COURSES OF STUDIES

FOR

THREE YEAR DEGREE COURSE

IN

SCIENCE HONOURS

BOTANY HONOURS

Choice Based Credit System(CBCS)

First & Second Semester Examination – 2019-20

Third & Fourth Semester Examination – 2020-21

Fifth & Sixth Semester Examination – 2021-22

GOVERNMENT AUTONOMOUS COLLEGE,
PHULBANI, KANDHAMAL

SYLLABI FOR CBCS COURSE

Sem	CORE COURESE (14)	Ability Enhancement Compulsory Course (AECC) (2)	Ability Enhancement Elective Course (AEEC) (2) (Skill Based)	Elective: Discipline Specific DSE (4)	Elective: Generic (GE) (4)
I	CORE-I	AECC-I			GE-IA
	CORE-II				
II	CORE-III	AECC-II			GE-1B
	CORE -IV				
III	CORE-V		SEC-II		GE-2A
	CORE-VI				
	CORE-VII				
IV	CORE-VIII		SEC-I		GE-2B
	CORE-IX				
	CORE-X				
V	CORE-XI			DSE-I	
	CORE-XII			DSE-II	
VI	CORE-XIII			DSE-III	
	CORE-XIV			DSE-IV / Project	

YEAR & SEMESTER-WISE PAPERS & CREDITS AT A GLANCE

Three-Year (6-Semester) CBCS Programme (B.Sc. Hons) (Botany Honours)				
Yr.	Sl.No.	**Course Structure**	**Code**	**Credit Points**
FIRST YEAR		**SEMESTER-I**		
	1	Microbiology and Phycology	C-1.1	4+2
	2	Biomolecules and Cell Biology	C-1.2	4+2
	3	Chemistry	GE-1.3	4+2
	4	EVS	AECC-1.4	6
		SEMESTER-II		
	5	Mycology and Phytopathology	C-2.1	4+2
	6	Archegoniate	C-2.2	4+2
	7	Zoology	GE-2.3	4+2
	8	MIL Communication – Odia / MIL (AE)	AECC-2.4	6
SECOND YEAR		**SEMESTER-III**		
	9	Anatomy of Angiosperms	C-3.1	4+2
	10	Economic Botany	C-3.2	4+2
	11	Genetics	C-3.3	4+2
	12	Chemistry	GE-3.4	6
	13	Quantitative & Logical Thinking	SECC-II-3.5	6
		SEMESTER-IV		
	14	Molecular Biology	C-4.1	4+2
	15	Plant Ecology & Phytogeography	C-4.2	4+2
	16	Plant Systematics	C-4.3	4+2
	17	Zoology	GE-4.4	4+2
	18	Communicative English	SECC-I-4.5	6
FINAL YEAR		**SEMESTER-V**		
	19	Reproductive Biology of Angiosperms	C-5.1	4+2
	20	Plant Physiology	C-5.2	4+2
	21	Analytical Techniques in Plants Sciences	DSE-5.3	4+2
	22	Natural Resource Management	DSE-5.4	4+2
		SEMESTER-VI		
	23	Plant Metabolism	C-6.1	4+2
	24	Plant Biotechnology	C-6.2	4+2
	25	Horticulture Practices & Post Harvest Technology	DSE-6.3	4+2
	26	Industrial & Environmental Microbiology / Project Work	DSE-6.4	4+2 / 6

Notes:

- C- Core Course
- GE- Generic Elective Course
- DSE- Discipline Specific Elective Course
- AECC- Ability Enhancement Compulsory Course
- SECC- Skill Enhancement Compulsory Course
- For a 6 credit course, the total teaching hours are: Minimum- 50 Hours, Maximum-65 Hours

SEMESTER-I

C-1.1 : MICROBIOLOGY AND PHYCOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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*.
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:

❖ Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
❖ Prescott, L.M., Harley J.P., Klein D. A. (2010). Microbiology, McGraw-Hill, India. 8th edition.
❖ Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
❖ Pelczar, M.J., Chan, E.C.S., Krieg, N.R. (2011) Microbiology, 8th edition, Tata McGraw-Hill Co, New Delhi.
❖ Willey, Sherwood and Christopher. Laboratory exercises in Microbiology. McGraw-Hill, India. 9th edition.
❖ Vasistha B.R. (2017) Botany for Degree student, Algae, S. Chand Publication, New Delhi.
❖ Mishra B. K. (2018) Microbiology and Phycology, Kalyani Publishers, New Delhi.

