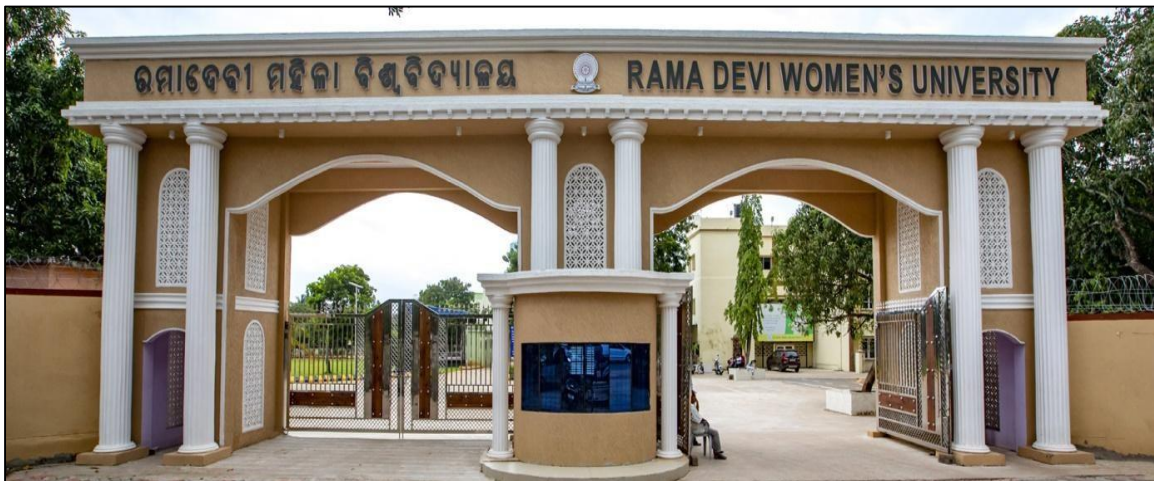


DEPARTMENT OF LIFE SCIENCE

SYLLABUS OF PG PROGRAMME (M.Sc.)



RAMA DEVI WOMEN'S UNIVERSITY
Vidya Vihar, Bhubaneswar-751022, Odisha
Website: <https://rdwu.ac.in>

DEPARTMENT OF LIFE SCIENCES
COURSE STRUCTURE AND SYLLABUS
FOR
P.G. LIFE SCIENCES



RAMA DEVI WOMEN'S UNIVERSITY

VIDYA VIHAR, BHUBANESWAR-751022

M. Mohan Prasad
13.10.23
Controller of Examinations
R.D. Women's University
Bhubaneswar

PAPER	COURSE CODE	COURSE TITLE	Units	Credits	Mid-sem	End-sem	Total
SEMESTER-I							
Hard Core	HC-101	Cell biology	5	5	30	70	100
Hard Core	HC-102	Microbiology	5	5	30	70	100
Hard Core	HC-103	Bioinstrumentation	5	5	30	70	100
Hard Core	HC- 104	Practical related to paper HC-101, HC-102, HC-103		5	30	70	100
Allied Core	AC-101	Computer application course by e-learning centre	3	3	Mid sem 10 + Practical 10= 20 marks	30	50
TOTAL				23	140	310	450
SEMESTER-II							
Hard Core	HC-201	Biochemistry	5	5	30	70	100
Hard Core	HC-202	Molecular Biology and Genetic Engineering	5	5	30	70	100
Hard Core	HC-203	Ecology, Evolution and Taxonomy	5	5	30	70	100
Hard Core	HC- 204	Practical related to paper HC-201, HC-202, HC-203 and CE-201 A/B		5	30	70	100
Core Elective	CE-201 A/B	A: Plant Diversity B: Animal Diversity	5	5	30	70	100
Open Elective	OE-201 A/B	A: Human health & Hygiene B: MOOCs (From SWAYAM/ NPTEL etc.)		4		50	50
TOTAL				29	150	400	550
SEMESTER-III							
Hard Core	HC-301	Immunology	5	5	30	70	100
Hard Core	HC-302	Genetics	5	5	30	70	100
Hard Core	HC-303	Practical related to paper HC-301, HC- 302 and CE-301 A/B, CE-302 A/B	-	5	30	70	100
Core Elective	CE-301 A/B	A: Plant Physiology Developmental Biology B: Animal Developmental Biology, Physiology & Endocrinology	5	5	30	70	100

Core Elective	CE-302 A/B	A: Research Methodology B: Waste Management	5	5	30	70	100
Field Internship	FI- 301	Field Internship		3		50	50
TOTAL				28	150	400	550
SEMESTER-IV							
Hard Core	HC-401	Review Literature	-	5	-	100	100
Hard Core	HC-402	Seminar	-	5	-	100	100
Hard Core	HC-403	Dissertation	-	5	-	100	100
Core Elective	CE-401	Final Presentation	-	5	-	100	100
Allied Core	AC-401	Theory : 'Women and Society' (For All PG Subjects/Programs)	03	03	15	35	50
TOTAL				23	15	435	450

Summary

HC-HardCore	14 x100	1400
CE-CoreElective	4 x100	400
OE-OpenElective	1x50	50
AC-AlliedCore	2x50	100
FI-FieldInternship	1x50	50
TotalMarks:		2000

Summary

	Credits	TotalMarks
Sem-I	23	450
Sem-II	29	550
Sem-III	28	550
Sem-IV	23	450
TOTAL	103	2000

PROGRAM OUTCOMES (POs):

PO1. The interaction of chemical substances with the human body and other organic life processes and the positive and negative effects of chemicals on specific body parts.

