B.D(1968). *Structural approach to the teaching of English*. Agra: Ramprasad and Sons

Discipline Specific Elective Paper-I

(A student has to choose ANY ONE from Pedagogy of English and Odia under DSE-1)

B. PEDAGOGY OF LANGUAGE (ODIA)

Learning Objectives

On completion of this course, the student will:

- State the importance and place of Odia as mother tongue in school curriculum.
- Develop the strategies to address the problems of Odia language acquisition in multilingual context.
- Use various strategies for facilitating the acquisition of language skills in Odia.
- Decide appropriate pedagogic approaches to transact different types of lessons in Odia.
- Prepare appropriate tools for comprehensive assessment of learning in Odia.
- Explain the fundamentals of Odia linguistics and their relevance in teaching learning Odia.
- Plan appropriate pedagogic treatment of the prescribed textual contents (in Odia) of classes IX and X.

UNIT 1: Odia as Mother Tongue in School Curriculum

(i) Importance of mother tongue in the life and education of an individual
(ii) Place of Odia as mother tongue in school curriculum in Odisha (both at elementary and secondary levels) in the context of language policy recommended by NPE, 1986 (three language formula) and NCF-2005
(iii) Learning Objectives of teaching-learning Odia at elementary and secondary levels
(iv) Inter-dependence of language skills in Odia and Strategies for facilitating acquisition of four-fold language skills in Odia

UNIT 2: Pedagogic Approaches to Teaching-Learning Odia

(i) Psychology of language learning and acquisition with reference to Odia as mother tongue.
(ii) Problems and issues related to acquisition of Odia language in multi-lingual context
(iii) Traditional versus modern methods of teaching-learning Odia.
(iv) Different approaches and strategies to the teaching-learning of : − Odia prose (detailed and non- detailed) , Odia poetry , Odia composition , Odia grammar .

UNIT 3: Curricular Activities in Odia

(i) Pedagogic analysis :
(ii) Content analysis- analysis of topics of Odia text book for identification of language items(new vocabulary, structural words, grammar components), learning Learning Objectives,
(iii) methods and strategies, teaching learning materials lncluding ICT materials, assessment strategies
(iv) Preparing Lesson Plans following Herbartian, 5E and Interpretation Construction Design Model(ICON)

UNIT 4: Assessment

(i) Types of Assessment-self assessment, peer assessment, teacher assessment, internal

assessment and external assessment

(ii) Techniques of Assessment in Odia : Continuous Assessment of Learners performance in Odia, preparation of different types of objective-based test items (Extended Response Type, Restrictive Response Type and Objective Type), preparation of check list, rating scale and rubric, Portfolio assessment in Odia

PRACTICAL

- School internship (delivery of 5 Lessons following Herbartian/5E/ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Barik, N. (2014). Odia shikshyadana paddhati. Cuttack: A.K.Mishra Publishers Pvt. Ltd.
- Kocchar, S.K. (2012). Teaching of Mother Tongue. Sterling Publishers, New Delhi.
- Mohanty, J., Barik, N. & Khandai, U. (1983). Odia sikshadana paddhati. Cuttack : Nalanda.
- Nayak, B.; Mohanty, J.(1999): Odia bhasa O Sahityara Bhitibhumi O Shikshyadan Padhati. Cuttack: Jagannath Process, Toni Road, Cutack-2.

Reference Books

- Daswani, C. J. Language Education in Multilingual India. New/Delhi (UNESCO)
- Dhal, G.B. (1974). Dhwani bijanana. Bhubaneswar : Odisha Rajya Pathya Pustaka Pranayana Sanstha.
- Dhal, G.B. (1972). English uchharana siksha. Cuttack : Friends Publisher.
- Mathur, S.A. Sociological Approach to Indian Education. Vinod Pustak Bhandar, Agra.
- Mohanty, B. (1970). Odia bhasara utpati O 65arma bikasha. Cuttack : Friends Publishers.
- Mohapatra, D. (1976). Odia Dhwani tattwa O sabdha sambhar. Cuttack : Grantha Mandir.
- Mohapatra, N. & Das, S. (1943). Sarbasara vykarana. Cuttack : New Student's Store
- Palmer, H.P. Principles of Language Teaching. George G. Harrep and Co. Ltd.
- Rybum, W.M.(1926). Suggestions for the Teaching of Mother Tongue. OUP.
- Saiyadain, K.G. Education and Social Order. Asia Publishing House, Bombay.

Discipline Specific Elective Paper-II

(A student has to choose ANY ONE from Pedagogy of Social Science and Mathematics under DSE-2)

A. PEDAGOGY OF SOCIAL SCIENCES

Learning Objectives

On completion of this course, the student will:

- State the meaning, scope and importance of Social science
- Specify the skills and competencies to formulate specific LEARNING OBJECTIVES for different History and Political Science lessons
- Identify the different methods and skills of teaching History and Political Science for transacting the contents effectively.
- Explain the importance of time sense and prepare / utilize timelines for effecting teaching of History
- Prepare Unit Plans and Lesson Plans in History and Political science
- Develop diagnostic achievement test, administer them and analyse the results for providing feedback

UNIT 1: Concept, Learning Objectives and Values Of Teaching Social Science

(i) Meaning, Nature and Scope of Social Science as NCF-2005
(ii) Learning Objectives of teaching Social Science at elementary and secondary levels
(iii) Importance of teaching Social Science In School Education
(iv) Identification of values/ competencies/ skills to be developed through Social Sciences

UNIT 2: Methods and Approaches to Teaching-Learning Social Science

(i) Story-telling
(ii) Narration-cum-discussion
(iii) Dramatization
(iv) Source Method
(v) Project method
(vi) Field Trips
(vii) Observation

UNIT 3: Curricular Activities in Social Sciences

Pedagogic analysis:

(i) Content analysis- analysis of topics of social science text book .
(ii) Learning Objectives,
(iii) methods and strategies,
(iv) teaching learning materials including ICT materials
(v) learning activities including student and teacher activities
(vi) assessment strategies
(vii) Preparing lesson plan following Herbart, 5E and Interpretation Construction Design Model(ICON)

UNIT 4: Development of Resource Materials and Assessment in Social Science

(i) Teaching-learning materials – Maps, Atlas, Globes, Charts, Graphs, Models, Filmstrips, T.V. Video, OHP, and Computer
(ii) Timeline – Concept, Aspects, Type and Use

(iii) Types of Assessment-self assessment, peer assessment, teacher assessment, internal assessment and external assessment
(iv) Techniques of Assessment in history and political science: Continuous Assessment of Learners performance in history and political science, preparation of different types of objective-based test-
(v) Items (Extended Response Type, Restrictive Response Type and Objective Type

PRACTICAL

- School internship (delivery of 5 Lessons following Herbatian /5E/ ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Kochhar, S.K. (1970). *Methods of Teaching Social Studies.* New Delhi, India: Sterling Publication.
- Mamgal, S.K. & Mangal, U. (2008). *Teaching of Social Studies*. New Delhi: PHI Learning Pvt, Ltd.
- Sharma, R.A. (2014). *Teaching of Sociaal Sceince*. Meerut: R Lal Book Depot.

Reference Books

- Kochhar, S.K. (1970). *Teaching of History*. New Delhi, India: Sterling Publishers Pvt. Ltd.
- Banks James, A. (1997). *Teaching Strategies for the Social Studies Enquiry, Valuing and Decision Making* . Massachusets,USA: Addition- Westely Publishing Co. Reading.
- Bining & Binning.(1952). *Teaching of Social Studies in Secondary Schools*. New York,USA: Mc Graw Hills.
- Burston,W.H.(1963). *Principles of History Teaching.* New Fetter Lance : Methuen & Co. Ltd.II.
- Burton W.H. (1972). Principles of history teaching, London: Methuen.
- Carretero, Mario, & Voss, James F. (Eds.) (1994). Cognitive and instructional processes in history and the social sciences. Hillsdale: Lawrence Erlbaum Associate.
- Choudhury, K.P. (1975).*The effective Teaching of History*. New Delhi,India: NCERT.
- Dhamiaja Neelam.(1993). *Multimedia Approaches in Teaching Social Studies*. New Delhi,India:Harmer Publishing House.
- Drake, Frederick D. & Lynn, R. Nelson (2005). Engagement in teaching history: Theory and practices for middle and secondary teachers. Columbus, OH: Pearson.
- Ghate, V.D. (1956). Teaching of history. Bombay: Oxford University Press. Gunnin, Dennis (1978). The teaching of history. Goom Helm Ltd. London.
- James H. (1953). *The Teaching of Social Studies in Secondary Schools*. . London,UK: Longman Green & Co.
- James, T. H., Arthur,J. and Hunt, M. (2001). Learning to teach history in the secondary school: A companion to school experience. London: Routledge Falme.
- Kochhar, S.K.(1970). *Teaching of political science*. New Delhi: Sterling Publishers
- NCERT. (1970). *Teaching of History of Secondary Schools*.New Delhi,India: Author.

- NCERT.(1966). *A Handbook for History Teachers*.Bombay:India: Allied Publishers.
- Taneja,V.R.(1970). *Fundamentals of Teaching Social Studies*. Mahendra Capital Publishers.
- Verma, O.P.(1984). New Delhi, India: Sterling Publishers Pvt. Ltd.
- Verma,O.P. & Vedanayagam E.G. *Geography Teaching.* New Delhi,India: Sterling Publishers Pvt. Ltd .
- Yagnik, K.S.(1966). *The Teaching of Social Studies in India*. Bombay,India: Orient Longman Ltd.

Discipline Specific Elective Paper-II

(A student has to choose ANY ONE from Pedagogy of Social Science and Mathematics under DSE-II)

B. PEDAGOGY OF MATHEMATICS

Learning Objectives

On completion of this course, the students will

- Narrate the evolution and nature of Mathematics and its importance in the school curriculum in the context of the recent curricular reforms.
- Use various methods and approaches of teaching and learning mathematics especially suitable for the secondary school classes.
- Plan lessons in Mathematics using traditional and constructivist approaches for effective classroom transactions.
- Develop and collect activities and resource materials for their use in enhancing the quality of learning Mathematics at the secondary level.
- Conduct continuous and comprehensive assessment for enhancing the quality of Mathematics learning.
- Explain the concepts in Mathematics included in the secondary school curriculum and make pedagogical analysis of those concepts

UNIT 1: Foundations of Mathematics Education

(i) Nature and Scope of Mathematics,
(ii) Learning of Mathematics: Importance of Mathematics at elementary and secondary level, Learning Objectives of teaching-learning Mathematics at the two levels,
(iii) Curriculum Reforms in School Mathematics: Rationale, Learning Objectives, principles, designs and materials in Mathematics, recent curricular reforms at the National and State levels (NCF 2005).

UNIT 2: Methods of Teaching-learning Mathematics

(i) Learning by Discovery: Nature and purpose of learning by discovery; guided discovery strategies in teaching Mathematical concepts.
(ii) Teaching for Understanding Proof: Proof by induction and deduction; proof by analysis and synthesis.
(iii) Problem Solving in Mathematics: Importance of problem solving in Mathematics,

Steps of problem solving in Mathematics.

(iv) Constructivist approaches: Self-learning and peer learning strategies, Collaborative strategies; 5E and ICON Models.

UNIT 3: Curricular Activities in Mathematics

(i) Pedagogic analysis :
(ii) Content analysis- analysis of topics of mathematics text book .
(iii) Learning Objectives,
(iv) methods and strategies,
(v) teaching learning materials including ICT materials
(vi) learning activities including student and teacher activities
(vii) assessment strategies
(viii) Process of preparing lesson plan following Herbatian, 5E and Interpretation Construction Design Model(ICON)

UNIT 4: Assessment In Mathematics

(i) Assessment of Mathematics learning: Unit test – Designing blue print, item construction, marking schemes.
(ii) Assessment for Mathematics Learning: Assignments, Projects and portfolios in Mathematics, group and collaborative assessment in Mathematics,
(iii) Non-testing methods of assessment of/for Mathematics Learning: Observation of learners in action, rating of participation in various Mathematics tasks and activities,
(iv) Diagnosis of difficulties in learning Mathematics concepts, Remediation of the difficulties, enrichment programmes in Mathematics learning –National Mathematics Talent Search, Mathematics Olympiad.
(v) Planning for continuous assessment of classroom learning in Mathematics.

PRACTICAL

- School internship (Delivery of 5 Lessons following Herbatian/5E/ICON model)

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Sidhu, K.S (1985).*Teaching of mathematics*. New Delhi: Sterling publication.
- James, A. (2003). *Teaching of mathematics*. Neel Kamal Publication: Hyderabad.
NCERT (2011). *Pedagogy of mathematics for two year B.Ed. course*. New Delhi:

Reference Books

- Cooney, Thomas J. et al. (1975). Dynamics of Teaching Secondary School Mathematics. Boston: Houghton Mifflin.
- Cooper, B. (1985). *Renegotiating secondary school mathematics*. The Hamer Press: East Sussex.
- Michel. (1982). *Teaching mathematics*. Nicholos Publication Co: New York.
- NCF (2005). *National curriculum framework*. NCERT: New Delhi
- NCERT (2006). *Position paper: National focus group (NFG) on teaching Mathematics*. NCERT: New Delhi.