C-1.2 : BIOMOLECULES AND CELL BIOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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.
iii. 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

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Counting the cells per UNIT volume with the help of haemocytometer. (Yeast/pollen grains).
5. Study the phenomenon of plasmolysis and deplasmolysis.
6. 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:

❖ Sahoo, K. (2017) Biomolecules and Cell Biology, Kalyani Publishers, New Delhi.
❖ Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012) Biochemistry: A short course, 2nd ed., W.H. Freeman
❖ Nelson, D.L. and Cox, M.M. (2008) Lehninger Principles of Biochemistry, 5th Edition, W.H. Freeman and Company.
❖ Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
❖ 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

GE-1.3 : 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, Schrodinger 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-Lande 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: Huckel'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, 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; 8th Edn, New Age International, 2015.

Reference books :

- ❖ Das Asim K., Fundamentals of Inorganic Chemistry, Vol. II, CBS Publications, 2nd Ed. 2010.
- ❖ Pradeep's Inorganic Chemistry, Vol. I & II, Universal Book seller, 14th Ed. 2017.
- ❖ Mallick, Madan and Tuli, S. Chand Selected Topic in Inorganic Chemistry, 17thEdn. 2010.
- ❖ Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications.

PRACTICAL

SECTION A: INORGANIC CHEMISTRY

Volumetric Analysis

a. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
b. Estimation of oxalic acid by titrating it with $KMnO_4$.
c. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
d. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
e. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

SECTION B: ORGANIC CHEMISTRY

a. Detection of extra elements (N, S, Cl) in organic compounds (containing up to two extra elements)
b. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
   i. 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.
   ii. Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- ❖ Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
- ❖ Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
- ❖ Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

AECC-1.4 : ENVIRONMENTAL STUDIES

Full Marks – 100
Mid Sem – 20/1 hr
End Sem – 80/3 hrs

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: Grass root 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

Books Recommended:

- ❖ Dash MC and Mishra PC, Man and Environment, McMillan, London.
- ❖ Mishra PC and Das MC, Environment and Society, McMillan, London.
- ❖ Odeem EP, Fundamentals of Ecology, Natraj Publication.
- ❖ Mishra DD, Fundamental Concept in Environmental Studies, S. Chand, New Delhi.
- ❖ Asthana DK and Asthana Meera, A Text book of Environmental Studies, S. Chand, New Delhi.
- ❖ Bharucah Erach, Textbook for Environmental Studies, Universities Press India Pvt. Ltd., Hyderabad.

SEMESTER-II

C-2.1 : MYCOLOGY AND PHYTOPATHOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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:

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

C-2.2 : ARCHEGONIATAE

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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

1. Morphology, anatomy and reproductive structures of *Riccia*, *Marchantia*, *Anthoceros*, *Funaria*.
2. *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).
3. *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).
4. *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).
5. Study of temporary preparations and permanent slides of *Marsilea*.
6. *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).
7. (vii)*Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll and megaspore, T.S root, leaflet, rachis
8. *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.
9. *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide).
10. 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:

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

GE-2.3 : FOOD, NUTRITION AND HEALTH

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

UNIT – I: Basic concept of food and nutrition

Food Components and food-nutrients, Concept of a balanced diet, nutrient needs and dietary pattern for various groups, adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

UNIT – II: Nutritional Biochemistry:

Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions

UNIT – III: Health

Introduction to health- Definition and concept of health, Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications, Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention, Common ailments- cold, cough, and fevers, their causes and treatment

UNIT – IV: Food hygiene:

Potable water- sources and methods of purification at domestic level Food and Water borne infections: **Bacterial infection**: Cholera, typhoid fever, dysentery; **Viral infection**: Hepatitis, Poliomyelitis, **Protozoan infection**: amoebiasis, giardiasis; **Parasitic infection**: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention. Brief account of food spoilage: Causes of food spoilage and their preventive measures