PO2. To improve scientific understanding of microorganisms and to apply this insight to enhance performance in medicine and related industries.

PO3. To cover a broad range of biological studies like drug research, ecology, genetics and apply this knowledge in biotech and pharmaceutical sectors for improving human living standard.

PO4. To understand the chemical nature of living entities such as cells, plants and animals. This might include biological processes, genetics, organism growth and disease.

PO5. Research and development to improve industries like food processing, pharmaceutical, health care and agriculture.

PO6. Enhance maintenance of laboratory equipment, help them to perform experiments, collect data and analyse it to discover new things.

PO7. Enhance various complex statistical skills, guidance, study genetics information and disease rates regularly.

PO8. Enhance their programming skills to improve software products, databases and analytical tools.

PO9. Making them capable of using their expertise and learning of chemistry, physiology, genetics, physics and biology to extract DNA and RNA samples from living organisms and study their interactions.

PO10. Making them capable to engage in research and development sectors such as biofuels, animal husbandry and environmental protection organizations, among others.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO-1 Students can further pursue jobs for lectureship post in different educational institutions.

PSO-2 Acquired practical learning from internship, field visit, industrial visit and research projects.

PSO-3 Students can continue their academic career by opting for PhD in the interested field.

PSO-4 Understand and develop new dimension of knowledge in the pharmaceutical industries.

SEMESTER I

HC-101	CELL BIOLOGY	5CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Developed a deeper understanding of cell structure and how it relates to cell function. And be able to discuss the mechanism behind the transport of molecules across plasma membrane.
2. Ability to explain the cell-cell interactions and & various types cell junctions with significant role.
3. Understood cell signalling and how it regulates cellular functions and how its dysregulation leads to cancer and other diseases.
4. Knowledge about interpreting protein translocation, protein folding and processing in ER and Golgi.
5. Knowledge about the events of cell cycle and its regulation.

Unit-I: The Cell Surface: Fluid mosaic model of plasma membrane, Transport of molecules Across Membranes: Passive transport, Active Transport, Bulk transport: Endocytosis, Exocytosis; Cell-Cell Interaction: Cell Adhesion Molecules (CAMs), Tight Junction, Gap Junction, Desmosomes, hemidesmosomes

Unit-II: Cell Signaling: Types of Signaling molecules and their receptors; Function of cell surface receptors: G Protein-Coupled Receptors, Receptor Protein-Tyrosine Kinases, Cytokine Receptors; Pathways of intracellular signal transduction: cAMP & cGMP Pathway, PI 3-Kinase/Akt & mTOR Pathway, MAP Kinase Pathway, JAK/STAT pathway, TGF- β /Smad Pathway, Hedgehog & Wnt pathway

Unit-III: Organization of Nucleus: Nuclear envelope, nuclear pore complex, Process of Nuclear protein Import and Export; Mitochondria and Chloroplast: Structure, biogenesis, transport of proteins

Unit-IV: Protein trafficking: Protein Translocation, Protein Folding in Endoplasmic Reticulum (ER), Protein Glycosylation in Golgi, Protein Sorting and Export from Golgi Apparatus, Mechanism of Vesicular Transport: Cargo Selection, Coat Proteins, and Vesicle Budding, Vesicle Fusion

Unit-V:

Cytoskeleton: Actin, myosin and motor proteins, Assemble of Microtubules, Cell cycle: Kinetochore structure, centrosome and its function, Different stages of mitosis and meiosis, Regulation of cell cycle by cyclin & Cyclin Dependent Kinases (CDKs), checkpoints, tumor-suppressor gene and effects on cell cycle

Reference Books

1. The cell: A molecular approach-5th Edn- Geoffrey M. Cooper and Robert E. Hausman, Publ. by Asm. Press
2. Chromosome – Organization and function, Adrian T. Summer, Blackwell Pub.

3. Chromosomes 3rd Edn. Archana Sharma, Oxford IBH

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	2	4	5	4	4	5
CO2	4	5	5	2	5	5	5	4	4	5
CO3	5	5	4	2	5	5	5	5	4	4
CO4	5	5	4	4	4	2	4	5	4	4
CO5	4	4	5	5	5	4	5	4	4	2

HC- 102	MICROBIOLOGY	5CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Ability to identify common infectious agents and the diseases that they cause.
2. Idea to evaluate methods used to identify infectious agents in the clinical microbiology lab.
3. Familiarized with microbial physiology including metabolism, regulation and replication.
4. Knowledge of microbiology in various field.
5. Ability to explain the mechanism of viral infections in current scenario.

Unit I: History and development of microbiology, Major microbial groups of aerobic and anaerobic habitats, Classification of microbes, Whittakar's five kingdom concept, Carl Woese's 3 domain Classification; Bergy's Manual for classification of microbes.

Unit II: Two Basic Cell Types: Prokaryotic cell: Size, Shape and Arrangement of Cells, Characteristics of a Typical Prokaryotic Cell, The Eukaryotic Cell, Structure and Functions of Prokaryotic and Eukaryotic Cell.