- NCERT (2005). *Position paper: national focus group (NFG) on examination reform*. NCERT: New Delhi.
  Scopes, P.G. (1973). *Mathematics in secondary schools- a teaching approach*. Cambridge: Cambridge University Press
- Driscoll,M., Egan, M., Nikula, J., & DiMatteo, R. W. (2007). Fostering geometric thinking: A guide for teachers, grades 6-10. Portsmouth, NH: Heinemann.
- Driscoll,M.(1999). Fostering algebraic thinking: A guide for teachers, grades 5-10. Portsmouth, NH: Heinemann.
- Grouws, D.A. (ed) (1992). Handbook of research on mathematics teaching and learning. New York: Macmillan Publishing.
- Malone, J. and Taylor, P. (eds) (1993). Constructivist interpretations of teaching and learning mathematics.
- Perth: Curtin University of Technology.
- Marshall, S.P. (1995). Schemes in problem-solving. New York: Cambridge University Press.
- Moon, B. & Mayes, A.S. (eds.) (1995). Teaching and learning in secondary school. London: Routledge.
- NCERT (1998). A textbook of content-cum-methodology of teaching mathematics. New Delhi: NCERT.
- NCERT (2005). National curriculum framework 2005. New Delhi:NCERT.
- NCERT (2006). Position paper: National focus group on teaching mathematics. New Delhi:NCERT.
- TESS India (2015). Key resources. The Open University U.K.(http//creativecommons.org/licences/ and http//www.tess-india.edu.in/)

Discipline Specific Elective Paper-III

(A student has to choose any one from A & B under DSE-III)

A. POLICY AND PRACTICES IN SCHOOL EDUCATION IN INDIA

Learning Objectives

On completion of this course, the student will:

- Analyse various policies on education for school education in India
- Evaluate progress of schools education
- Examine the problems in implementation of the policies on school education
- Explore status of women education and education for SC, ST and Minorities in Indian

UNIT 1: Policies in School Education

(i) National education policy, 1986, revised in 1992 and its corresponding document Programme of Action with reference to Elementary Education and Secondary Education.

(ii) Implementation of Elementary Education with reference to RTE Act-2009 and Policy issues.

(iii) Implementation of Secondary Education with reference to Rashtriya Madhyamik Siksha Abhiyan (RMSA) and policy issues
(iv) Guiding principles of NCF-2005 and curriculum revision at the school level.

UNIT 2: Policies for Vocationalisation of Education

(i) Vocationalisation of education- A policy analysis with reference to the report of Patel Committee (1977), Adisheshia Committee (1978) and National Policy on Education (1986) revised NPE (1992)
(ii) Vocational Education at Higher Secondary level: Policy challenges
(iii) Work education in schools –concept to implementation

UNIT 3: Policies for Inclusive Education

(i) Education of Children with Special Needs (CWSN): Policy perspectives with reference to NPE,1986, 1992, Mental Health Act, 1987, Persons with Disabilities Act, 1995, Rehabilitation Council of India Act, 1992, National Trust Act,1999
(ii) Inclusive education- Policies, Progress and Problems.

UNIT 4: Policy on Access and equity in Education

(i) Women's education and empowerment of women with reference to National Policy on Women Empowerment, , NPE-1986
(ii) Progress of Women Education and Problems.
(iii) Access and Equity in Education with focus to SC, ST and Minorities
(iv) Policy for SC children- Implementation, Progress and Problems.
(v) Policy for ST children- Implementation, Progress and Problems with reference to Mother Tongue based Multilingual Education
(vi) Policy for Minority Children- Implementation, Progress and Problems.

PRACTICAL

- Analysis of any Policy documents being implemented at School Education level

NB: It will be evaluated by both Internal and External examiners

Text Books

- Aggarwal, J.C. (2010). Landmarks in the history of modern Indian education (7th Ed) New Delhi: Vikash Publishing Pvt. Ltd.
- Rawat, P.L. (1989). History of Indian education New Delhi: Ram Prasad & Sons.

Reference Books

- Das, K.K. (1993). *Development of education in India*. New Delhi: Kalyani Publishers
- Dash,B.N. (1991). *Development of education in India*. New Delhi: Ajanta Prakashan
- Keay, F. E. & Mitra, Sukumar (1978). A history of education in India. New Delhi: Oxford University Press
- Mukherjee, R.K. (1988). Ancient Indian education. New Delhi: Motilal Banarsidass
- Mukherjee, R.K. (1989). The Gupta Empire. New Delhi: Motilal Banarsidass
- Naik, J.P. & Narullah, S. (1996). A student's history of education in India.New Delhi: Mc Millan India Ltd

- Ghosh, S.C. (1989). Education policy in India since warren Hastings, Calcutta: N-Prakashan.
- Reference Books
- Altekar, A.S. (1934), Education in ancient India, Banaras: Indian book Shop.
- Das Gupta, S.N. (1988). A history of Indian philosophy. (5 Vols.) Delhi: Motilal Banarasi Dass.
- MHRD, GOI (1986). National policy on education. New Delhi: The Author
- MHRD, GOI (1993). Learning without burden. Yashpal Committee Report (1993). New Delhi: The Author
- Ministry of Education, GOI (1964-66). Education and national development. (Report of education commission (1964-66). New Delhi: The Author
- Sen, Bimal (1989). Development of technical education in India and state policy-a historical perspective. Indian Journal of History of Science, 24 (2): 224-248, Indian National Science Academy.
- Sen, S.N. (1988). Education in ancient and medieval India. Indian Journal of History of Science, 23 (1): 1-32.
- Shanker, Uday (1984). Education of Indian teachers. New Delhi: Sterling Publishers Pvt. Ltd.
- Singh. R.P. (1970). Education in ancient and medieval India. Delhi: Arya Book Depot.Rao, K.Sudha (Ed.) (2002). Educational policies in India: Analysis and review of promise and performance. New Delhi: NUEPA.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- MHRD, Gov. of India (1986). *National policy on education.* New Delhi: GoI.
- MHRD, Gov. of India (1992), *National policy on education (*revised) New Delhi: GoI. MHRD, (1992), *Programme of action*., New Delhi: Govt. of India.
- NCTE (1998b). *Curriculum Framework for Quality Teacher Education.* New Delhi:NCTE.
- NCTE (2009). *National Curriculum Framework for Teacher Education TowardsPreparing Professional and Humane Teacher.* New Delhi:NCTE.
- Ministry of Law Justice (2009). The Right of Children to Free and Compulsory Education Act, 2009. *The Gazette of India*, Ministry of Law Justice, Govt. of India.
- Kurrien, J (1983). *Elementary Education in India*. New Delhi: Vikas. MHRD (). *Report to the People on Education 2011-12.* New Delhi: Author. MHRD (1986): *National Policy on Education*. New Delhi: MHRD.
- MHRD (2000). *Sarva Shiksha Abhiyan: A program for Universal Elementary Education A framework for implementation.* New Delhi: Author.
- Government of India, Ministry of Human Resource Development (2005), Report of the CABE Committee on Autonomy of Higher Education Institutions, Department of Secondary and Higher Education, New Delhi, June.

Websites to be referred:

- http://www.rehabcouncil.nic.in/
- writereaddata/RCI_Amendments_ACT.pdf
- http://socialjustice.nic.in/pwdact1995.php
- http://mhrd.gov.in/rmsa

Discipline Specific Elective Paper-III

(A student has to choose ANY ONE from A & B under DSE-III)

B. POLICY AND PRACTICES IN HIGHER EDUCATION IN INDIA

Learning Objectives

On completion of this course, the student shall:

- Analyse various policies on education for Higher education in India
- Evaluate progress of Higher education
- Examine the problems in implementation of the policies on higher education
- Explore status of higher education.
- Analyse role of various agencies of higher education in India.

UNIT 1: Policies in Higher Education

(i) NPE-1986, revised in 1992 and its corresponding document Programme of Action (POA) with reference to Higher Education.
(ii) Recommendations of National Knowledge Commission-2006.
(iii) Implementation of Policies, progress and problems.

UNIT 2: Future of Higher Education

(i) Rashtriya Uchattar Shiksha Abhiyan (RUSA)- goals, features, strategies and implementation- problems and issues.
(ii) Progress Higher Education in Odisha.
(iii) Autonomy and Accountability in Higher Education

UNIT 3: Curriculum and Assessment

(i) Curriculum issues in higher education
(ii) Choice Based Credits System, Semester system, Grading.
(iii) Role of UGC, NAAC and Accreditation
(iv) Quality Assurance in Higher Education
(v) ICT in Higher Education

UNIT 4: Educational Management System

(i) Funding and management of Higher Education
(ii) Open and Distance Learning System: Policy and Development-Role of IGNOU.
(iii) Research in higher education-problems and issues- Role of ICSSR, UGC, Association of Indian Universities
(iv) Capacity Building of Teachers in Higher Education.

PRACTICAL

- Analysis of any Policy Document being implemented in the field of Higher Education in India

NB: It will be evaluated by both Internal and External examiners

Text Books

- Rao, K.Sudha (Ed.) (2002). Educational policies in India: Analysis and review of promise and performance. New Delhi: NUEPA.

Reference Books

- Government of India, Ministry of Human Resource Development. 2011a. 'Indian Institutes of Development'. Available at http://mhrd.gov. in/itt_higher_english.
- Government of India, Ministry of Statistics and Programme Implementation. No date. NSS Survey Reports. Available at http:// mospi.nic.in/Mospi_New/site/inner. aspx?status=3&menu_id=31.
- Cheney, G. R., with B. B. Ruzzi and K. Muralidharan. 2005. India Education Report. NCEE (National Center on Education and the Economy). Available at http://www.ncee. org/wp-content/uploads/ 2013/10/ IndiaEducation-Report.pdf.
- UCG (University Grants Commission). 2008. Higher Education in India: Issues Related to Expansion, Inclusiveness, Quality and Finance. New Delhi: University Grants Commission. Available at http://www.ugc.ac.in/oldpdf/pub/report/12. pdf.
- Agarwal, P. 2006. 'Higher Education in India: The Need for Change'. ICRIER Working Paper No. 180, June. Delhi: Indian Council for Research on International Economic Relations.
- BhallaVeena& et al (1998), Accountability and Autonomy in Higher Education, AIU.
- Country paper (1998), Higher Education in India: Vision & Action, presented in UNESCO world conference of Higher Education in the Twenty-first century, Paris 5-9th Oct 1998, National Commission for Cooperation with UNESCO.
- UNESCO (1998), report on Higher Education in the Twentieth First Century Vision & Actions held at Paris 5-9th Oct 1998, UNESCO.
- Meek, V Lynn (2000), Diversity and marketisation of higher education: incompatible concepts? Higher Education Policy, 13 (2000), p-25 & 26.
- Government of India, Ministry of Human Resource Development (2005), Report of the CABE Committee on Autonomy of Higher Education Institutions, Department of Secondary and Higher Education, New Delhi, June.
- Tilak, J.B.G. (1996), "Higher Education under Structural Adjustment", Journal of Indian School of Political Economy 8 (2) (April-June): 266-93.
- UGC (2005), University Development in India: Basic Facts and Figures (1995-96 to 2001-02), University Grants Commission, Information & Statistics Bureau, New Delhi, November

Discipline Specific Elective Paper-IV

INCLUSIVE EDUCATION

Learning Objectives

On completion of the course the students shall be able to:

- Define meaning and scope of inclusive education.
- identify the assumptions of disability underlying current general and special education practices

- understand the various suggestions given by different recent commissions on education of children with disabilities for realizing the concept of "Universalization of Education";
- explore and utilize pedagogical approaches that can support students with a variety of learning profiles in respectful ways
- explain the meaning and implications of universal design in learning (UDL) for classroom pedagogy
- examine the different support services and collaboration for inclusive education

UNIT 1: Meaning, Genesis and Scope Inclusive Education

(i) Special education and inclusive education: Concept and Principles
(ii) Historical developments of special and inclusive education in India.
(iii) Medical and social models of disability
(iv) Examining the practice of labeling
(v) Social, psychological and educational contexts of inclusion

UNIT 2: Polices & Frameworks Facilitating Inclusive Education

(i) International Declarations: Universal Declaration of Human Rights (1948), World Declaration for Education for All (1990)
(ii) International Conventions: United Nations Convention of Rights of Persons with Disabilities (UNCRPD) (2006)
(iii) International Frameworks: Salamanca Framework (1994), Biwako Millennium Framework of Action (2002)
(iv) Constitutional Obligations; RCI Act 1992; PwD 1995 and NTA 1999; RTE-SSA and RPD Act. 2016.

UNIT 3: Understanding and Support Needs of Students with Disability

(i) Understanding and support needs of students with different Labels of Disability including: Autism, Learning Disabilities, Speech & Hearing Disability, Blindness, and Intellectual Disabilities in inclusive classroom.

UNIT 4: Frameworks, Support and Collaboration for Inclusive Education

(i) Universal Design for Learning: Multiple Means of Access, Expression, Engagement & Assessment
(ii) Principles of Differentiated Instruction and Assessment
(iii) Capacity Building of Teachers for Inclusive Education
(iv) Assistive Technology & Devices for Inclusive Education

PRACTICAL

- Visit to a centre for students with special needs (special school/special institute). Observe the process of teaching learning and write a report.

NB: It will be evaluated by both Internal and External examiners

Text Books

- Panda, K.C. (nd). *Education of Exceptional Children*
- Daniels, H. (1999) . *Inclusive education*. London: Kogan.

- Mangal, S.K. (2013). Exceptional Childred. New Delhi: PHI Learning Pvt. Ltd.