PRACTICAL

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
2. Estimation of Lactose in milk
3. Ascorbic acid estimation in food by titrimetry
4. Estimation of Calcium in foods by titrimetry
5. Study of the stored grain pests from slides/ photograph (*Sitophilus oryzae*, *Trogoderma granarium*, *Callosobruchus chinensisand Tribolium castaneum*): their identification, habitat and food sources, damage caused andcontrol. Preparation of temporary mounts of the above stored grain pests.
6. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups. OR Identify nutrient rich sources of foods **(fruits and vegetables),** their seasonal availability and price OR Study of nutrition labeling on selected foods

Text Books :

1. Mudambi, SR and Rajagopal, MV (2018). Fundamentals of Foods, Nutrition and Diet Therapy; Sixth Ed; New Age International Publishers.
2. Bamji MS, Rao NP, and Reddy V.(2017) Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd., 4th edition

Suggested Readings :

❖ Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
❖ Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
❖ Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO

AECC – 2.4 : MIL COMMUNICATIONS – ODIA

(ଯୋଗାଯୋଗ ଅନୁବିଧି, ରୀତି ଓ ମାଧ୍ୟମ)

Full Marks – 100
Mid Sem – 20/1hr
End Sem – 80/3 hrs

୧ମ ଏକକ / ୟୁନିଟ୍ – ୧ :

ଯୋଗାଯୋଗର ପରିଭାଷା, ଅନୁବିଧି, ପରିସର ଓ ପ୍ରକାରଭେଦ

୨ୟ ଏକକ / ୟୁନିଟ୍ – ୨ :

ସାକ୍ଷାତକାର, ଭାଷଣ କଳା

୩ୟ ଏକକ / ୟୁନିଟ୍ – ୩ :

ସମ୍ବାଦର ପରିଭାଷା, ପରିସର ଓ ସମ୍ବାଦ ପ୍ରସ୍ତୁତି

୪ର୍ଥ ଏକକ / ୟୁନିଟ୍ – ୪ :

ଓଡ଼ିଆ ଭାଷାର ବର୍ଣ୍ଣମାଳା, ବର୍ଣ୍ଣାଶୁଦ୍ଧିର ନିରାକରଣ । (ବନାନ ତ୍ରୁଟି - ସାଦୃଶ୍ୟଜନିତ ଅଶୁଦ୍ଧି, ଲିଙ୍ଗଗତ ଅଶୁଦ୍ଧି, ସନ୍ଧିଗତ ଅଶୁଦ୍ଧି, ସମାସଗତ ଅଶୁଦ୍ଧି, ବଚନ ଓ ବିଭକ୍ତିଗତ ଅଶୁଦ୍ଧି, ବାକ୍ୟ ବିଧିଜନିତ ଅଶୁଦ୍ଧି, ସମାର୍ଥବୋଧକ ଶବ୍ଦାଶୁଦ୍ଧି, ପ୍ରତ୍ୟୟ ଜନିତ ଅଶୁଦ୍ଧି, ଶବ୍ଦ ସଂଯୋଗାତ୍ମକ ଓ ସ୍ୱରସଙ୍ଗତି ଜନିତ ଅଶୁଦ୍ଧି)

ସହାୟକ ଗ୍ରନ୍ଥସୂଚୀ :

୧. ଯୋଗାଯୋଗ ମୂଳକ ମାତୃଭାଷା (ଓଡ଼ିଆ) - ସାମଲ ବିରଞ୍ଚି ନାରାୟଣ, ସତ୍ୟନାରାୟଣ ବୁକ ଷ୍ଟୋର, କଟକ

୨. ସଂଯୋଗ ଅନୁବିଧି - ସନ୍ତୋଷ କୁମାର ତ୍ରିପାଠୀ, ନାଳନ୍ଦା, କଟକ

୩. ଭାଷଣ କଳା ଓ ଅନ୍ୟାନ୍ୟ ପ୍ରସଙ୍ଗ - କୃଷ୍ଣଚନ୍ଦ୍ର ପ୍ରଧାନ, ସତ୍ୟନାରାୟଣ ବୁକ୍ ଷ୍ଟୋର,କଟକ

୪. ପ୍ରାୟୋଗିକ ଓଡ଼ିଆ ଭାଷା – ଓଡ଼ିଶା ରାଜ୍ୟପାଠ୍ୟ ପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୫. ସମ୍ବାଦ ଓ ସାମ୍ବାଦିକତା – ଚନ୍ଦ୍ରଶେଖର ମହାପାତ୍ର, ଓଡ଼ିଶା ରାଜ୍ୟ ପାଠ୍ୟପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା, ଭୁବନେଶ୍ୱର