Unit III:: Basic idea about Archaeobacteria, Mycoplasma, Rickettsia, Protozoa, Cyanobacteria, Eubacteria, General features of Mycoplasma.

Unit- IV: Isolation, Culture and Maintenance of microorganisms; Growth media and culture conditions: Microbial growth, Measurement of growth, batch, continuous and Synchronous culture, Factors regulating microbial growth.

Unit- V: Cell structure of bacteria, Genetic recombination in bacteria-Transduction, Transformation and Conjugation; Role of Plasmids, General features and classification of virus, Bacteriophage: structure, replication and life cycle, TMV Structure and replication, General features of Viroids and Prions. SARS

Reference Books:

1. Cellular and Molecular Immunology- Abul, K. Abbas-Saunders Publ.
2. Microbiology- M. J. Jr. Pelezar- Ecs Chan
3. General Microbiology- R. Y. Stainer, J. H. Ingraham.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	2	5	4	4	5
CO2	5	5	4	5	5	5	5	4	4	5
CO3	4	4	5	2	2	5	4	5	4	4
CO4	5	5	4	2	4	5	4	5	4	4
CO5	4	5	5	4	5	4	5	4	4	2

HC- 103	BIO INSTRUMENTATION	5CH	100 Marks
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Course Outcomes:

After reading this paper, students should have:

1. Ability to describe the methodology involved in biotechniques and application of bioinstruments.
2. Knowledge to demonstrate and practical skills of using instruments in biology and medical field.
3. Ability to perform techniques involved in molecular biology and diagnosis of diseases.
4. Updated current knowledge regarding biomedical engineering involving new methods and the instrumentation.
5. Improved system productivity, reliability, safety and stability.

Unit-I: Basic Instruments: Digital Balance, pH meter, pH calibration, Autoclave and its principle. Hot air oven, Laminar air flow and its function, HEPA filters, Membrane filters, Separation of biomass, Filtration and types of Filtrations and their applications.

Unit-II: Instrumentation I: Microscopy- Principle of light transmission, Types of Microscopes- Simple, Compound, Fluorescence, Electron (SEM, TEM), Centrifugation: principles of centrifugation and types and applications, differential and density gradient centrifugation.

Unit- III: Instrumentation II: Electrophoresis: Principles, Types- Agarose, polyacrylamide gel, 2-D Electrophoresis, Pulsed Field Gel Electrophoresis; working applications, Chromatography: Principles, types and applications-gel filtration chromatography, paper chromatography, TLC, GLC, Ion exchange and affinity chromatography, HPLC.

Unit IV: Instrumentation III: Spectrophotometry: Principles, Beer-Lamberts Law, Components, Working mechanism and applications of UV-Vis spectrophotometer, Atomic Absorption spectrophotometer, Fourier Transform Infrared Spectroscopy

Unit V: Advanced Techniques in Biology: Polymerase Chain Reaction (PCR) and its variants. Application of PCR in biology, ELISA- Types and Applications, Radio Immuno Assay, Blotting techniques and their application, DNA sequencing. Geiger Muller Counter - Principles and uses. XRD

Reference Books:

1. Physical Biochemistry - Friefelder, Publ. D.W.H. Freeman Press.
2. 2Biophysical Chemistry: Principles and Techniques, 2nd Edition, By- A.Upadhyay, K. Upadhyay & N. Nath. Himalaya Publishing House, Delhi.
Principles of Techniques of Practical Biochemistry Wilson, K. and Walker, J. Publ. Cambridge.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	2	2	4	4	5
CO2	5	5	4	5	5	5	2	4	4	5
CO3	4	4	5	4	4	5	4	2	4	4
CO4	5	5	4	4	5	2	4	5	4	4
CO5	4	5	5	4	5	4	5	2	4	4

HC-104	PRACTICAL BASED ON PAPERS HC 101, HC 102, HC 103	6CH	100 Marks
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Course Outcomes:

After reading this paper, students should have:

1. Knowledge to perform and evaluate methods used to identify microbes and their activity.
2. Ideas to analyse microbial physiology including metabolism, regulation and replication.
3. Ideas to evaluate and apply knowledge of microbiology in various field.
4. Ability to execute various basic instruments of life sciences.
5. Familiarized with perform various cell interaction experiments.

Practical

1. Squash preparation of Mitosis in onion root tip
2. Squash preparation of Meiosis
3. Temporary and permanent squashing of Grasshopper testis for observation of meiotic cell division.
4. Preparation of liquid and solid media for growth of microorganisms.
5. Study of organisms by Gram Stain

6. Isolation & Maintenance of organisms by plating, streaking and serial dilution slant and slab cultures, pure culture method (Collection from soil, water & rice fields).
7. Antibiotic assay
8. Preparation of Normal and Molar solutions and Buffers.
9. Electrophoresis of protein
10. To perform the experiments using following instruments
 - (i) pH Meter (to measure the pH of the supplied sample)
 - (ii) Microscope (to identify the morphology of the supplied sample)
 - (iii) Spectrophotometer (to determine the absorption maxima, measure the concentration of the supplied sample)
 - (iv) Chromatography (to separate the supplied sample on the basis of mass, charges and weight)
 - (v) Centrifuge (to separate biomass of the supplied sample)
 - (vi) Autoclave/pressure cooker for sterilization