Reference Books

- Bartlett, L. D., & Weisentein, G. R. (2003). *Successful inclusion for educational leaders*. New Jersey: Prentice Hall.
- Deiner, P. L. (1993). *Resource for Teaching Children with Diverse Abilities*. Florida: Harcourt Brace and Company.
- Dessent, T. (1987). *Making Ordinary School Special*. Jessica Kingsley Pub.
- Gargiulo, R.M. *Special Education in Contemporary Society: An Introduction to Exceptionality*. Belmont: Wadsworth.
- Gartner, A., & Lipsky, D.D. (1997). *Inclusion and School Reform Transferring America's Classrooms*. Baltimore: P. H. Brookes Publishers.
- Giuliani, G.A. & Pierangelo, R. (2007). *Understanding, Developing and Writing IEPs*. Corwin press:Sage Publishers.
- Gore, M.C. (2004) . *Successful Inclusion Strategies for Secondary and Middle School Teachers,* Crowin Press, Sage Publications.
- Hegarthy, S. & Alur, M. (2002). *Education of Children with Special Needs: from Segregation to Inclusion*. Corwin Press, Sage Publishers.
- Karant, P., & Rozario, J. ((2003). *Learning Disabilities in India*. Sage Publications.
- Karten, T. J. (2007). *More Inclusion Strategies that Work*. Corwin Press, Sage Publications.
- King□Sears, M. (1994). *Curriculum□Based Assessment in Special Edcuation*. California: Singular Publications.
- Kluth, P. (2009). *The autism checklist: A practical reference for parents and teachers.* San Francisco, CA: Jossey-Bass.
- Lewis, R. B., & Doorlag, D. (1995). *Teaching Special Students in the Mainstream*. 4th Ed. New Jersey: Pearson.
- Rayner, S. (2007). *Managing Special and Inclusive Education*, Sage Publications.
- Rose, D. A., Meyer, A. & Hitchcock, C. (2005). *The Universally Designed Classroom: Accessible Curriculum and Digital Technologies.* Cambridge, MA: Harvard Education Press.
- Ryandak, D. L. & Alper, S. (1996). Curriculum Content for Students with Moderate and Severe Disabilities in Inclusive Setting. Boston, Allyn and Bacon.
- Thousand, J., Villa, R., & Nevin, A. (2007). *Differentiating instruction: Collaborative planning and teaching for universally designed learning*. Thousand Oaks, CA: Corwin Press.
- Turnbull, A., Turnbull, R., Turnbull, M., & Shank, D.L. (1995). *Exceptional Lives: Special Education in Today's Schools*. 2nd Ed. New Jersey: Prentice□Hall.Inc
- Udvari-Solner, A. & Kluth, P. (2008). *Joyful Learning: Active and collaborative learning in inclusive classrooms*. Thousand Oaks, CA: Corwin Press.

DSE Paper – IV

DISSERTATION/ RESEARCH PROJECT

(College can give this choice only for students with above 60% aggregate marks)

The students will select a research project on any Educational issue or problem or topic and prepare a report. The project will be prepared based on proposal already developed in Semester-III, Core-6.

Distribution of Marks will be as follows:

Item	**Total**
Report	75
Viva-voce	25
Total	**100**

The assessment of students' performance will be made jointly by the external and internal examiners.

Generic Elective Paper I

EDUCATIONAL PHILOSOPHY

Learning Objectives

On completion of this course, the learners shall be able to:

- State and analyse the meaning of education and form own concept on education

- Explain philosophy as the foundation of education
- Analyse aims of education
- Describe the essence of different formal philosophies and draw educational implications
- Compare and contrast Indian and western philosophies of education

UNIT 1: Education in Philosophical Perspective

(i) Etymological meaning of education

(ii) Narrower and broader meaning of education, Lifelong Education

(iii) Aims of Education- Individual and Social Aims of Education

(iv) Meaning and nature of philosophy

(v) Branches of Philosophy- Metaphysics, Epistemology and Axiology, and its educational implications

(vi) Functions of Philosophy in relation to education

UNIT 2: Formal Schools of Philosophy and their Educational Implications

(i) Idealism, Naturalism, Pragmatism with reference to:

(ii) Aims of Education, Curriculum, Methods of Teaching, Role of Teacher, Discipline

UNIT 3: Indian Schools of Philosophy and their Educational Implications

(i) Common Characteristics of Indian Philosophy

(ii) Sankhya, Vedanta, , Buddhism, Jainism with reference to:

(iii) Philosophical tenets, Aims of education, Curriculum, Methods of Teaching, Role of Teacher

UNIT 4: Educational Thought of Western and Indian Thinkers

(i) Plato

(ii) Dewey

(iii) Gopabandhu Das

(iv) Gandhi

(v) Tagore

(vi) Aurobindo

PRACTICAL

- Field visit to a seat of learning in the locality and prepare report.

NB: It will be evaluated by both the internal and External examiners.

Text Books

- Safaya, R.N. & Shaida, B.D. (2010). *Modern Theory and Principles of Education*. New Delhi: Dhanpatrai Publishing Company Pvt. Ltd. Nayak, B.K. (2018).
- Ravi, Samuel.S. (2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.
- Nayak, B.K . (ND). *Text Book of Foundation of Education.* Cuttack, Odisha: Kitab Mhal.

Reference Books

- Aggrawal, J.C. (2013). Theory and principle of education. New Delhi: Vikash Publishing House Pvt Ltd.
- Anand, C.L. *et.al*. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
- Dash, B.N. (2011) Foundation of education, New Delhi; Kalyani Publishers.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Krishnamurthy, J. (1953). Education and significance of life. New Delhi: B.I. Publications
- Kumar Krishna (1996). Learning from conflict. New Delhi: Orient Longman.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson. Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Peters, R.S. (1967). The Concept of education. London: Routledge Kegan & Paul. Radhakrishnan, S. Indian philosophy Vol. I and Vol. II
- Ross, James S.(1981). Ground work of educational theory.Delhi: Oxford University Press Rusk, Robert R., Philosophical bases of education, London: Oxford University Press.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling Publishers Pvt. Limited.
- Wingo, G. Max (1975). Philosophies of education. New Delhi: Sterling Publisher Pvt. Limited.

Generic Elective Paper II

EDUCATIONAL PSYCHOLOGY

Learning Objectives

On completion of this course, the students will:

- Explain the concept of educational psychology and its relationship with psychology.
- Understand different methods of educational psychology.
- Explain the concepts of growth and development of child and adolescence, and underlined general principles of growth and development.
- Describe briefly the periods and the typical characteristics ofgrowth and development during childhood and adolescence.
- Explain the theory of cognitive development and its educational implications.
- State the different forms and characteristics of individual differences and the ways of meeting the classroom issues arising out of the differences.
- Identify the learning needs during the different stages of development and adopt appropriate strategies in and out of school to meet the learning needs.

UNIT 1: Educational Psychology in Developmental Perspective

(i) Meaning, nature, scope and relevance of educational psychology
(ii) Methods of educational psychology- observation, experimentation, and case study
(iii) Application of educational psychology in understanding learner
(iv) Growth and Development-Concept, difference between growth and development, and principles of growth and development
(v) Characteristics of development during adolescence in different areas:
(vi) Physical, social, emotional and intellectual (with reference to Piaget)

UNIT 2: Intelligence, Creativity and Individual difference

(i) Individual difference-concept, nature, factors and role of education
(ii) Intelligence- meaning and nature of intelligence, concept of I.Q, theories of intelligence- Two factor theories, Guildford's structure of intelligence (SI) model, Gardner's multiple theory of intelligence.
(iii) Measurement of intelligence- individual and group test, verbal, non-verbal test
(iv) Creativity- meaning, nature and stages of creative thinking, strategies for fostering creativity

UNIT 3: Learning and Motivation

(i) Learning- meaning, nature and factors of learning
(ii) Theories of learning with experiment and educational implications-
(iii) Classical conditioning, operant conditioning, insightful learning and constructivist approach to learning
(iv) Motivation – concepts, types, and techniques of motivation

UNIT 4: Personality and Mental health

(i) Personality- meaning and nature of personality
(ii) Theories- type theory(Jung), trait theory(Allport)

(iii) Assessment of personality- subjective, objective and projective techniques
(iv) Mental health-concept, factors affecting mental health and role of teacher, mental health of teacher.
(v) Adjustment mechanism: Concept and Types

PRACTICAL

- Case study of an exceptional child and reporting

N.B: It will be evaluated by both the Internal and External examiners**.**

Text Books

- Chauhan, S.S. (1978). *Advanced educational psychology*. New Delhi: Vikas Publishing House Pvt. Ltd.
- Mangal, S.K. (2002). *Advanced educational psychology*. New Delhi: Prentice Hall of India.
- Woolfolk, A. (2015). *Educational psychology (9th Ed.)*. New Delhi: Pearson Publication

Reference Books

- Aggarwal, J.C. (2014). Essentials of Educational Psychology. New Delhi: Vikas Publishing House Pvt. Ltd.
- Attri, A.K. (2015). *Psychology of development and learning*. New Delhi: APH Publishing Corporation.
- Bernard, P.H. (1970). *Mental Health in the class room*. New York: McGraw Hill.
- Biehier, R.F. & Snowman, J., (1997). *Psychology applied to teaching*. New York: Houghton MIflin.
- Bigge, M.L., *Psychological foundations of education*, Harper and Row, New York, 1985.
- Chandraiah,K.(2011). *Emotional intelligence*. New Delhi: APH Publishing Corporation.
- Dececco, J.P. & Crawford, W.R. (1997). *Psychology of learning and institution*. New Delhi: Prentice Half of India.
- Good T., (1990). *Educational psychology*. Longman, New York, 1990.
- Lindgren, H.C. (1980). *Educational psychology in the classroom*. New York: Oxford University Press.
- Mouly, G.J. (1982). *Psychology for teaching*. Allyn & Bacon, Boston.
- Rothstein, P.R. (1990). *Educational psychology*. New York: McGraw Hill..
- Salvin, R, (1990). *Educational psychology: theory into practice,* N.J.: Prentice hall, Englewood Cliffs,
- Snowman and Biehler **(---).** *Psychology applied to teaching*……..
- Sprint hall, RC. & Sprint hall, NA, (1990). *Educational psychology, development approach*, New York: McGraw Hill.

Generic Elective Paper III

CONTEMPORARY TRENDS AND ISSUES IN INDIAN EDUCATION

Learning Objectives

On completion of this course the students will

- Understand the importance of pre-school and elementary school education. Analyze various problems and issues for ensuring quality education.
- State the importance of secondary education and analyze various problems and issues forensuring quality in secondary education.
- Enumerate the importance of higher education and analyze various problems and issues forensuring quality in higher education.
- Justify the importance of teacher education and analyze various problems and issues forensuring quality in teacher education.
- Analyze emerging concerns in Indian education.

UNIT 1: Pre-school and Elementary School Education

(i) Meaning, nature and importance of ECCE, problems and issues with regard to ECCE
(ii) Universalization of Elementary Education: efforts to achieve UEE, SSA
(iii)Problems and issues in implementing Right to Education Act 2009.
(iv)Problems and issues in bringing the community to school, role of SMC
(v) Problems in ensuring equity and quality of elementary education

UNIT 2: Secondary and Higher Secondary Education

(i) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and ensuring secondary education for all.
(ii) Role of School Management and Development Committee (SMDC)
(iii)Shifting the teaching learning process from teacher centered to learner centered and activity based classroom –problems and issues
(iv)Problems and issues with regard to vocationalisation of secondary and higher secondary education
(v) Examination reforms at the secondary level
(vi)Widening the access to secondary education through National Open School

UNIT 3: Higher Education and Teacher Education

(i) Challenges in Higher education- expansion, quality and inclusion
(ii) Role of RUSA and NAAC for quality assurance in Higher education
(iii)Higher education through open and distance learning mode
(iv)Elementary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009
(v) Secondary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009

UNIT 4: Emerging Concerns

(i) Examination system: defects and reforms for making examination system flexible (internal assessment and semester system , grading, open book examination, online examination)
(ii) Choice Based Credits System (CBCS):Concept, Learning Objectives, importance, problems and issues.
(iii) Human Rights Education: Concept, Learning Objectives, importance, problems and issues.
(iv) Life-Skill Education: Concept, Learning Objectives, importance, problems and issues.
(v) Peace Education: Concept, Learning Objectives, importance, problems and issues.

PRACTICAL

- Study of Perception of Stakeholder's of Education on any of the current issues and concerns, and reporting.

NB: It will be evaluated both by the Internal and External Examiners.

Text Books

- Kumar, Chanchal & Sachedeva, M.S. (2017). *Vision of Secondary Education In India in the context of 21st century*. Twentyfirst Century Publications; First Edition edition (2015)
- Pathak, K. R. (2007). *Education in the Emerging* India. New Delhi: Atlantic Publishers**.**

  Saxena, V. (2011). Contemporary trends in education: A handbook for educators. New Delhi: Pearson.

Reference Books

- Broudy, H.S. (1977) *Types of knowledge and purposes of education*. In R.C. Anderson, R.J., Spiro and W.E. Montanaque (Eds.) Schooling and the acquisition of knowledge (PP. Hillsdale, NJ: Erlbaum.
- Bruner, J.S. (1996). *The culture of education*. Cambridge, M.A.: Harvard University Press.
- Butchvarov, P. (1970). *The concept of knowledge*. Evanston, Illinois, North Western University Press.
- Dearden R. F. (1984). *Theory and practice in Education*. Routledge K Kegan & Paul.
- Delors, Jacques, et al; (1996). *Learning: the Treasure within report of the international commission on education for 21st century*, UNESCO.
- Illich, I. (1996). *Deschooling society*. Marion Boyers, London.
- Matheson, David (2004). *An Introduction to the study of education* (2 Ed.). David Fulton Publish.
- MHRD (2008). *Framework for implementation of Rashtriya Madhyamik Shiksha Abhiyan: A scheme for universalisation of access to and improvement of quality at the secondary stage.* New Delhi: Department of School Education and Literacy.
- MHRD (2011). *Sarva Shiksha Abhiyan: Framework for implementation based on the Right of Children to Free and Compulsory Education Act, 2009*. New Delhi: Department of School Education and Literacy.
- MHRD, (1992). *Programme of action*. Govt. of India, New Delhi.