୬. ନିର୍ଭୁଲ ଲେଖାର ମୂଳସୂତ୍ର - ନୀଳାମ୍ବିଭୂଷଣ ହରିଚନ୍ଦନ, ପି.ସି.ଆର ପବ୍ଲିକେସନ, ଭୁବନେଶ୍ୱର

୭. ସର୍ବସାର ବ୍ୟାକରଣ - ନାରାୟଣ ମହାପାତ୍ର ଓ ଶ୍ରୀଧର ଦାସ, ନିୟୁ ଷ୍ଟୁଡେଣ୍ଟସ୍ ଷ୍ଟୋର, କଟକ

ମୂଲ୍ୟ ବିଭାଜନ ପଦ୍ଧତି : (ସବୁଥିରୁ ବିକଳ୍ପ ପଢ଼ିବ)

(କ) ପତ୍ରର ମୋଟ ନମ୍ବର – ୧୦୦

(ଖ) ଅନ୍ତଃପରୀକ୍ଷା – ୨୦ ଓ ମୁଖ୍ୟ ପରୀକ୍ଷା – ୮୦

(ଗ) ନିର୍ଦ୍ଧାରିତ ପାଠ୍ୟର ସବୁ ଏକକ(ୟୁନିଟ୍)ରୁ ବିକଳ୍ପସହ ଦୁଇଟି ଲେଖାଏଁ ମୋଟ ୮ଟି ୧୫ନମ୍ବର ବିଶିଷ୍ଟ ଦୀର୍ଘ ପ୍ରଶ୍ନ ପଡିବ । ବିଦ୍ୟାର୍ଥୀଙ୍କୁ ୪ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (୧୫ x ୪ = ୬୦)

(ଘ) ନିର୍ଦ୍ଧାରିତ ପାଠ୍ୟର ସବୁ ଏକକରୁ ୧୨ଟି ଅତିସଂକ୍ଷିପ୍ତ ପ୍ରଶ୍ନ ପଡ଼ିବ । ସେଥିରୁ ୧୦ଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ । (୧୦ x ୨ = ୨୦)

AECC-2.4 : MIL (ALTERNATIVE ENGLISH)

Full Marks – 100
Mid Sem – 20/1hr
End Sem – 80/3 hrs

Introduction:
The paper is focused upon developing one fundamental skills of Language learning; reading which needs a thorough rethink and revision. In order to build a strong base for acquisition of the communication skills, suitable reading content is selected from diverse areas in prose form. This would boost the learner's competence in expressive and comprehension skills. The well researched language exercises in the form of usage, vocabulary and grammar is the other area that should attract the teacher and learner to work out for giving decent shape to the mastery of English language.

UNIT - I: Short Story

a. Jim Corbett-The Fight between Leopards
b. Dash Benhur- The Bicycle
c. Dinanath Pathy- George V High School
d. Alexander Baron- The Man who knew too much
e. Will F Jenkins- Uneasy Homecoming

UNIT - II: Prose

a. Mahatma Gandhi- The way to Equal Distribution
b. S Radhakrishnan- A Call to Youth
c. C V Raman-Water- The Elixir of Life
d. Harold Nicolson- An Educated Person
e. Claire Needell Hollander- No Learning without Feeling

UNIT - III:

Comprehension of a passage and answering the questions

UNIT - IV:

Language exercises-test of vocabulary, usage and grammar

Text Books:

1. All Stories and Prose pieces

Reference Books:

- *The Widening Arc: A Selection of Prose and Stories*, Ed. A R Parhi, S Deepika, P Jani, Kitab Bhavan, Bhubaneswar.
- *A Communicative Grammar of English*, Geoffrey Leech.
- *A University Grammar of English*, Randolph Quirk and Sidney Greenbaum
- *Developing Reading Skills*. F. Grellet. Cambridge: Cambridge University Press, 1981.