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	2	5	4	4	5
CO2	5	5	4	4	5	5	4	4	4	5
CO3	5	4	5	5	4	5	4	2	4	4
CO4	5	4	4	2	5	4	2	5	4	4
CO5	4	5	5	4	5	4	5	2	4	4

SEMESTER-II

HC 201	BIOCHEMISTRY	5CH	100 Marks
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Course Outcomes:

After reading this paper, students should have:

1. Knowledge to demonstrate the role of carbohydrates in biological system by relating its structure.
2. Ability to explain the structure of proteins and their role in metabolic pathways.
3. Knowledge to provide indebt knowledge of lipids, their structure as well as their function.
4. Learned basic function of enzymes, their properties and components.
5. Understood the metabolism pathways of various biomolecules.

Unit-I: Carbohydrates: Chemical and biological function of monosaccharides; Structure and function of disaccharides; glycosidic bond; General structure and function of common polysaccharides, homo and hetero polysaccharides.

Unit-II: Proteins: Amino acids: Acid-base properties and classification, titration curves. Peptide bond: Character of peptide bond and formation of polypeptide. Protein: Primary, Secondary, Tertiary and Quaternary Structures, protein folding, motifs, domains protein denaturation.

Unit-III: Lipid and Nucleic acids: Lipids: Storage and structural lipids: Structure and function. Signaling lipids; Phosphatidyl inositol, Sphingosine derivatives, Cofactors and pigments. Nucleotides: Composition, structures and functions. Nucleic acids: Structure of DNA and RNA, Nucleic acid chemistry; Chemical synthesis, Denaturation.

Unit-IV: Enzymes: Properties, Classification and Nomenclature (IUBN), factors affecting enzyme activity, Activation energy, Enzyme kinetics: Michaelis-Menten equation and its transformations – Lineweaver-Burk plot, Eadie-Hofstee plot, Enzyme Inhibition: Competitive, non-competitive and uncompetitive inhibition

Unit-V: Metabolism: Bioenergetics: Glycolysis, Gluconeogenesis and pentose phosphate path way. Oxidative phosphorylation: Citric acid cycle and its regulation. Fatty acid catabolism, Electron transfer reaction in Mitochondria; Proton motive force and ATP synthesis. Photophosphorylation: Photosynthetic pigments and light harvest, light driven electron flow, photophosphorylation; C₃, C₄ and CAM pathways of CO₂ Assimilation; Photorespiration.

Reference Books:

1. Lehninger principles of biochemistry: David L. Neison, Michael, M.Cox Publisher: W.H Freeman.
2. Biochemistry: 4th Edition-Donald Voet, Judith G. Voet, Publisher-John Willy & Sons
3. Principles of Biochemistry: Mammalian Biochemistry-Smith,EL,Hill R.L. White A, Publisher-TATA McGraw Hill.
4. Biochemistry: U Satyanarayana.
5. Fundamentals of Biochemistry J L Jain (Author), Sunjay Jain (Author), Nitin JainPublisher: S Chand; Seventh edition

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	2	5	4	4	5
CO2	5	5	5	4	5	5	4	4	2	5
CO3	4	4	4	5	4	2	4	2	4	4
CO4	5	4	4	2	4	4	2	5	5	4
CO5	4	2	5	4	5	4	5	4	4	4

HC-202	MOLECULAR BIOLOGY	5 CH	100 Marks
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Course Outcomes:

After reading this paper, students should have:

1. Ability to distinguish between DNA, gene, chromosome and genome.
2. Understanding of the basic rules governing replication, DNA repair and Recombination.
3. Knowledge to describe the process of transcription in prokaryotes, eukaryotes post transcriptional modification.
4. Working ideas on the process of Translation in prokaryotes and eukaryotes.
5. Ideas to explain the regulation of gene expression in prokaryotes and eukaryotes.

Unit-I: Genome and DNA Replication: DNA as the genetic material: Fred Griffith's experiment, Avery, Macleod and McCarty's experiment, Hershey & Chase Experiment, Replication strategies: Semiconservative mode of replication, Enzymes & Proteins associated with DNA Replication: Prokaryotes and Eukaryotes

Unit-II: DNA repair and Recombination: Types and causes of DNA damage, Repairs of DNA damages: Direct repair, Excision repair, Mismatch repair, SOS repair and mutagenesis, DNA repair associated disorders. Concept of DNA recombination, Homologous recombination, Mechanism of recombination

Unit-III: Transcription: structure of mRNA, tRNA, rRNA, noncoding RNA. Central Dogma. Mechanism of transcription in prokaryotes: RNA polymerases; proteins associated with transcription; Initiation, Elongation and Termination. Transcription in Eukaryotes: Eukaryotic polymerases and their promoters. Concept of Enhancer and Silencer, Transcription factors Post transcriptional modification: Capping, polyadenylation, RNA splicing.

Unit-IV: Translation: Genetic code: Characters, discovery of codons and Wobble hypothesis. Translation: Translational machinery- prokaryotic and eukaryotic Ribosomes, t-RNA synthetase, Mechanism of Translation: initiation, elongation and termination in prokaryotes and eukaryotes, Translational modification of proteins.