- MHRD, Gov. of India (1992). *National policy on education* (revised) New Delhi: MHRD.
- Ministry of Law and Justice (2009). *Right to education Act 2009*. New Delhi: Govt of India.
- Naik, J.P. (1975). *Equality, quality and quantity: The elusive triangle of Indian education.* Allied Publications, Bombay.
- NCERT (2005). *National curriculum framework 2005*. New Delhi: NCERT.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- Slatterry, P. and Dana R. (2002). *Ethics and the foundations of education-Teaching Convictions in a postmodern world*. Allyn & Bacon.
- UN (2015). *The sustainable development goals (SDGs) – UNDP*. United Nations
- UNESCO (1998). *Educating for a sustainable future: A transdisciplinary vision for concerted action*. Paris: UNESCO.
- UNICEF (2000). *Defining quality in education*. New York: Programme Division (Education), Unicef.
- Wall, Edmund (2001). *Educational theory: philosophical and political Perspectives*. Prometheus Books.
- WHO (1991). *Comprehensive school health programme*. New Delhi: World Health Organization Regional Office.
- Winch, C. (1996). *Key concepts in the philosophy of education*. Routledge.
- Yadav, M. S. & Lakshmi, T. K. S. (1995). Education: Its disciplinary identity. *Journal of Indian Education,* XXI (*1*), 01-21.

Generic Elective Paper IV

EDUCATIONAL ASSESSMENT AND EVALUATION

Learning Objectives

On completion of this course, the students will.

- State the nature, purpose and types of educational assessment and evaluation.
- Develop and use different types of tools and techniques for continuous and comprehensive assessment of learning in the school situation.
- Explain the importance of assessment for learning and its processes for enhancing the quality of learning and teaching.
- Describe the characteristic of a good test.
- Analyze the trends and issues in learning and learner assessment.
- Analyze and interpret results of the assessment using standard score.
- Illustrate the principles of test construction in education.

UNIT 1: Assessment and Evaluation in Education

(i) Understanding the meaning and purpose of test, measurement, assessment and evaluation
(ii) Scales of measurement- nominal, ordinal, interval and ratio
(iii) Types of test- teacher made and standardized
(iv) Approaches to evaluation- placement, formative, diagnostic and summative
(v) Types of evaluation- norm referenced and criterion referenced
(vi) Concept and nature of continuous and compressive evaluation

UNIT 2: Instructional Learning Objectives

(i) Taxonomy of instructional Learning Objectives with special reference to cognitive domain
(ii) Criteria of selecting appropriate Learning Objectives, and stating of general and specific instructional Learning Objectives
(iii) Relationship of evaluation procedure with Learning Objectives
(iv) Difference between objective based objective type test and objective based essay type test

UNIT 3: Tools and Techniques of Assessment and construction of Test

(i) Steps of test construction: planning, preparing, trying out and evaluation
(ii) Principles of construction of objective type test items- matching, multiple choice, completion and true – false
(iii) Principles of construction of essay type test
(iv) Non- standardized tools: Observation schedule, interview schedule, rating scale, check list, portfolio and rubrics.

UNIT 4: Characteristics of a good Test

(i) Validity-concept, types and methods of validation
(ii) Reliability- concept and methods of estimating reliability
(iii) Objectivity- concept and methods of estimating objectivity
(iv) Usability- concept and factors ensuring usability

PRACTICAL

- Construction of Unit test on a school subject based on Blueprint and Reporting.

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Aggrawal, J.C. (1997). *Essentials of examination system, evaluation, tests and measurement*. New Delhi: Vikas Publishing House Pvt Ltd.
  Gronlund, N.E. (2003). *Assessment of student Achievement*. Boston: Allyn & Bacon
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books

- Anastasi, A.(1976). Psychological testing. New York: Macmillan Publishing Co.
- Anderson, L.W. (2003). Classroom assessment: Enhancing the quality of teacher decision making.
- Banks, S.R. (2005). *Classroom assessment: issues and PRACTICES*. Boston: Allyn & Bacon.
- Blooms, B.S.(1956). *Taxonomy of educational Learning Objectives*. New York: Longman Green and Company
- Cohen, R.J., Swerdlik, M.E., & Phillips, S.M. (1996). *Psychological testing and assessment. an introduction to the tests and measurement*. California: Mayfield Publishing Co.
- Earl, L.M. (2006). *Assessment as learning: using classroom assessment to maximize*

student learning. Thousand Oaks, California: Corwin Press

- Hopkins, KD. (1998). *Educational and psychological measurement and evaluation.* Boston: Allyn and Bacon.
- Linn, R.L. & Gronlund, N.E. (2000). *Measurement and assessment in teaching.* London: Merrill Prentice Hall.
- Macmillan, J.H. (1997). *Classroom assessment, principles and practice for effective instruction.* Boston: Allyn and Bacon
- Mohan, R. (2016). *Measurement evaluation and assessment in education*. Delhi: PHI Learning Pvt. Ltd.
- National Council of Educational Research and Training (2006). *Position paper: Examination Reforms.* New Delhi: NCERT
- Noll, N.H. S cannell, D.P. & Craig, RC. (1979). *Introduction to educational measurement.* Boston: Houghton Miffin.

Course structure of UG Education Pass

Semester	Course	Course Name	Credits	Total marks

I	DSC-I DSC-I Practical	Educational philosophy	04 02	75 25
II	DSC-II DSC-II Practical	Educational psychology	04 02	75 25
III	DSC-III DSC-III Practical	Educational sociology	04 02	75 25
IV	DSC-IV DSC-IV Practical	Changing pedagogical perspective	04 02	75 25
V	DSE-I DSE-I Practical	Contemporary trends and issues in Indian education	04 02	75 25
VI	DSE-II DSE-II Practical	Educational assessment and evaluation	04 02	75 25
			30	**600**

Education Papers for PASS students

Discipline Specific Core – 4 papers

Discipline Specific Elective – 2 papers

Marks per paper - Midterm : 15 marks, End term : 60 marks, Practical: 25 marks

Total – 100 marks Credit per paper – 6

Teaching hours per paper – 40 hours + 20 hours practical

Discipline Specific Core Paper I

EDUCATIONAL PHILOSOPHY

Learning Objectives

On completion of this course, the learners shall be able to:

- State and analyse the meaning of education and form own concept on education
- Explain philosophy as the foundation of education
- Analyse aims of education
- Describe the essence of different formal philosophies and draw educational implications
- Compare and contrast Indian and western philosophies of education

UNIT 1: Education in Philosophical Perspective

(i) Etymological meaning of education

(ii) Narrower and broader meaning of education, Lifelong Education

(iii) Aims of Education- Individual and Social Aims of Education

(iv) Meaning and nature of philosophy

(v) Branches of Philosophy- Metaphysics, Epistemology and Axiology, and its educational implications

(vi) Functions of Philosophy in relation to education

UNIT 2: Formal Schools of Philosophy and their Educational Implications

(i) Idealism, Naturalism, Pragmatism with reference to:

(ii) Aims of Education, Curriculum, Methods of Teaching, Role of Teacher, Discipline

UNIT 3: Indian Schools of Philosophy and their Educational Implications

(i) Common Characteristics of Indian Philosophy

(ii) Sankhya, Vedanta, , Buddhism, Jainism with reference to:

(iii) Philosophical tenets, Aims of education, Curriculum, Methods of Teaching, Role of Teacher

UNIT 4: Educational Thought of Western and Indian Thinkers

(i) Plato

(ii) Dewey

(iii)Gopabandhu Das

(iv)Gandhi

(v) Tagore

(vi)Aurobindo

PRACTICAL

- Field visit to a seat of learning in the locality and prepare report.

NB: It will be evaluated by both internal and External examiners.

Text Books

- Safaya, R.N. & Shaida, B.D. (2010). *Modern Theory and Principles of Education*. New Delhi: Dhanpatrai Publishing Company Pvt. Ltd. Nayak, B.K. (2018).
- Ravi, Samuel.S. (2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.
- Nayak, B.K (2012). *Text Book of Foundation of Education*. Cuttack, Odisha: Kitab Mhal.

Reference Books

- Aggrawal, J.C. (2013). Theory and principle of education. New Delhi: Vikash Publishing House Pvt Ltd.
- Anand, C.L. *et.al*. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
- Clarke, P. (2001). Teaching and learning: The Culture of pedagogy. New Delhi: Sage Publication.
- Dash, B.N. (2011) Foundation of education, New Delhi; Kalyani Publishers.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.
- Krishnamurthy, J. (1953). Education and significance of life. New Delhi: B.I. Publications
- Kumar Krishna (1996). Learning from conflict. New Delhi: Orient Longman.
- Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th

Edn.). Boston: Houghton Mifflin Co.
- Pathak, R. P. (2012). Philosophical and sociological principles of education. Delhi: Pearson. Pathak, Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Peters, R.S. (1967). The Concept of education. London: Routledge Kegan & Paul. Radhakrishnan, S. Indian philosophy Vol. I and Vol. II
- Ross, James S.(1981). Ground work of educational theory.Delhi: Oxford University Press Rusk, Robert R., Philosophical bases of education, London: Oxford University Press.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling Publishers Pvt. Limited.
- Wingo, G. Max (1975). Philosophies of education. New Delhi: Sterling Publisher Pvt.Limited.

Discipline Specific Core Paper II

EDUCATIONAL PSYCHOLOGY

Learning Objectives

On completion of this course, the students will:
- Explain the concept of educational psychology and its relationship with psychology.
- Understand different methods of educational psychology.
- Describe the theoretical perspectives of educational psychology.
- Explain the concepts of growth and development of child and adolescence, and underlined general principles of growth and development.
- Describe briefly the periods and the typical characteristics ofgrowth and development during childhood and adolescence.
- Explain the theory of cognitive development and its educational implications.
- State the different forms and characteristics of individual differences and the ways of meeting the classroom issues arising out of the differences.
- Identify the learning needs during the different stages of development and adopt appropriate strategies in and out of school to meet the learning needs.

UNIT 1: Educational Psychology in Developmental Perspective

(i) Meaning, nature, scope and relevance of educational psychology
(ii) Methods of educational psychology- observation, experimentation, and case study
(iii) Application of educational psychology in understanding learner
(iv) Growth and Development-Concept, difference between growth and development, and principles of growth and development
(v) Characteristics of development during adolescence in different areas:
(vi) Physical, social, emotional and intellectual (with reference to Piaget)

UNIT 2: Intelligence, Creativity and Individual difference

(i) Individual difference-concept, nature, factors and role of education
(ii) Intelligence- meaning and nature of intelligence, concept of I.Q, theories of intelligence- Two factor theories, Guildford's structure of intelligence (SI) model, Gardner's multiple theory of intelligence.
(iii) Measurement of intelligence- individual and group test, verbal, non-verbal test
(iv) Creativity- meaning, nature and stages of creative thinking, strategies for fostering creativity

UNIT 3: Learning and Motivation

(i) Learning- meaning, nature and factors of learning
(ii) Theories of learning with experiment and educational implications-
(iii) Classical conditioning, operant conditioning, insightful learning and constructivist approach to learning
(iv) Motivation – concepts, types, and techniques of motivation

UNIT 4: Personality and Mental health

(i) Personality- meaning and nature of personality
(ii) Theories: type theory and trait theory
(iii) Assessment of personality- subjective, objective and projective techniques
(iv) Mental health-concept, factors affecting mental health and role of teacher, mental health of teacher.
(v) Adjustment Mechanism: Concept and Types

PRACTICAL

- Administration and interpretation of any psychological test relating to Intelligence OR Personality

N.B: It will be evaluated by both the Internal and External examiners.

Text Books

- Chauhan, S.S. (1978). *Advanced educational psychology*. New Delhi: Vikas Publishing House Pvt. Ltd.
- Mangal, S.K. (2002). *Advanced educational psychology*. New Delhi: Prentice Hall of India.
- Aggarwal, J.C. (2014). *Essentials of educational psychology*. New Delhi: Vikas Publishing House Pvt. Ltd.

Reference Books

- Woolfolk, A. (2015). Educational psychology (9th Ed.). New Delhi: Pearson Publication
- Attri, A.K. (2015). Psychology of development and learning. New Delhi: APH Publishing Corporation.
- Bernard, P.H. (1970). Mental Health in the class room. New York: McGraw Hill.
- Biehier, R.F. & Snowman, J., (1997). Psychology applied to teaching. New York:

Houghton Mifflin.
- Bigge, M.L., Psychological foundations of education, Harper and Row, New York, 1985.
- Chandraiah,K.(2011). Emotional intelligence. New Delhi: APH Publishing Corporation.
- Dececco, J.P. & Crawford, W.R. (1997). Psychology of learning and institution. New Delhi: Prentice Half of India.
- Good T., (1990). Educational psychology. Longman, New York, 1990.
- Lindgren, H.C. (1980). Educational psychology in the classroom. New York: Oxford University Press.
- Mouly, G.J. (1982). Psychology for teaching. Allyn & Bacon, Boston.
- Salvin, R, (1990). Educational psychology: theory into practice, N.J.: Prentice hall, Englewood Cliffs,
- Sprint hall, RC. & Sprint hall, NA, (1990). Educational psychology, development approach, New York: McGraw Hill

Discipline Specific Core Paper III

EDUCATIONAL SOCIOLOGY

Learning Objectives

On completion of this course, the students will:

- State the relationship between education and society.
- Understand the meaning of Educational Sociology and function of education as a social system.
- State different agencies of education and their functions.
- Justify the importance of education for social change.
- Describe the role of education in modernization and globalization.
- Describe the function of education to ensure equality and equity.