SEMESTER-III

C-3.1 : ANATOMY OF ANGIOSPERMS

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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); cytodifferentiation 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 examplesof 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, C4 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:

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

C-3.2 : ECONOMIC BOTANY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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

1. Cereals: Rice (habit sketch, study of paddy and grain, starch grains).
2. Legumes: Soya bean/moong bean/black gram, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. 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).
4. Spice and Beverages: clove, black pepper,Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
5. Oils & Fats: Groundnut, Mustard–plant specimen, seeds; tests for fats in crushedseeds.
6. Drug-yielding plants: Specimens of *Digitalis*, *Papaver* and *Cannabis.*
7. Woods: *Tectona*, *Pinus*/Sal: Specimen, Section of young stem.
8. 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:

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

C-3.3 : GENETICS

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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 effectsshell 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:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & Sons, India. 8th edition.
- Sinnot, E.W., Dunn, L.C. and Dobzhansky, T. (1985) Principles of Genetics, Tata Mc Grow Hill, New Delhi
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
- 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.
- Strickberger, M.W. Genetics, Pearson Publishers, 3rd Edition
- Rastogi V. B. (2017). Genetics, Kedar Nath & Ram Nath, Meerut

GE-3.4 : CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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 Kp, Kc and Kx 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 (S_N1, S_N2 and S_Ni) 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:

❖ Kheterpal S.C., Pradeep's Physical Chemistry, Vol. I & II, Pradeep Publications.
❖ Dhawan, S.N., Pradeep's Organic Chemistry, (Vol. I and II), Pradeep Publications

PRACTICAL

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

❖ A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
❖ Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
❖ Khosla, B.D.; Garg, V.C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).
❖ Ahluwalia, V.K., Dhingra, S. and Gulati A, College Practical Chemistry, University Press (2005).

SECC-II-3.5 : QUANTITATIVE AND LOGICAL THINKING

Full Marks – 100
Mid Sem – 20/1hr
End Sem – 80/3 hrs

I. QUANTITATIVE APTITUDE & DATA INTERPRETATION

UNIT – I :

Whole numbers, Integers, Rational and irrational numbers, Fractions, Square roots and Cube roots, Surds and Indices, Problems on Numbers, Divisibility

Steps of Long Division Method for Finding Square Roots:

UNIT – II :

Basic concepts, Different formulae of Percentage, Profit and Loss, Discount, Simple interest, Ratio and Proportion, Mixture

UNIT – III :

Time and Work, Pipes and Cisterns, Basic concepts of Time, Distance and Speed; relationship among them

UNIT – IV :

Concept of Angles, Different Polygons like triangles, rectangle, square, right angled triangle, Pythagorean Theorem, Perimeter and Area of Triangles, Rectangles, Circles

UNIT – V :

Raw and Grouped Data, Bar Graphs, Pie charts, Mean, Median and Mode, Events and Sample Space, Probability

II. LOGICAL REASONING

UNIT – I :

Analogy basing on kinds of relationships, Simple Analogy; Pattern and Series of Numbers, Letters, Figures. Coding-Decoding of Numbers, Letters, Symbols (Figures), Blood relations

UNIT – II :

Logical Statements– Two premise argument, More than two premise argument using connectives

UNIT – III :

Venn Diagrams, Mirror Images, Problems on Cubes and Dices

Books Prescribed :

1. Quantitative And Logical Thinking – Odisha State Higher Education Council, Bhubaneswar

SEMESTER-IV

C-4.1 : MOLECULAR BIOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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)

ii. 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:

- 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.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
- Sheeler, P. and Bianchi, D.E. (2009) Molecular Biology of the Cell, Willey Publisher, New Delhi
- 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.
- Alberts, B. et al. 2014. Molecular Biology of the cell Garland Science. 6th Edition
- Power, C. B. (2017) Cell Biology, Himalaya Publishing House, New Delhi
- Sahu, A.C. (2017). Essentials of Molecular Biology, Kalynai Publishers, New Delhi.