Unit-V: Regulation of gene expression: Constitutive and induced gene expression: Regulation gene expression at DNA Structural level, methylation, phosphorylation,

acetylation and ubiquitination: Transcriptional level, post transcriptional level, Translational level and post translational level. Mechanism of regulation of gene expression in prokaryotes: Operon Concept-Positive and negative control, Lac operon and trp operon. Regulation of gene expression in eukaryotes.

Reference Books:

1. Molecular Biology of genes-Watson, Baker, Bell, Gann, Levine and Losick
2. Fundamentals of Molecular biology-Allison
3. Molecular Biology: Clarke
4. Gene Cloning and DNA analysis: TA Brown
5. Cell and Molecular Biology-Clarke
6. Biotechnology- RC Dubey

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	5	5	4	4	5
CO2	5	5	5	4	5	5	4	4	2	5
CO3	2	4	4	5	5	5	4	2	4	2
CO4	5	2	4	5	5	4	2	5	2	4
CO5	4	2	5	4	5	4	5	4	4	4

HC-203	ECOLOGY AND EVOLUTION	5CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Knowledge to provide definitions of environment, management, systems and organisations in relation to environmental management.
2. Ability to demonstrate broad-based knowledge of the fundamentals of Ecology, Behaviour, Evolution and physiology and the relationships among these disciplines.
3. Familiarized with skills in the observation and experimental study of organisms, using both field-based and laboratory-based approaches.
4. Ability to demonstrate skills in identifying, accessing, comprehending and synthesizing scientific information.
5. Able to demonstrate the ability to conceive and execute independent scientific research, theoretical or empirical/experimental approach.

Unit I: System concept in ecology and ecosystem analysis: Diversity of ecosystem, Food web concept, grazing, detritus, Ecological pyramids, Energy flow in ecosystem, Biogeochemical cycles: water, carbon dioxide, Nitrogen, Environmental pollutants as stress factors: sources and pathways of pollutants, photochemical smog, acid rain, ozone hole, Global warming, green house gases and climate changes

Unit II: Population and community ecology: Concept of autecology and synecology, Concept of population and population attributes: Density, natality, mortality, survivorship curves, life table, age structure, population growth forms, Concept of carrying capacity and environment resistance,

Unit III: Concept of community: Concept of habitat, niche and guild, quantitative features, and attributes of community, Interaction and their types in the community, Ecosystem Development: Concept and Theories pertaining to the development, concept of climax.

Unit IV: Concept of resource and population: Introduction to resources, Biotic and abiotic resources, renewable and non-renewable resources, exhaustible and non exhaustible resources, Conservation and management, Concept of sustainable development, Concept of stress and strain, Tolerance hypothesis, Steno and eury species,.

Unit V: Evolution: Theories of evolution, variation, natural selection, and artificial selection, Species concept and speciation, Mutation and its role in evolution, synthetic theory of evolution, and molecular basis of evolution, allopatric , sympatric basis of evolution, Hardy-weinberg law, Paleobotany, fossil and its dating, Evidences of evolution

Reference Books:

1. Begon, M., Townsend, C. R. and Harper, J. L. (2005). *Ecology: From individuals to*
2. *Ecosystems* 4th edition, Wiley-Blackwell.
3. Odum, E. P. (2007) *Fundamentals of Ecology*, 5th edition, Thomson books.
4. Collier, B. D., Cox, G.W. and Miller, P. C. (1973). *Dynamic Ecology*, Prentice-Hall, Inc. Englewood Cliffs, New Jersey.
5. Hynes, H. B. N. (1978) *Biology of polluted water*, 1st edition, Liverpool University Press.
6. Kumar, H. D. (1981) *Modern concepts of ecology*, (8th edition), Vikas publication.
7. Mishra, R. (1968) *The Ecology Work Book*, Oxford and IBH public. Co., Kolkata.
8. Mukherjee, B. (2000) *Environmental management: Basic and applied aspects of management of ecological environmental system*, 1st edition, Vikas Publication House.
9. Mukherjee, B. (1996) *Environmental Biology*, 1st edition, Tata Mcgraw Hill.
10. Yadav, P. R., and Mishra, S. R. (2004) *Environmental biology*, Discovery publication, New Delhi

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	5	5	4	4	5
CO2	5	4	5	5	5	5	4	4	2	5
CO3	2	4	5	5	5	5	4	2	4	2
CO4	5	4	4	5	5	4	4	5	2	4
CO5	4	2	5	4	5	4	5	4	4	4

HC-204	PRACTICAL BASED ON PAPER -201, 202, 203 & CE-201 A/B	6CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Working knowledge on performing experiments related to enzyme kinetics.
2. Able to describe the methodology involved in molecular biology.
3. Working knowledge on performing experiments involved in ecology and evolution.
4. Updated current knowledge regarding diversity of plant and animal kingdom.
5. Working knowledge on understanding all biological processes.