UNIT 1: Education and Society

(i) Relationship between education and society, school as a miniature society
(ii) Educational Sociology- Concept, nature, scope and importance;
(iii) Relationship between education and sociology.
(iv) Education as a process of Socialization.
(v) Education and Politics, Education and Economic Development

UNIT 2: Agencies of Education

(i) Family- Importance, functions and role for education and socialization of the children
(ii) School - Importance, functions and role for education and socialization of the children
(iii) Society- Importance, functions and role for education and socialization of the children
(iv) Mass Media- Importance, functions and role for education and socialization of the children

UNIT 3: Education, Social change and Modernization

(i) Concept of social change and factors affecting Social Change
(ii) Education as an instrument of social change and social control
(iii) Concept and Attributes of modernization
(iv) Education for accelerating the process of modernization
(v) Impact of Globalization, Liberalization, and Privatization on Education

UNIT 4: Equalization of Educational opportunities for ensuring equity and Inclusion

(i) Concept of equality, equity and inclusion: its educational implication
(ii) Ensuring equality in the Education of SC and ST
(iii) Education for Women Empowerment
(iv) Inclusive Education with reference to children with special needs (CWSN)

PRACTICAL

- Field Visit: Study of a social unit (Home/School/Village/slum) and reporting.

NB: It will be evaluated by both the internal and external examiners

Text Books

- Aggrawal, J.C.(2013). *Theory and principle of education*. New Delhi: Vikash Publishing House Pvt Ltd.
- NCERT (2014). Basics in Education. New Delhi: Author.
- Pathak, R. P. (2012). *Philosophical and sociological principles of education*. Delhi: Pearson. Pathak

Reference Books

- Anand, C.L. et.al. (1983). Teacher and education in emerging in Indian society, New Delhi: NCERT. Brubacher, John.S.(1969). Modern philosophies of education. New York: McGraw Hill Co.
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  Ravi, Samuel.S.(2015). *A Comprehensive Study of Education*. Delhi: PHI Learning Pvt. Ltd.
- Dewey, John (1956). The Child and the curriculum, school and society. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). Experience and education. New York: Touchstone.
- Ganesh, Kamala & Thakkar, Usha (Ed.) (2005). Culture and making of identity in India. New Delhi: Sage Publications.
- Govt. of India (1986/'92). National policy on education. New Delhi: MHRD.
  Ministry of Education (1966). Education and national development. New Delhi: Ministry of Education, Government of India.
- Ornstein, Allan C. & Levine, Daniel U. (1989).Foundations of education (4th Edn.). Boston: Houghton Mifflin Co.
- Avijit (2002). Social implications of schooling. New Delhi: Rainbow Publishers.
- Safaya, R.N. & Shaida, B.D. (2010), Modern theory and principles of education. New Delhi: Dhanpati Publising Company Pvt. Ltd.
- Salamatullah, (1979). Education in social context. New Delhi: NCERT.

Saraswati, T.S. (Ed.) (1999). Culture, socialization and human development. Theory, research and applications in India. New Delhi: Sage Publication.
- Srinivas, M.N., (1986). Social changes in modern India. Bombay: Allied Publishers.
- Taneja, V.R. (2000). Educational thought and practice, New Delhi: Sterling Publishers Pvt. Limited.

Discipline Specific Core Paper IV

CHANGING PEDAGOGICAL PERSPECTIVE

Learning Objectives

- On completion of this course, the students will:
- Explain the concept of pedagogy
- Differentiate pedagogy from other allied concepts
- Explain different teaching task with example
- Establish relationship between teaching and learning
- List out different approaches and methods of teaching
- Prepare a lesson plan following different designs

UNIT 1: Concept of Teaching and Learning

(i) Meaning and definition of teaching and learning
(ii) Relationship between teaching and learning
(iii) Variables involved in teaching task: independent, dependent and intervening
(iv) Phases of teaching: Pre- active, inter- active and post- active
(v) Levels of teaching: memory, understanding and reflective
(vi) Lesson plan design- The Herbartian steps, 5 E and ICON design model

UNIT 2: Theories of Teaching

(i) Meaning and nature of teaching theory
(ii) Types of teaching theories:
(iii) Formal theories of teaching- communication theory of teaching
(iv) Descriptive theories of teaching– Gagne's hierarchical theory of instruction and Bruner's cognitive theory of instruction
(v) Normative theories of teaching - Mitra's psychological theory of teaching and Clarke's general theory of teaching

UNIT 3: Principles and maxims of teaching

(i) General principles of teaching
(ii) Psychological principles of teaching
(iii) Maxims of teaching
(iv) Core teaching skills: Introducing the lesson, explaining, illustrating with examples, stimulus variation, and reinforcement, questioning, and probing questions, closure.

UNIT 4: Approaches and methods of Teaching

(i) Concept of approach, method, strategy and techniques
(ii) Methods of teaching: inductive-deductive, analytic- synthetic, problem solving and project
(iii) Shift in focus from teaching to learning- constructivist approach to learning

PRACTICAL

- Preparation of Rating Scale/ Observation Schedule and evaluate a classroom teaching and reporting.

NB: It will be evaluated by both the internal and external examiners

Text Books

- Mangal, S.K. and Mangal, U.(2010). Essentials of Educational Technology. New Delhi, PHI Learning Pvt. Limited.
- Walia, J.S. (2013). *Educational Technology*. Jalandhar, Punjab: Ahim Publications.
- Sharma, R.A.(1986). *Technology of Teaching*. International Publishing House, Meerut.

Reference Books

- Aggarwal, J.C.(1995). Essentials of Educational Technology, Vikash Publishing House, New Delhi
- Chauhan, S.S.(1995). Innovations of teaching learning process, Vikash Publishing House, New Delhi
- Kochar, S.K.(2011) Methods and Techniques of teaching, Sterling Publisher Pvt. Ltd., New Delhi
- Mangal, S.K.(1988) Foundations of Educational Technology, Ludhiana, Tandan Publications
- Nageswar Rao, S., Sreedhar, P. & Rao, B.(2007). Methods and techniques of teaching, Sonali Publications, New Delhi
- Oliver,R.A. (1963) Effective teaching, JM Dent & Sons
- Pathak, R.P. & Chaudhary, J. (2012) Educational Technology, Pearson, New Delhi
- Ryburn, W.M.(1955) Principles of Teaching, Geoffrey Cembridge, OUP
- Sampath,K, Pannir Salvam,A.,& Santhanam, S.(1981) introduction to Educational Technology, Sterling Publisher, New Delhi

Discipline Specific Elective Paper I

CONTEMPORARY TRENDS AND ISSUES IN INDIAN EDUCATION

Learning Objectives

On completion of this course the students will

- Understand the importance of pre-school and elementary school education. Analyze various problems and issues for ensuring quality education.
- State the importance of secondary education and analyze various problems and issues forensuring quality in secondary education.
- Enumerate the importance of higher education and analyze various problems and issues forensuring quality in higher education.
- Justify the importance of teacher education and analyze various problems and issues forensuring quality in teacher education.
- Analyze emerging concerns in Indian education.

UNIT 1:Pre-school and Elementary School Education

(i) Meaning, nature and importance of ECCE, problems and issues with regard to ECCE
(ii) Universalization of Elementary Education: efforts to achieve UEE, SSA
(iii)Problems and issues in implementing Right to Education Act 2009.
(iv)Problems and issues in bringing the community to school, role of SMC
(v) Problems in ensuring equity and quality of elementary education

UNIT 2: Secondary and Higher Secondary Education

(i) Rashtriya Madhyamik Shiksha Abhiyan (RMSA) and ensuring secondary education for all.
(ii) Role of School Management and Development Committee (SMDC)
(iii)Shifting the teaching learning process from teacher centered to learner centered and activity based classroom –problems and issues
(iv)Problems and issues with regard to vocationalisation of secondary and higher secondary education
(v) Examination reforms at the secondary level
(vi)Widening the access to secondary education through National Open School

UNIT 3: Higher Education and Teacher Education

(i) Challenges in Higher education- expansion, quality and inclusion
(ii) Role of RUSA and NAAC for quality assurance in Higher education
(iii)Higher education through open and distance learning mode
(iv)Elementary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009
(v) Secondary level pre-service teacher education- problems, issues and reforms with reference to National Curriculum Framework for Teacher Education-2009

UNIT 4: Emerging Concerns

(i) Examination system: defects and reforms for making examination system flexible (internal assessment and semester system , grading, open book examination, online

examination)

(ii) Choice Based Credits System(CBCS):Concept, Learning Objectives, importance, problems and issues.

(iii) Human Rights Education: Concept, Learning Objectives, importance, problems and issues.

(iv) Life-Skill Education: Concept, Learning Objectives, importance, problems and issues.

(v) Peace Education: Concept, Learning Objectives, importance, problems and issues.

PRACTICAL

- Study of perception of Stakeholder's of Education on any of the current issues based on Pass DSE-1 and concerns, and reporting.

NB: It will be evaluated both by the Internal and External Examiners.

Text Books

- Kumar, Chanchal & Sachedeva, M.S. (2017). *Vision of Secondary Education In India in the context of 21st century*. Twentyfirst Century Publications; First Edition edition (2015)
- Pathak, K. R. (2007). *Education in the Emerging* India. New Delhi: Atlantic Publishers**.**
- Saxena, V. (2011). *Contemporary trends in education: A handbook for educators*. New Delhi: Pearson.

Reference Books

- Broudy, H.S. (1977) *Types of knowledge and purposes of education*. In R.C. Anderson, R.J., Spiro and W.E. Montanaque (Eds.) Schooling and the acquisition of knowledge (PP. Hillsdale, NJ: Erlbaum.
- Bruner, J.S. (1996). *The culture of education*. Cambridge, M.A.: Harvard University Press.
- Butchvarov, P. (1970). *The concept of knowledge*. Evanston, Illinois, North Western University Press.
- Dearden R. F. (1984). *Theory and practice in Education*. Routledge K Kegan & Paul.
- Delors, Jacques, et al; (1996). *Learning: the Treasure within report of the international commission on education for 21st century*, UNESCO.
- Illich, I. (1996). *Deschooling society*. Marion Boyers, London.
- Matheson, David (2004). *An Introduction to the study of education* (2 Ed.). David Fulton Publish.
- MHRD (2008). *Framework for implementation of Rashtriya Madhyamik Shiksha Abhiyan: A scheme for universalisation of access to and improvement of quality at the secondary stage.* New Delhi: Department of School Education and Literacy.
- MHRD (2011). *Sarva Shiksha Abhiyan: Framework for implementation based on the Right of Children to Free and Compulsory Education Act, 2009*. New Delhi: Department of School Education and Literacy.
- MHRD, (1992). *Programme of action*. Govt. of India, New Delhi.
- MHRD, Gov. of India (1992). *National policy on education* (revised) New Delhi: MHRD.

- Ministry of Law and Justice (2009). *Right to education Act 2009*. New Delhi: Govt of India.
- Naik, J.P. (1975). *Equality, quality and quantity: The elusive triangle of Indian education.* Allied Publications, Bombay.
- NCERT (2005). *National curriculum framework 2005*. New Delhi: NCERT.
- NCERT (2005). *National curriculum framework*, New Delhi: NCERT.
- Slatterry, P. and Dana R. (2002). *Ethics and the foundations of education-Teaching Convictions in a postmodern world*. Allyn & Bacon.
- UN (2015). *The sustainable development goals (SDGs) – UNDP*. United Nations
- UNESCO (1998). *Educating for a sustainable future: A transdisciplinary vision for concerted action*. Paris: UNESCO.
- UNICEF (2000). *Defining quality in education*. New York: Programme Division (Education), Unicef.
- Wall, Edmund (2001). *Educational theory: philosophical and political Perspectives*. Prometheus Books.
- WHO (1991). *Comprehensive school health programme*. New Delhi: World Health Organization Regional Office.
- Winch, C. (1996). *Key concepts in the philosophy of education*. Routledge.
- Yadav, M. S. & Lakshmi, T. K. S. (1995). Education: Its disciplinary identity. *Journal of Indian Education,* XXI (*1*), 01-21.

Discipline Specific Elective Paper II

EDUCATIONAL ASSESSMENT AND EVALUATION

Learning Objectives

On completion of this course, the students will.

- State the nature, purpose and types of educational assessment and evaluation.
- Develop and use different types of tools and techniques for continuous and comprehensive assessment of learning in the school situation.
- Explain the importance of assessment for learning and its processes for enhancing the quality of learning and teaching.
- Describe the characteristic of a good test.
- Analyze the trends and issues in learning and learner assessment.
- Analyze and interpret results of the assessment using standard score.
- Illustrate the principles of test construction in education.