C-4.2 : PLANT ECOLOGY & PHYTOGEOGRAPHY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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:

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

C-4.3 : PLANT SYSTEMATICS

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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

1. 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).
2. 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:
- Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi.3rdedition.
- Jeffrey, C. (1982). An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge.
- 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.
- Saxena, H. O. and Brahman, M..The Flora of Orissa, CSIR Publication.
- Bose T. K. (2009). Trees of the World, Regional Plant Resource Centre, Bhubaneswar, Odisha, India
- Radford, A.E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York.
- Hanes, H. H. (2009). Botany of Bihar and Orissa,
- Mohanty, C. R. (2017). Text Book of Plant Systematics, Kalynai Publisher, New Delhi.
- Subrahmainayam, M. S. (2011) Modern Plant Taxonomy, Vikash Publishing House, New Delhi
- Pandey, B. P., (2017). Taxonomy of Angiosperm. S. Chand Publication.

GE-4.4 : ENVIRONMENT AND PUBLIC HEALTH

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

UNIT – I: Environmental hazards

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

UNIT – II: Pollution

Air, water, noise pollution sources and effects, Pollution control; Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

UNIT – III: Waste Management Technologies

Sources of waste, types and characteristics, Sewage disposal and its management,

Solid waste disposal, biomedical waste handling and disposal, nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath

UNIT – IV: Diseases

Causes, symptoms and control of: Tuberculosis, Asthma, Cholera, Typhoid, Malaria and AIDS

PRACTICAL

1. To determine pH, Cl, SO4, NO3 in soil and water samples from different locations.

Text Books :
1. Cutter, S.L. (1999) Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Park K (2017) Parks Text Book Of Preventive & Social Medicine, Banarsidas Bhanot Publishers

Suggested Readings :
- Kolluru Rao, Bartell Steven, Pitblado R and Stricoff 1996. “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York.
- Kofi Asante Duah 1998 “Risk Assessment in Environmental management”, John Wiley and sons, Singapore.
- Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., 2003. Global Environmental Risks, V.N. University Press, New York,
- Joseph F Louvar and B Diane Louver 1997 Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.

SECC-I-4.5 : COMMUNICATIVE ENGLISH

(Enriching Linguistic Knowledge & Communication Proficiency)

Full Marks – 100
Mid Sem – 20/1hr
End Sem – 80/3 hrs

UNIT-I : BUSINESS COMMUNICATION AND GRAMMAR

Why English Communication is Essential and How to Improve the Skill?
Introduction to Voice and Accent , Why do we have such different accents?, Accent Training-Consequences, Voice and accent in the Enterprise Industry, Globally Comprehensible Accent, Introduction to Phonetics, International Phonetic Alphabet
Consonant Sounds
Vowels
Diphthongs
A Few Phonic Rules
Word Stress: Syllables
Intonation : Intonation and Stress
Pacing and Chunking : Common Patterns of Pacing, Importance of Chunking
Fluency
Indianisms : Errors relating to Grammar, Vocabulary

UNIT-II : GRAMMAR

English: Spoken Versus Written Communication
Nouns : Kinds of Nouns, Activity 3: Noun Ping-pong, Nouns-Number, Noun-Gender, Countable and Uncountable Nouns
Pronouns : Reflexive Pronouns, Relative Pronouns, Demonstrative Pronouns, Interrogative Pronouns, Indefinite pronouns, Activity 4: Sentence Auction
Adjectives : Activity 5 : Picture perfect, Positioning of adjectives, Comparative Degrees of Adjectives, Order of Adjectives
Adverbs : Kinds of Adverb, Degree of Comparison, Word Order with Adverbs, Activity 6: Relay Race
Prepositions : Activity 7: Treasure Hunt, Activity 8: Route Map, Prepositions with Adjectives, Nouns and Verbs
Conjunctions : Coordinating conjunctions, Subordinating Conjunctions, Correlative Conjunctions, Connecting Adverbs, Activity 9: The Socks Story
Verbs : Verb Classification, List of irregular verbs, Activity 10: Word Search
Subject and verb agreement, Activity 11: Tossed Word Salad, Activity 12: The Sentence Pageant Determiners and Modifiers : Kinds of determiners, The Definite and the Indefinite Article, Definite Article: The, Activity 13: Proof Reading
Tenses : Reference Table, Present Tense, Activity 14: Instruction Manual, Activity 15: Commentary, Past Tense, Activity 16:The Chain List, Activity 17: Transcription, Future Tense, Activity 18: This Week for You, Activity 19: Verb Grand Prix
Punctuation : Forms of Punctuation