Practical

1. Enzymes kinetics: Urease activity, effect of pH, temperature and substrate concentration
2. Isolation and estimation DNA
3. Electrophoresis of DNA
4. Estimation of DO by Winkler's CO₂ contents
5. To estimate total dissolved solid of collected water sample (TDS)
6. To estimate total suspended solid of collected water sample (TSS)
7. Determination of pH, Conductivity, Turbidity, Alkalinity of the soil samples
8. Community analysis in grasslands (species area curve, biodiversity indices by simpson and shannon method)
9. Estimation of Chloride content of collected water samples
10. Estimation of Fluoride content of collected water samples
11. Study of fossils
12. Study of adaptations
13. Study of Algae, Fungi, Lichen, Bryophytes, Pteridophytes and Gymnosperms through Permanent Slides and Temporary Preparations
14. Angiosperm- Study of floral characters of different families for their identification
15. Field study, Collection and Submission of reports and herbarium.
16. Study of museum specimens of related phyla
17. Comparative study of axial and appendicular skeleton of Tetrapoda

18. Permanent slide preparation (Algae, Fungi)
19. Permanent slide preparation (Bryophyta, Pteridophyta)

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	5	5	4	4	5
CO2	4	4	5	5	5	5	4	4	5	5
CO3	2	4	5	5	4	5	4	2	4	2
CO4	5	4	4	5	5	4	4	4	2	4
CO5	4	2	5	4	5	4	5	4	4	4

CE-201 A	PLANT DIVERSITY AND TAXONOMY	5CH	100RKS
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Course Outcomes:

After reading this paper, students should have:

1. Understood diversity of various cryptogams and phanerogams.
2. Explained evolution of gametophytes and saprophytes.
3. Enumerated affinities of Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.
4. Understood the structure of gametophytes and saprophytes.
5. Understood the range of floral structure of Angiosperms.

Unit-I: Algae and Fungi: Classification of Algae with general characters, Origin and evolution of sex in Algae, Lifecycle pattern in Algae, Economic importance of Algae, Classification of Fungi with general characters, Reproduction of Fungi, Life cycle patterns of Fungi, Lichens

Unit-II: Origin, evolution and classification of Bryophytes General characteristics and affinities of bryophytes, Origin, evolution and classification of pteridophytes, General characteristics and affinities of Pteridophytes, Stellar evolution.

Unit-III: Evolution and classification of Gymnosperms, General characteristics and affinities of Gymnosperms, Geological time scale, Pteridospermales and its affinities, Origin and classification of Angiosperms, General characteristics and affinities of Angiosperms, Bentham and Hooker's system, Hutchinson System and APG System of Classification, ICBN, Rule of Nomenclature

Unit-IV: Taxonomy 1 (Algae, Fungi, Bryophytes): Algae: Chlorophyceae, Phaeophyceae and Rhodophyceae, Fungi: Phycomycetes, Ascomycetes and Basidiomycetes, Bryophytes: Hepaticopsida: Marchantiales, Metzgeriales, Jungermanniales, Anthocerotopsida: Anthocerotales; Bryopsida: Sphagnales, Funariales and Polytrichales,

Unit-V: Taxonomy 2 (Pteridophytes, Gymnosperms and Angiosperms): Pteridophytes: Psilotales, Lycopodiales, Selaginellales, Equietales and Filicales. Gymnosperms: Cycadales, Coniferales, Ginkgoales, and Gnetales, Range of floral structure of Angiosperms Magnoliales, Rosales, Gentianales, Rubiales, Asterales, Poales, Orchidales.

References:

- 1 Smith G M Crptogamic Botany Vol I Algae and Fungi McGraw Hill Publ.
- 2 Mehrotra, R. S. and Aneja, R. S. (1998). An Introduction to Mycology, New Age International, New Delhi
- 3 Kumar, H. D. (1988). Introductory Phycology. East-West Press, New Delhi.
- 4 Smith G M Crptogamic Botany Vol II Bryophytes and Pteridophytes McGraw Hill Publ.
- 5 Dubey. H.C. (1990) An introduction of fungi. 2nd Edition. Vikas Publishers. ISBN PB : 9788125914334.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	5	5	4	4	5
CO2	4	4	5	5	5	2	4	4	2	5
CO3	5	5	5	5	4	5	4	5	4	2
CO4	5	4	2	4	5	4	2	4	5	4
CO5	4	2	5	4	5	4	5	4	4	4

CE-201 B	ANIMAL DIVERSITY AND TAXONOMY	5CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Knowledge to describe general characteristics, functions, ecological role and diversity of invertebrate and vertebrate phyla.
2. Knowledge to describe the similarities and differences between the members of the chordate subphyla protochordates, and Vertebrata.
3. Familiarized with explaining the parental care in fish and amphibia
4. Knowledge to discuss the origin and evolutionary relationships between each chordate group.
5. Knowledge to understand taxonomic collection, preservation and identification of samples

Unit-I: Non Chordata-I: General character and classification upto Class of phylum Protozoa, Porifera, Coelenterate, Helminthes; Locomotion in protozoa, Canal system in Porifera, Coral and coral reefs formation in Coelenterate, Parasitism and Parasitic adaptation in Helminthes

Unit-II: Non Chordata-II: General characters and classification upto class of phylum Annelida, Arthropoda, Mollusca, Echinodermata; Excretion in Earthworm, Larval forms in crustacean and their significance, Torsion and Detorsion in Gastropoda, Water vascular system in Echinodermata

Unit-III: Protochordates and Cyclostomes: Balanoglossus: Morphology, Development; Herdmania: Salient features, Retrogressive metamorphosis and its significance in Herdmania, Amphioxus: Characteristics and Reproductive system, Salient features and affinities of cyclostomes