UNIT 1: Assessment and Evaluation in Education

(i) Understanding the meaning and purpose of test, measurement, assessment and evaluation
(ii) Scales of measurement- nominal, ordinal, interval and ratio
(iii) Types of test- teacher made and standardized
(iv) Approaches to evaluation- placement, formative, diagnostic and summative
(v) Types of evaluation- norm referenced and criterion referenced
(vi) Concept and nature of continuous and compressive evaluation

UNIT 2: Instructional Learning Objectives

(i) Taxonomy of Instructional Learning Objectives with special reference to cognitive domain
(ii) Criteria of selecting appropriate Learning Objectives, and stating of general and specific instructional Learning Objectives
(iii) Relationship of evaluation procedure with Learning Objectives
(iv) Difference between objective based, objective type test and objective based essay type test

UNIT 3: Tools and Techniques of Assessment and construction of Test

(i) Steps of test construction: planning, preparing, trying out and evaluation
(ii) Principles of construction of objective type test items- matching, multiple choice, completion and true – false
(iii) Principles of construction of essay type test
(iv) Non- standardized tools: Observation schedule, interview schedule, rating scale, check list, portfolio and rubrics.

UNIT 4: Characteristics of a Good Test

(i) Validity-concept, types and methods of validation
(ii) Reliability- concept and methods of estimating reliability
(iii) Objectivity- concept and methods of estimating objectivity
(iv) Usability- concept and factors ensuring usability

PRACTICAL

- Construction of Unit test on a school subject based on blueprint and reporting.

NB: It will be evaluated by both Internal and External examiners.

Text Books

- Aggrawal, J.C. (1997). *Essentials of examination system, evaluation, tests and measurement*. New Delhi: Vikas Publishing House Pvt Ltd.
- Goswami, M. (2011). *Measurement and evaluation in psychology and education*. Hyderabad: Neelkamal Publishers
  Gronlund, N.E. (2003). *Assessment of student Achievement*. Boston: Allyn & Bacon
- Singh, A.K. (2016). *Tests, measurements and research methods in behavioural sciences*. New Delhi: Bharati Bhawan Publishers.

Reference Books

- Anastasi, A.(1976). Psychological testing. New York: Macmillan Publishing Co.
- Anderson, L.W. (2003). Classroom assessment: Enhancing the quality of teacher decision making.
- Banks, S.R. (2005). *Classroom assessment: issues and PRACTICES.* Boston: Allyn & Bacon.
- Blooms, B.S.(1956). *Taxonomy of educational Learning Objectives*. New York: Longman Green and Company
- Cohen, R.J., Swerdlik, M.E., & Phillips, S.M. (1996). *Psychological testing and*

assessment. an introduction to the tests and measurement. California: Mayfield Publishing Co.

- Earl, L.M. (2006). *Assessment as learning: using classroom assessment to maximize student learning*. Thousand Oaks, California: Corwin Press
- Hopkins, KD. (1998). *Educational and psychological measurement and evaluation.* Boston: Allyn and Bacon.
- Linn, R.L. & Gronlund, N.E. (2000). *Measurement and assessment in teaching.* London: Merrill Prentice Hall.
- Macmillan, J.H. (1997). *Classroom assessment, principles and practice for effective instruction.* Boston: Allyn and Bacon
- Mohan, R. (2016). *Measurement evaluation and assessment in education*. Delhi: PHI Learning Pvt. Ltd.
- National Council of Educational Research and Training (2006). *Position paper: Examination Reforms.* New Delhi: NCERT
- Noll, N.H. S cannell, D.P. & Craig, RC. (1979). *Introduction to educational measurement.* Boston: Houghton Miffin.

HIST-P-401

Application of History in Tourism

Unit-I

1. Concept, Definition and Characteristics of Tourism, Types of Tourism.
2. Historical Sites of National Importance (a) Dhauli (b) Ayodhya (c)Mahabalipuram.
3. Historical Events of National Importance (a) Kalinga War (b) Dandi March.
4. Archaeological Sites of National Importance (a) Sisupalagarh (b) Hampi

Unit-II

1. Monuments of National Importance (a) Taj Mahal (b) Caves at Khandagiri and Udayagiri.
2. Architectures of National Importance (a) Sun Temple at Konark (b) Sanchi Stupa.
3. Museums of National Importance (a) Indian Museum, Kolkata.(b)National Museum, New Delhi (c) Salarjung Museum, Hyderabad

Unit-III

1. Religious Centres of National Importance: (a) Puri and (b) Dwarka.
2. Tourist places of National Importance (a) Amritsar (c) New Delhi.
3. Fairs and Festivals of National Importance (a) Kumbhamela (b) RathaYatra

Unit-IV

1. Policy and Planning in Tourism.
2. Tourism Organisation and Promotion.
3. Travel Agencies and Travel Management.

Reading List:

1. Duglas Foster, *Travel and Tourism Management*
2. Fletcher et. Al, *Tourism Principles and Practice Copper,* 1993.
3. K.C. Panigrahi, *Archaeological Remains in Bhubaneswar*
4. M.P. Beibaruah, *Fairs and Festivals of India (5 Volumes)*
5. Negi, *Travel Agency and Tour Operation: Concepts and Principles.*
6. Ram Acharya ,*Tourism and Cultural Heritage of India*, 1986, Jaipur
5. S. Punja, *Great Monuments of India*

Third Semester

HIST-P-301

Cultural Heritage of Odisha

Unit-I

1. Cultural Heritage: It's Meaning, Nature and Classification.
2. Buddhist Stupas and Chaityas: Ashokan Art, Architecture at Ratnagiri.
3. Rock-cut Sculptures: Jain Sculpture at Khandagiri and Udayagiri.

Unit-II

1. Saiva and Vaishnava Heritage in Odisha.
2. Sakti Culture in Odisha.
3. Evolution of Kalingan Style of Temple Architecture: Muktesvar, Vaital,Lingaraj, Sun Temple, Konark.

Unit-III

1. The Cult of Jagannath: Origin and Development and Philosophy.
2. Mahima Dharma: Principles and Development, Its Impact on Socio-Cultural Life.
3. Sarala Mahabharata and Panchasakha Literature.

Unit-IV

1. Fairs and Festivals: Hindu, and Tribals
2. Terracotta Art and Crafts
3. Modern Odia Literature: Radhanath Roy, Phakir Mohan Senapati and Gangadhar Meher

Reading List:

1. A Easchmann, H. Kulke and G. C. Tripathy (eds),*The Cult of Jagnnatha and The Regional Traditions of Odisha*, Manohar, New Delhi, 1978.
2. B.K. Mallik, *Paradigms of Dissent and Protest: Social Movements in Eastrn India (1400-1700)*, Manohar, New Delhi, 2004.
3. J. Dora, *Sakta Monuments of Orissa: A Study of Art, Architecture and Iconography*, Delhi, 2009.
4. K.C. Mishra, *The Cult of Jagnnatha,*
5. M. Manasingha, *History of Oriya Literature,* Sahitya Akademi, New Delhi.
6. M.N. Das (ed), *Sidelights on History and Culture of Orissa*, Vidyapuri, 1977.
7. N.K. Bose, *Canons of Orissan Architecture*
8. N.K. Sahu, *Buddhism in Orissa*, Utkal University, 1965.
9. P.K. Mishra et al(eds), *Comprehensive History and Culture of Orissa*, Vol-I Pt. II, Kaveri Publication, New Delhi.
10. S. Pradhan,*Rock Art in Orissa.*
11. T. E. Donaldson ,*Hindu Temple Art of Orissa.*
12. Vidya Dehejia, *Early Stone Temples of Orissa*

+3 THIRD YEAR SIXTH SEMESTER
DSE - 3
NANO MATERIALS AND APPLICATIONS

Time : 3 Hrs.
Credit : 04

End Semester Theory : 60 Marks
Mid Semester Theory : 15 Marks

		No of Classes
UNIT-I	**Nanoscale Systems:** Length scales in physics, Nanostructures: ID, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, size effects in nano systems, Quantum confinement, Applications of Schrodinger equation-infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, ID nanostructure and its consequences.	10
UNIT-II	**Synthesis of Nanostructure Materials:** Top down and botton up approach, Photolithography Ballmilling. Gas phase condensation,Vacuum deposition, Physical vapour deposition (PVT): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition, Chemical vapour deposition (CVD), Sol-Gel Electrodeposition, Spray pyrolysis, Hydro themal synthesis, Preparation through colloidal methods, MBE growth of quantum dots.	10
UNIT-III	**Characterization:** X-Ray Diffraction, Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunneling Microscopy.	8
UNIT-IV	**Applications:** Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation). CNT based transistors. Nonmaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots-magmetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems(NEMS).	12

Text Books:

CORE - 1 - LAB

Credit : 02 **25** Marks

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems.
- The course will consist of lectures (both theory and practical) in the Lab.
- Evaluation done not on the programming but on the basis of formulating the problem.
- Aim at teaching students to construct the computational problem to be solved.
- Students can use any one operating system Linux or Microsoft Windows.

Introduction and Overview:

Computer architecture and organization, memory and Input output devices.

Basics of scientific computing:

Binary and decimal arithmetic, Floating pointnumbers, algorithms. Sequence. Selection and Repetition, single and double precision arithmetic, underflow and overflow emphasize the importance of making equations in terms of dimension less variables, Iterative methods Algorithm.

Errors and error Analysis:

Truncation and round off errors, Absolute and relative errors. Floating point computations. Systematic and Random Errors. Propagation of Errors, Normal Law of Errors. Standard and Probable Error.

Review of C and C++ Programming :

Introduction to Programming, constants, variables and Fundamentals data types, operators and Expressions. I/O statements, scanf and printf, c in and c out. Manipulators for data formatting, Control statements (decision making and looping statements) (If Statement. If else Statement, NestedIf structure, ElseIf Statement. Ternary operator. Go to Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D and 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects.

Programs:

Sum and average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search

Random number generation:

Area of circle, area of square, volume of sphere, value of π.

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Schaum's out line of Programming with C++ J.Hubbard, 2000, McGraw-Hill Pub.
3. Numerical Recipesin C: The Art of Scientific Computing. W.H. Pressetal, 3rd Edn. 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M. Ascher and C. Greif. 2012, PHI Learning.
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.
6. Numerical Methods for Scientists and Engineers, R.W. Hamming. 1973, Courier Dover Pub.
7. An Introduction to computational Physics, T. Pang, 2nd Edn. 2006. Cambridge Univ. Press.

7. Mathematical Physics B.D.Gupta (4th edition, Vikas Publication)

CORE - 5 - LAB

Credit : **02** **25** Marks

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem.

Topics Introduction to Numerical Computation Software Scilab: Introduction to Scilab, Advantages, disadvantages, Scilab computation software, Scilab environment Command window, Edit window, Figure window, Variables and arrays, Initialising variables in Scilab. Multidimensional arrays, Subarray, Special Values, Displaying output data, data file, Scalar and array operations. Hierarchy of operations, Built in Scilab . Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational and logical perators, the while loop, for loop, details of loop operations, break and continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variables Passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program(2).

Curve fitting, Least square fit Goodness of fit. standard constant Deviation: Ohms law to calculate, R. Hookes law to calculate spring constant.

Solution of Linear system of equations by Gauss elimination Solution method and Gauss Seidal method. Diagonalization matrices, Inverse of a matrix, Eigenvectors, problems: Solutions of mesh equations of electric circuits (3 meshes), Solution of coupled spring mass systems (3 masses)

Solution of ODE First order Differential equadon, Euler, modified Euler, Runge-Kutta second methods, Second order differential equation. Fixed difference method: First order differential equation

- Radioactive decay
- Current in RC, LC circuits with DC source
- Newtons law of cooling
- Classical equations of motion

Second order DifferentialEquation $m\frac{d^2x}{dt^2} + kx = 0$

- Harmonic oscillator (no friction)
- Damped Harmonicoscillator $m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + Kx = 0$ $t = 0, x(0) = 3, x'(0) = 0$

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Paper -VII
EDUCATIONAL PSYCHOLOGY

Unit-1: Teaching-Learning process and Sociocultural Diversity

Teaching-Learning process; Culture, socioeconomic status, Ethnicity, Language issues, Multi-cultural education, culturally relevant teaching, Gender, Views on Gender Development, Gender Stereotyping, Gender-role classification, eliminating gender bias.

Unit- 2: Motivation, Teaching and Learning

Exploring motivation; Nature of motivation; Perspectives on motivation; Motivation to achieve; Motivation, Relationships and Socio-cultural contexts; How to reach low achieving students.

Unit-3: Effective Teaching and Managing the Classroom

Teacher Effectiveness defining teaching quality time analysis, Essential teaching skills, Direct instruction, Helping students construct knowledge. Need for management; Designing the physical environment of the classroom; Creating positive environment for learning; Being a good communicator; Dealing with problem behavior.

Unit-4: Learners who are Exceptional

Children with disabilities; Educational issues; Involving children with disabilities; children who are gifted and their education, National Education Policy 2020 and Disability issues.

Unit-5: Classroom Assessment

Classroom as an assessment context, Traditional tests, Alternative assessments, Grading and reporting performance, Computers in the assessment system, standardized tests, nature of standardized tests, Aptitude and achievement test, Issues in assessment, Students diversity and assessment

Books:

- **Educational Psychology :Paul Eggen & Don Kauchak,**
- **Educational Psychology-by John W. Santrock**
- **Educational Psychology-by N. L. Gage and David C. Berliner**

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Paper VIII
CLINICAL PSYCHOLOGY

S-Sm

Unit-1 Current paradigms in Psychopathology: Biological, psychoanalytic, humanistic and existential, learning and cognitive. Classification and diagnosis: DSM (Changes in the current classification) and ICD. Issues in the classification of abnormal behavior.