UNIT-III : READING COMPREHENSION

Reading – A 7 Step Process, Techniques to enhance students' reading skills, Types of reading skills, Skimming, Scanning, Extensive reading, Intensive reading, Three levels of Reading, Improving your reading speed, Reading Comprehension Practice Exercises

Text Books:

1. Communicative English – Odisha State Higher Education Council, Bhubaneswar

SEMESTER-V

C-5.1 : REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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

1. 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.
2. 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.
3. Ovule: Types-anatropous, orthotropous, amphitropous/ campylotropous, circinotropous, UNITegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent
4. slides/specimens/photographs). Female gametophyte through permanent slides/photographs: Types, ultrastructure of mature egg apparatus.
5. 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.
6. Tracing the path of pollen tube.
7. 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.
❖ Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
❖ Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
❖ Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.
❖ 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.

C-5.2 : PLANT PHYSIOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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, antitranspirants, 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 photomorphogenesis, 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:

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

DSE-5.3 : ANALYTICAL TECNIQUES IN PLANT SCIENCES

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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 densitygradient, CsCl2gradient, 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:

- Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
- Ruzin, S.E. (1999). Plant Micro technique and Microscopy, Oxford University Press, New York. U.S.A.
- 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.
- Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.
- Aneja, K. R. (2014). Laboratory manual of microbiology and biotechnology, Medtech, New Delhi

DSE-5.4 : NATURAL RESOURCE MANAGEMENT

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

UNIT-I

i. Natural resources: Definition and types.
ii. Sustainable utilization :Concept, approaches (economic, ecological and sociocultural).
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

1. Estimation of solid waste generated by a domestic system (biodegradable and nonbiodegradable) and its impact on land degradation.
2. Collections of data on forest cover of specific area.
3. Measurement of dominance of woody species by DBH (diameter at breast height) method.
4. Calculation and analysis of ecological footprint.
5. Ecological modeling.
6. Estimation of soil moisture content and soil texture.
7. Estimation of soil porosity
8. Estimation of soil water-holding capacity.
9. Estimation of soil organic matter and soil carbon

Text Books:

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

Reference Books:

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

SEMESTER-VI

C-6.1 : PLANT METABOLISM

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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, C3, C4 pathways; Crassulacean acid metabolism; Factors affecting CO2 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, cyanideresistant 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:

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

C-6.2 : PLANT BIOTECHNOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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:

- Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
- Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
- Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
- Singh, B. D. (2018). Plant Biotechnology Kalynai Publishers, New Delhi.
- Gupta, P. K. (2017). Plant Biotechnology, Rastogi Publication, Meerut.
- Dubey, R. C. (2017). Advanced Biotechnology, S, Chand Publication, New Delhi

DSE-6.3 : HORTICULTURAL PRACTICES AND POST-HARVEST TECHNOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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

1. Identification and description of salient features of ornamental plants included in the syllabus.
2. Horticultural techniques (Drip irrigation, surface irrigation, furrow and border irrigation).

3. Study of practice of asexual propagation methods (grafting, cutting, layering, budding)
4. Planning and layout of parks and avenues
5. Handing of harvested fruits, vegetables and cut flowers
6. Methods of fruit preservation
7. Basic tissue cultures technique

Text Books:

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

Reference Books:

- Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
- Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
- NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
- Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.
- Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.
- Pandey, P. H. (2007). Principles and Practices of Post Harvest Technology, Kalyani Publishers, New Delhi.

DSE-6.4 : INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

Full Marks – 100
Mid Sem – 15/1hr
End Sem Theory – 60/3 hrs
End Sem Practical – 25/3 hrs

THEORY

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

- Pelzar, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
- Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.

- Pradipta K. Mohapatra (2008). Text Book of Environmental Microbiology, I.K. International Publishing House, New Delhi
- A. K. Rath (2018). Industrial and Environmental Microbiology, Kalyani Publishers, New Delhi.

OR

DSE-6.4 : DISSERTATION / PROJECT WORK

Full Marks – 100
End Sem Project– 100

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

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