Unit-IV: Higher Chordates: General Characters and classification upto orders (Fish, Amphibia, Reptiles, Birds, Mammals), Accessory respiratory organ in fishes, Parental care in amphibia, skull in reptiles, Flight adaptation of Birds, Dentition of Mammals

Unit-V: Taxonomic Collection & Identification: Collection methods of insect specimen, preservation and curating, Mounting, Storage, cataloguing of specimen, Identification methods (Literature, Identification keys, Pictures, Direct comparison, combination of methods), Problems encountered in Identification

Reference Books

1. Modern Text Book of Zoology: Invertebrates by R. L. Kotpal, Rastogi Publications
2. Modern Text Book of Zoology: Vertebrates by R. L. Kotpal, Rastogi Publications
3. Invertebrate Zoology by P S Verma, E L Jordon, S Chand Publication
4. Chordate Zoology by P S Verma, E L Jordon, S Chand Publication
5. Theory And Practice Of Animal Taxonomy And Biodiversity by V C Kapoor, Oxford & IBH Publisher
6. Principles of Animal Taxonomy by G.G. Simpson, Scientific Publishers
7. Animal Taxonomy : Principles and Practices by D N Pandit, Narendra Publishing House

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	5	5	4	4	5
CO2	4	2	5	5	5	5	5	4	2	4
CO3	5	5	5	5	4	5	4	5	4	2
CO4	5	4	2	4	5	5	5	2	5	4
CO5	4	2	5	4	5	4	5	5	5	4

OE-201A	HUMAN HEALTH AND HYGIENE	4CH	50 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Ability to describe the major life style diseases affecting each organ system.
2. Familiarized with explain the common infectious communicable diseases and their specific symptoms.
3. Able to explain the Implications of climate change and management of communicable diseases.
4. Developed positive attitude towards health issues and promoting decision making.
5. Ability to promote the detection and prevention of various diseases through research and innovation.

Unit-I: Human health, disease and lifestyle disorders: WHO definition of health, disease, disorder and classification of diseases based on source of pathogens, terminologies used in infectious disease (Etiology, epidemiology, vector, incubation period, infective period, causative agent, carrier, notifiable disease, epidemic, endemic, pandemic, signs, symptoms, prevention/prophylaxis, treatment). Vaccination: Definition of vaccine, types of vaccines

Unit-II: Cardiovascular disorders: Heart attack (causes, treatment and prevention). Myocardial infarction (cause, treatment and prevention), Cancer: Definition, Types, causes of cancer, prevention and control, Diabetes mellitus: Types (Type I and Type II); Type II diabetes- causes, clinical symptoms, treatment, control and prevention. Obesity: Definition, cause, prevalence, effect and preventive measures.

Unit-III: Communicable Diseases: Water borne diseases: Typhoid (causative agents, transmission, signs and symptoms, treatment and prevention). Air borne disease: Influenza, H1N1 (causative agents, transmission, signs and symptoms, treatment and prevention). Vector borne disease: Malaria (causative agents, transmission, signs and symptoms, treatment and prevention, eradication). Food-borne disease: Botulism (cause, epidemiology, clinical symptoms, treatment, control and prevention). Animal-borne disease: Rabies (cause, epidemiology, clinical symptoms, treatment, control and prevention). STDs: AIDS (causative agents, transmission, signs and symptoms, treatment and prevention, eradication).

Unit-IV: Implications of climate change and management of communicable, Climate Change: Meaning, causes and impact on human health; Management of communicable diseases: Disinfectants, antiseptics and antibiotic; Definition, various types of antiseptics (hypochlorite, phenol, ethanol, isopropanol, aldehydes, detergents, chloroxylenol), antibiotics, types (biostatic, biocidal) and most commonly used antibiotic, antibiotic resistance

Reference Books:

1. Nandini N, Sunitha N and Sucharita Tandon, (2007) Environmental Studies, Sapna Book House, Bangalore
2. Park, K. (2011) Preventive and Social Medicine. Benarsi Das Publications
3. Sekhsaria, P. (2007) Conservation in India and the Need to Think Beyond 'Tiger vs. Tribal'. Biotropica
4. Tyler Miller and Scott E. Spoolman 'Environmental Science' (2012) 13th Edition First Indian Reprint

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	5	5	4	4	5
CO2	4	2	5	5	5	5	5	4	2	4
CO3	5	5	5	5	4	5	4	5	4	2
CO4	5	4	2	4	5	5	5	2	5	4
CO5	4	2	5	4	5	4	5	5	5	4

SEMESTER III

HC 301	IMMUNOLOGY	5CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Learned to demonstrate the basic knowledge of immunological processes at a cellular and molecular level
2. Knowledge to describe which cell types and organs present in the immune response
3. Illustrative ideas about various mechanisms that regulate immune responses and their mechanisms
4. Ability to exemplify the adverse reactions of immune responses like Allergy, hypersensitivity and autoimmunity
5. Knowledge to elucidate the reasons for immunization and aware of different Infectious Diseases.

Unit I: Concept of immune system: innate and acquired immunity, Cells of the immune system, Major Histocompatibility Complex, Cytokines, Complement system lymphocytes, Maturation, activation and regulation of T lymphocyte and B lymphocyte.