Unit-2 Stress- Clinical reaction to stress, adjustment disorder: Acute stress disorder; Dissociative Disorder; Conversion disorder; treating stress-related problems.

Unit-3 Anxiety Disorders: generalized Anxiety disorders: Phobias, Obsessive-Compulsive disorder, Trauma, Interpreting and treating Anxiety disorders.

Unit 4 Schizophrenia: Clinical features; subtypes; causes; Treatment; Mood Disorder: Unipolar and Bipolar- Clinical features; causes; Treatment

Unit-5 Personality disorders: Paranoid, Schizoid and Schizotypal Personality Disorder, Histrionic and narcissistic Disorder, Border- line Personality Disorder, Anti-social behavior, Treatment of Personality Disorder

BOOKS:

1. **Abnormal Psychology: Davison & Neale: Wiley**
2. **Introduction to Health Psychology: Branon, & Feist (2007) Thomson & Wadsworth**
3. **Abnormal Psychology: Sarason & Sarason ;Pearson**

2nd sem
S.Sah.

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Paper IX
Organisational Psychology

Unit 1 Defining Organisational Psychology, Meaning of organisational behaviour (OB); Foundations of OB, Importance of OB; OB Models; Traditional and modern organisations; Challenges and Opportunities for Managers, Organisation as an open system; Concept of Psychological capital; Building a learning organisation

Unit 2 Organizational Structure and Design; Organizational Culture, Creativity, and Innovation: Meaning and Definition; How is culture created? Creativity in organisations; Characteristics of creative individuals, methods of enhancing creativity; Innovation in organisations

Unit 3 Work-Related Attitudes: Job Satisfaction: Theories, Job satisfaction and employee performance; Employee Motivation: Theories of work motivation: Need/Content, Process, Reinforcement and Cognitive approaches; Personality attributes and work performance, personality-job fit

Unit 4 Leadership: Difference between management and leadership, Theories and current approaches in Leadership, Managerial grid, Effective Team building, Organisational Communication: Types and functions; overcoming barriers in organisational communication

Unit 5 International organizational Behaviour: Trends in international business; Behaviour across countries; Hofstede's cultural dimensions; leadership across cultures; Technology and international business environment; Achieving corporate excellence.

BOOKS:

1. **Organizational Behaviour, 2009 by K.Aswathappa, Himalya Publishing House**
2. **Behaviour in organizations, 2003 by J. Greenberg & R.A. Baron.**

(2007). Abnormal Psychology (13th Ed.).ND:
Sarason (2005). Abnormal Psychology. New Delhi: Prentice Hall Publication.
Varadwaj, K. & Mishra, H.C. (2014). Explorations of Human Nature and Strength: Practicals in Psychology, DivyaPrakashani, Samantarapur, Bhubaneswar.

Reference Books:

- Kring,A.M.,Johnson,S.L.,Davison G.C. & Neale J.M. (2010). Abnormal Psychology (11th Ed.).NY: John Wiley.

+3 SECOND YEAR FOURTH SEMESTER

Core Paper - 9

EDUCATIONAL PSYCHOLOGY

Time : **3** Hrs.
Credit : **04**

End Semester Theory : **60** Marks
Mid Semester Theory : **15** Marks

		No of Classes
UNIT-I:	**Foundations of Educational Psychology** (i) Concepts and principles of educational psychology, The teaching-learning process, Goals of teaching and objectives for learning, transfer of training, reinforcements in learning process. (ii) Theories of cognitive development-Piaget, Bruner, and Vygotsky.	10
UNIT-II:	**Motivation and Classroom Management** (i) Meaning of motivation, Intrinsic and extrinsic motivation, Approaches to understand classroom motivation, Motivational techniques in classroom teaching (ii) The goals of classroom management, Creating a positive learning environment, Characteristics of an effective teacher, Teacher expectation and students' performance.	12

UNIT- III:	**Creativity and Aptitude** (i) Nature and characteristics of creativity; Theories of creativity; Fostering creativity among children. (ii) Nature and characteristics of aptitude; Types of aptitude; Measurement of aptitude; Utility of aptitude tests	**No of Classes** 10
UNIT-IV:	**Dealing with ability differences and Testing** (i) Teaching children with mental retardation, learning disability, social class differences and educational difficulties, and attention deficit Hyperactive disorder. (ii) Types of standardized tests- Achievement test, and aptitude tests, Advantages and limitations of standardized test.	10

PRACTICAL

Credit : **02**

25 Marks

(i) **Academic Behavior:** To assess the academic attitude and behavior of college students by using Sia's Academic Behavior Scale.

(ii) **Academic Stress:** To assess the academic stress of two higher Secondary students using Rao's Academic Stress Scale.

Text Books:

- Gage, N. L., & Berliner, D. C. (2009) *Educational psychology* (5th ed.). Boston, MA: Houghton Mifflin.
- Woolfolk, A.E. (2004). Educational Psychology (9th Ed.), Allyn& Bacon, London / Boston
- Mohanty, N., Varadwaj, K. & Mishra, H.C. (2014). Explorations of Human Nature and Strength: Practicals in Psychology, DivyaPrakashani, Samantarapur, Bhubaneswar.

Reference Books:

- Chauhan, S. S. (2010). Advanced Educational Psychology, Vikash Publishing.

+3 SECOND YEAR FOURTH SEMESTER

Research. New York Surjeet Publications
(1993). Statistical Reasoning in Psychology and Education New

+3 THIRD YEAR FIFTH SEMESTER
Core Paper - 11
ORGANIZATIONAL BEHAVIOR

Time : 3 Hrs.
Credit : 04

End Semester Theory 60 Marks
Mid Semester Theory 15 Marks

		No of Classes
UNIT I:	**Historical context of organizational behavior** (i) Contributions of Taylor, Weber and Fayoll, Challenges, Scope and opportunities for OB (ii) OB perspectives-Open system approach, Human relations perspective, Socio-technical approach, OB model responsive to Indian realities.	12
UNIT-II:	**Organization System** (i) Structure and functions of organization, Common organizational designs, Management roles, functions and skills. (ii) Group decision making processes in organizations, Organizational leadership and types of leadership in organizations.	10
UNIT-III:	**Work, Power and Politics** (i) Contemporary theories of work motivation- ERG theory, McClelland's theory of needs Cognitive evaluation theory, Goal-setting theory, Reinforcement theory. (ii) Defining power in organization, Bases of power, Power tactics, Nature of organizational politics, Impression management, and defensive behavior.	10
UNIT-IV:	**Human resource development and Evaluation** (i) Human Skills and Abilities, Selection Practices for Optimal Use of Human Resources; Training Programs for the Development of Human Resources. (ii) Performance Evaluation- Purpose, Methods, Potential Problems and methods to overcome them.	10

PRACTICAL

Credit : 02

25 Marks

(i) **Leadership Style:** To measure his basic leadership style of 4 college students by using Greenberg Basic Leadership Style scale

(ii) **Conflict-Handling:** To measure the conflict-handling style of 4 college students by using Rahim's scale to identify their conflict handling style.

Text Books:

- Robbins, S.P.; Timothy, A.J. &Vohra, N. (2012). Organizational Behavior, 15th Edn. Pearson Education: New Delhi
- Luthans, F. (2009). Organizational behavior. New Delhi: McGraw Hill.
- Mohanty, N., Varadwaj, K. & Mishra, H.C. (2014). Explorations of Human Nature and Strength: Practicals in Psychology, DivyaPrakashani, Samantarapur, Bhubaneswar.

Reference Books:

- Greenberg, J. & Baron, R.A. (2007). Behaviour in Organizations (9th Ed.). India: Dorling Kindersley.

+3 THIRD YEAR FIFTH SEMESTER
Core Paper - 12
HEALTH PSYCHOLOGY

Time : 3 Hrs
Credit : 04

End Semester Theory : 60 Marks
Mid Semester Theory : 15 Marks

		No of Classes
UNIT-I:	**Introduction** (i) Goals of Health Psychology, Biopsychosocial model of health and illness (ii) Basic nature of stress, Cognitive appraisal of stressors, Some major causes of stress, Management of stress.	10
UNIT- II:	**Health and Illness** (i) Behavioral and psychological correlates of illness, Approaches to promoting wellness, Some common health beliefs and their implications (ii) Models of health- The cognition models- The health belief model, The protection motivation model, Leventhal's self-regulatory model.	10
UNIT-III:	**Health and Coping** (i) Individual differences in symptom perception, Coping with the crises of illness; Compliance behavior and improving compliance. (ii) Health enhancing behavior- Diet management, Yoga and Exercise.	10
UNIT-IV:	**Health Issues** (i) Children health issues- Malnutrition, Immunization, Autism, ADHD (ii) Health issues of women and elderly: **Diabetes, Osteoporosis, Alzheimer's Disease, Depression.**	10

PRACTICAL

Credit : **02** **25** Marks

(i) **Sleep Quality**: To assess the Sleep quality of 4 college students by The Pittsburgh Sleep Quality Index (PSQI)

(ii) **Coping Strategies**: To assess of the Coping Strategies of 4 college students by Tobin's Coping Strategy Inventory (TCSI)

Text Books:

- Taylor, S.E. (2006). Health Psychology (6th Ed.). New York: Tata McGraw Hill
- Brannon and Feist. Health Psychology.
- Mohanty, N., Varadwaj, K. & Mishra, H.C. (2014). Explorations of Human Nature and Strength: Practicals in Psychology, DivyaPrakashani, Samantarapur, Bhubaneswar.

Reference Books:

Ogden, J. (2007). Essentials of Health Psychology. McGraw Hill.

+3 THIRD YEAR SIXTH SEMESTER
Core Paper - 13
COUNSELING PSYCHOLOGY

(PSQI)

(ii) **Coping Strategies**: To assess of the Coping Strategies of 4 college students by Tobin's Coping Strategy Inventory (TCSI)

Text Books:

- Taylor, S.E. (2006). Health Psychology (6th Ed.). New York: Tata McGraw Hill
- Brannon and Feist. Health Psychology.
- Mohanty, N., Varadwaj, K. & Mishra, H.C. (2014). Explorations of Human Nature and Strength: Practicals in Psychology, DivyaPrakashani, Samantarapur, Bhubaneswar.

Reference Books:

Ogden, J. (2007). Essentials of Health Psychology. McGraw Hill.

+3 THIRD YEAR SIXTH SEMESTER

Core Paper - 13

COUNSELING PSYCHOLOGY

Time : **3** Hrs.
Credit : **04**

End Semester Theory : **60** Marks
Mid Semester Theory : **15** Marks

UNIT-I:	**Basics of Counseling** (i) Meaning, scope and purpose of counseling with special reference to India, The counseling process, counseling relationship, counseling interview. (ii) Characteristics of a good counselor, Ethics and values in counseling; Education and training of the counselor.	**No of Classes** **10**

UNIT-II:	**Theories and Techniques of Counseling** (i) Psychodynamic approach-Freud and Neo Freudians; Humanistic approach-Existential and Client centered. (ii) Cognitive approach- Rational-emotive and transaction analysis;Behavioral approach-Behavior modification; Indian contribution- yoga and meditation.	No of Classes 10
UNIT-III:	**Counseling Programs** (i) Working in a counseling relationship, transference and counter transference. termination of counseling relationship, Factors influencing counseling. (ii) Student counseling, Emphases, roles and activities of the school, and college counselor.	10
UNIT-IV:	**Counseling application** (i) Family and Marriage Counseling, Family life and family cycle, Models and methods of family counseling. (ii) Alcohol and drug abuse counseling; Counseling the persons with Suicidal tendencies, and Victims of Harassment and Violence.	10

PRACTICAL **25** Mark

Credit : **02**

(i) **Marital Relationship-** To assess the marital relationship of 2 couples using Lerner's Couple adjustmen scale.

(ii) **Case Reporting:** To complete four case studies of high school students with problem behavior in the appropriate case record proforma.

Text Books:

profession (6th Ed.). New Delhi: Pearson India

+3 SECOND YEAR THIRD SEMESTER
Core Paper - 7
ENVIRONMENTAL PSYCHOLOGY

Time : 3 Hrs.
Credit : 04

End Semester Theory : 60 Marks
Mid Semester Theory : 15 Marks

		No of Classes
UNIT-I:	**Environment and Behavior** (i) Earth as a living system: The Gaia hypothesis, Deep ecology; Man-environment relationship- physical, social, cultural, orientation and product. (ii) Effects of Environment on behavior: Noise pollution, Air pollution, Crowding and Population explosion.	15
UNIT- II:	**Ecology and Development** (i) Human behavior and Environmental Problems: Global warming, Greenhouse effect, Energy depletion; Pro-environmental behaviors. (ii) Ecosystem and their components; Sustainable development; Resource use: Common property resources. Ecology: Acculturation and psychological adaptation	12
UNIT-III:	**Psychological Approaches to environment** (i) Field theory approach; Eco-cultural Psychology (Berry); Biosocial Psychology (Dawson); (ii) Ecological Psychology (Barker); Ecological system approach (Bronfenbrenner)	10
UNIT-IV:	**Environmental Assessment** (i) Socio-psychological dimensions of environmental impact; Environmental deprivation, nature and consequences. (ii) Creating environmental awareness; Social movements- Chipko, Tehri, Narmada.	8

PRACTICAL

Credit : 02 — 25 Marks

(i) To assess the environmental literacy of 4 college students using Bob Simpson's Environment literacy and awareness survey questionnaire.
(ii) To assess the environmental attitude, concern and sensitivity of 4 college students using Bob Simpson's Environment literacy and awareness survey questionnaire.

Text Books:

- Dreze, J. and Sen, A. (1992). Indian Development. Delhi: Oxford University Press.
- Gadgil, M. and Guha, R. (1995). Ecology and Equity. New Delhi, Penguine Books
- Mohanty, B. and Misra, S. (2017). A text book on Environmental Psychology. Krupajala Books, Bhubaneswar, Odisha
- Mohanty, N., Varadwaj, K. & Mishra, H.C. (2014). Explorations of Human Nature and Strength: Practicals in Psychology, DivyaPrakashani, Samantarapur, Bhubaneswar.

Reference Books:

- Goldsmith, E. (1991). The way: The ecological World View. Boston: Shambhala.

CORE PAPER VII

SOCIOLOGY OF GENDER

The biological basis to the differences between the sexes does not explain the inequalities faced by the sex groups in the society. In the society variations are marked in the roles, responsibilities, rights of and relations between sex groups depending on the social prescriptions relating to sex affiliations. The differences, inequalities and the division of labour between men and women are often simply treated as consequences of 'natural' differences between male and female humans. But, in reality the social norms, institutions, societal expectations play a significant role in deciding and dictating the behaviour of each sex group. This is the fundamental of the study of Gender and Society.

Objectives: After studying this paper, the student can

- Conceptualize what is "Gender" and what is "Sex" and draw a line of distinction between the two.
- Note the difference in gender roles, responsibilities, rights and relations.
- Trace out the evolution and institutionalization of the institution of "Patriarchy".
- Get to know the theories of Feminism that brought women issues and demands to the forefront.
- Assess the initiatives undertaken for gender development with the paradigm shift from time to time.

Learning Outcomes: This paper is expected to generate ideas and sensitivity about gender in a student which he/she can put into practice in daily life. This will lead to change the prevalent biases and gender practices and create a gender neutral social world where both men and women can enjoy their basic rights and cherish to achieve their dreams.

Unit-1: Social Construction of Gender

1.1 Gender as a Social Construct

1.2 Gender Vs. Sex

1.3 Gender Stereotyping and Socialization

1.4 Gender Role and Identity

Unit-2: Feminism

2.1 Meaning and Definitions

2.2 Origin , Growth of Feminism, Waves of Feminism

2.3 Patriarchy

2.4 Theories of Feminism-Liberal, Radical, Socialist, Marxist, Materialist

Unit-3: Gender and Development

3.2 Approaches -WAD, WID and GAD

3.3 Gender Mainstreaming: Meaning, Policies and Programmes

3.3 Gender Development Index

3.4 Women Empowerment: Meaning and Dimensions: Political, Economic and Social.

Unit-4: Women in India through ages

4.1 Status of Women in Ancient Period

4.2 Medieval Period

4.3 Women in Pre- independence India

4.4 Women in Contemporary Indian Society

CORE PAPER- IV

SOCIOLOGY OF ENVIRONMENT

Environment and society are in constant interaction with each other. It is the environment which sustains life in society and it is the society that is responsible for the preservation and the degradation of the environment. In the recent years environmental challenges have posed a threat to the lives on the planet. Keeping this in view, the present paper tries to create awareness among the students about the major environmental issues and the efforts geared to tackle them.

Objectives: After going through this paper, the student can

- Derive knowledge about the close interaction between society and environment.
- Gain substantial idea about the environmental issues and their repercussions on humanity.
- Accumulate ideas about the ideological currents, issues that drive environment movements.
- Get aware about the global and national efforts to conserve environment.

Learning Outcomes: The very aim of this paper is to disseminate knowledge about the significance of environment for society, to change the practices that can protect and preserve the environment and to make the students participate in the mission to preserve, protect and promote the cause of environment.

Unit-1: Basics of Sociology of Environment

1.1 Sociology of Environment: Meaning, emergence and scope

1.2 Environment and Society – their inter-relations, Ecology and Environment.
1.3 Eco-system.
1.4 Sustainable Development

Unit-2: Environmental Movements

2.1 Narmada Bachao Andolan,
2.2Ganga Bachao Abhiyan,
2.3 Silent valley movements,
2.4 Eco-feminist movement

Unit-3: Major Environmental Issues:

3.1 Global Warming& Climate Change.
3.2 Loss of Biodiversity (water & air)
3.3 Deforestation.
3.4 Urban Wastes, Industrial wastes

Unit-4: Environmental Protection:

4.1 Environment protection efforts at the global level
4.2 Efforts at national level
4.3 Role of Civil Society Organizations
4.4 Role of Corporate Social Responsibility in environmental protection

CORE PAPER- XIV

SOCIAL DISORGANIZATION & DEVIANCE

No society is fully organized in character. Disorganization is apt to occur from time to time. Disorganization is a manifestation of the deviant behavior found among some individuals. This deviance occurs when the individuals feel that the normative order of the society and its institutions are not need fulfilling in character. This present paper makes an attempt to provide an impression about the scenario of disorganization, its forms, causes and consequences with the theories explaining the situation.

Objectives: After going through this paper, the student can

- Understand the meaning, causes, consequences and forms of social disorganization.
- Learn about the theories explaining the disorganization situations.
- Comprehend the concept of crime and the existing theories of punishment.

Learning Outcomes: This paper is designed with an expectation to impress upon a student on the concept of deviant behavior leading to social disorganization, forms, theoretical foundations and criminal activities which he encounters in real life situations.

Unit-1 : Social Disorganization:

1.1Meaning and Nature

1.2Causes and Consequences of Social Disorganization

1.3Family Disorganization - Causes and Consequences

1.4Personality Disorganization- Causes and Consequences

Unit- 2: Theories of Deviant Behaviour

2.1 Durkheim's Theory

2.2 Merton's Theory

2.3 Differential Association theory,

2.4 Delinquent Sub-Culture theory

Unit- 3 : Crime and Punishment :

3.1Crime-Definitions and types

3.2Causes & Consequences of Crime

3.3Juvenile Delinquency-Causes and consequences

3.4 Theories of Punishment (Retributive, Deterrant, Reformative)

Unit-4: Social Problems:

4.1 Alcholism,

4.2 Terrorism

4.3 Human Trafficking

4.4 Drug Addiction

CORE PAPER- XIII

POPULATION & SOCIETY

Demography is both an index and instrument of development and change. India as a country is plagued by population explosion which retards, the economy and blocks social progress. Irrespective of several positive attempts undertaken by the government, India has failed to control its population problem. This paper is designed to provide an idea to the students about population dynamics and its impact on society.

Objectives: After going through this paper, the student can

- Understand the various facets of population studies and the theories that depict pollution change.
- Develop specific idea on Indian population structure, policies adopted and programmes launched in the country to check population.
- Assess the role of various agencies in population control.

Learning Outcomes: The very aim of this paper is to acquaint the students with a perennial problem of the Indian society that is population growth and the measures introduced to control it.

Unit: 1 Population Studies

1.1 Meaning & Scope of Population Studies
1.2 Population & Society-Relationship
1.3 Importance of Population Studies
1.4 Causes and effects of Population Growth

Unit: 2 Population Theories

2.1 Malthusian Theory
2.2 Optimum Theory of Population
2.4 The Theory of Demographic Transition
2.4 Applicability of Population Theories in Contemporary Scenario

Unit: 3 Determinants of Population Growth

3.1 Fertility
3.2 Migration
3.3 Mortality
3.4 Measures to control population growth

Unit: 4 Population Compositions in India

4.1 Sex Composition
4.2 Age Compositions
4.3 Literacy Composition
4.4 Rural & Urban Composition

CORE PAPER- IX

GLOBALISATION & SOCIETY

Globalization is the dominant process of social change in the contemporary world. It has resulted in the sinking of time and space and collapse of borders. It is a new coinage for an old process. It has its own dimensions, distinct features and impacts on society. It has given birth to new role players. All these are the focal points of discussion of this paper.

Objectives: By going through this paper, the student can

- Collect information about the meaning and nature of this process, its historical mooring.
- Amass knowledge about its dimensions and impacts, both positive and negative.
- Get introduced to the agencies that manage the process.

Expected Outcomes:
This paper is expected to acquaint the student with an ongoing social process; which can bring tremendous changes in the nations.

Unit-1: Globalisation
1.1 Meaning, characteristics of Globalisation
1.2 Emergence of Globalisation
1.3 Liberalisation- Meaning & characteristics
1.4 Privatisation- Meaning & characteristics

Unit-2: Dimensions of Globalisation

2.1 Economic
2.2 Technological
2.3 Political
2.4 Cultural

Unit-3: Consequences of Globalisation

3.1 Rising Inequality
3.2 Environmental Degradation
3.3 Consumerism
3.4 Health and Security

Unit-4: Impact of Globalisation in Indian Context:

4.1 Cultural Impacts
4.2 Impact on Education
4.3 Impact on Religion
4.4 Impact on Women

DISCIPLINE SPECIFIC ELECTIVES, PAPER-2

SOCIOLOGY OF EDUCATION

Course Objectives: After going through this paper, the student can

- Get to know the meaning and theoretical perspectives on sociology of education
- Get familiar with the relationship between education and society
- Get insights on role of education in Nation building
- Get an understanding on inequality in education that persists at various levels.
- Gain knowledge on constitutional provisions and various education policies

Learning Outcomes: The students are expected to learn various perspectives on education through the contributions of both Indian and western thinkers. Knowledge on education policies and constitution provisions can prepare the students for the development of their own higher education. Students can develop academic interest by knowing the contribution of education in nation building as well as the educational inequalities which persist in the society.

Unit-1: Sociology of Education

1.1 Meaning & Concept of Sociology of Education
1.2 Interrelationship between Education and Society
1.3 Literacy & Education
1.4 Education as Social Construct

Unit-2: Perspectives on Sociology of Education

2.1 Dominant Perspectives on Sociology of Education
2.2 Functionalist
2.3 Conflict
2.4 Critical Perspectives

Unit-3: Education, Social Process

3.1 Education and Socialization
3.2 Education and Social Change
3.3 Education and Social Mobility
3.4 Education and Development

Unit-4: Educational Programs, Policies & Issues in India

4.1 Educational Policies in India
4.2Universalisation of Primary Education
4.3 Privatisation of Education
4.4 Right to Education in Contemporary India

DISCIPLINE SPECIFIC ELECTIVE, PAPER-1

SOCIOLOGY OF HEALTH

Objectives: After studying this paper, the student can

- Gain knowledge on the sociology of health and medicine.
- Can get an insight on socio-cultural dimensions in the construction of illness and medical knowledge.
- Can gain understanding on health sector reforms of Government of India.
- Gain knowledge on medical pluralism for treatment of disease.

Learning Outcome: Students are expected to know the concept of health from different perspectives. They can also learn about the contemporary trend of Sociology of Health in India. By knowing various health policies and programs in India student can expand the information base and disseminate the same to others.

Unit – 1: Sociology of Health

1.1 Meaning & Perspectives

1.2 Emergence of Health Sociology

1.3 Scope of Sociology of Health

1.4 Social Determinants of Health

Unit – 2: Sociological Perspectives of Health

2.1 Functionalist

2.2 Marxist

2.3 Post structuralist

2.4 Feminist

Unit-3: Health Programs in India

3.1 Pradhan Mantri Swasthya Suraksha Yojana (PMSSY)

3.2 Janani SurakshaYojana (JSY)

3.3 National Urban Health Mission

3.4 National AIDS Control Programme

Unit-4: Health Sector Reforms of the Government of India:

4.1 Health Policies of the Government of India

4.2 Role of ICDS

4.3 Protective & Preventive measures

4.4 Promotive measures (modern & indigenous)

CORE PAPER- XI

RESEARCH METHODOLOGY

Since the days of August Comte, a debate and a deliberate attempt has been initiated to provide a scientific character to social sciences. In this attempt empirical research has been introduced as an integral part of observing social reality and generalizing it objectively without any subjective predisposition. Gradually, research methods have been developed and introduced in social sciences to bring it in par with scientific observations. The essence of this paper lies in introducing the students with these methods of research to ensure objectivity as far as practicable in social research.

Objectives: By going through this paper, the student can

- Get an understanding of the nature of scientific methods, nature of social Phenomena and the way of attaining value neutrality.
- Have a grip over the basic steps involved in social research and the types of social research with their applicability
- Develop an insight into the need and types of research design and the use of sampling method for attending objectivity and scientific study.

Learning Outcomes: This paper is designed and incorporated to acquaint the students with the scientific ways of studying social phenomena. This provides them with a research insight that will enable them to capture the most relevant data in an objective manner. The market demand of this paper will be very high as the students well versed with this paper will be highly demanded in academics, fundamental research, and policy research undertaken both by Government and Non-Government agencies.

Unit-1: Meaning & Significance of Social Research

1.1 Meaning ,Definitions& Utility of Social Research
1.2 Major Steps in Social Research
1.3 Scientific Method-Characteristics
1.4 Applicability of Scientific Method

Unit-: 2 Hypothesis & Sampling

2.1 Meaning, definitions and Characteristics of Hypothesis
2.2 Types of and sources of Hypothesis
2.3 Sampling-Meaning & Characteristics
2.4 Types of sampling-probability & non-probability

Unit -3: Tools and Techniques of Data Collection

3.1 Qualitative methods and Quantitative methods
3.2 Observation
3.3 Interview Schedule, Questionnaire
3.4 Case study

Unit-:4 Data Analysis & Report Writing

4.1 Significance of Measures of Central Tendency
4.2 Mean, Median, Mode
4.3 Tabulation and Data Analysis
4.4 Report Writing