Unit II: Antibodies, its types & function, Generation of antibody diversity, Structure and properties of immunoglobulin classes, Polyclonal antibodies and Monoclonal antibodies, its production, Hybridoma technology for monoclonal antibody production and applications of monoclonal antibodies for diagnosis and pharmaceutical industries.

Unit III: Antigen, types of antigens, Haptens, adjuvants, Immunoassay procedures ELISA, SDS PAGE, Immuno-detection, Western blotting, Immuno-diffusion, Immuno-chromatography etc. their uses and their applications in diagnostics.

Unit IV: Transplantation immunology, Hypersensitivity and autoimmunity, Immuno disorders,

B- Cell immune disorder, T cell immuno disorder, SCID (Severe combined immuno disorder).

Unit V: Cancer, genes associated with the cancer, Immuno surveillance of the cancer, Epidemiology of Infectious Disease, the Infectious Disease Cycle, Virulence and the Mode of Transmission, Control of Epidemics.

Reference Books:

1. Kuby's Immunology
2. Cellular and Molecular Immunology- Abul, K. Abbas-Saunders Publ.
3. Immunology- An Introduction- Ian R. Tizart- Thomson Publ.
4. Clinical Immunology- Roitt.
5. Microbiology- M. J. Jr. Pelezar- Ecs Chanw

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	5	5	4	4	5
CO2	4	2	5	5	5	5	5	4	2	4
CO3	2	5	5	5	5	5	5	5	4	2
CO4	5	4	2	5	2	5	5	2	4	4
CO5	4	2	5	4	5	5	5	5	5	4

HC 302	GENETICS	5 CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Working knowledge on explaining structure of the chromosome and hereditary characteristic.
2. Familiarized with on listing the important developments of genetics.
3. Ability to defining the of basic concepts of genetics can debate mechanisms of the genetic variation.
4. Able to comparing chromosome structure in mitosis and meiosis divisions.
5. Working knowledge on explaining Mendel's rules. calculate of phenotypic and genotypic ratios of crosses.

Unit-I: Chromosome structure: Organization of chromatin and its modifications, Centromeres, telomeres, heterochromatin, euchromatin, Mechanism of sex determination in man and Drosophila, dosage compensation, Chromosomal aberration: deletion, duplication, inversion and translocation, aneuploidy, polyploidy, Diseases associated with Chromosomal aberration

Unit-II: Mendelian Principles: Mendel's Experiment, segregation, independent assortment, Deviation from Mendelism: Incomplete dominance, co-dominance, Lethal gene, Multiple allele, gene interaction, maternal effect, extranuclear (cytoplasmic) inheritance

Unit-III: Linkage and Recombination: complete linkage, incomplete linkage, recombination, Crossing Over, three-point mapping, Physical and Genetic mapping of chromosomes, somatic cell hybridization, molecular markers, sex-linkage,

Unit-IV: Population genetics: allele frequencies, Hardy-Weinberg Principle, Assumptions for Hardy-Weinberg Equilibrium, determining allele frequencies, genotype frequencies and allele frequencies for X-linked traits, Processes that change allele frequencies in population, Natural selection, Genetic Drift.

Unit-V: Quantitative genetics and Multifactorial Inheritance: Polygenic traits, Significance of polygenic inheritance, statistics of quantitative genetics – mean, variance, covariance,

standard deviation, correlation, regression, Heritability- broad sense, narrow sense, artificial selection, Quantitative trait loci.

Reference Books:

1. Genetics- Monroe W. Strickberger, Prentice Hall India Learning Private Limited
2. Principle of Genetics- Sinnott, Dunn, Dobzhnsky
3. Genetics Principles and Analysis- D.L. hart, E.W. Jones
4. Genetics- PJ Russel- Benjamin Carnni Publication

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	2	5	4	4	5
CO2	5	5	4	5	5	5	5	4	4	5
CO3	4	4	5	2	2	5	4	5	4	4
CO4	5	5	4	2	4	5	4	5	4	4
CO5	4	5	5	4	5	4	5	4	4	2

CE- 301 A	PLANT PHYSIOLOGY AND DEVELOPMENT	5CH	100 Marks
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Course Outcomes:

After reading this paper, students should have:

1. Ability to explain the transportation and translocation of water and solute
2. Familiarized with explain the importance of photosynthesis and respiration for plants.
3. Able to explain the assimilation of mineral nutrients and role of secondary metabolites.
4. Ability to explain the plant hormones and their significance in plant development.
5. Learnt the development of male and female gametophyte

Unit-I: Transport and translocation of water and solute: Water and cellular water transport processes, Water absorption by roots, Water transport through xylem, Transpiration: regulation of Stomatal opening and closing, soil-plant-atmosphere continuance, Mineral nutrition, Solute transport, Phloem translocation

Unit-II: Photosynthesis: Leaf anatomy, light absorption, photosynthetic pigments, Photosystem I, Photosystem II, cyclic and non-cyclic photophosphorylation, Photosynthetic

responses to CO₂: C₃, C₄ and CAM plants, Photosynthetic responses to O₂ : photorespiration, Proton gradient across the thylakoid membranes and ATP synthesis. Thylakoid ATPase - Structure, function and regulation

Unit-III: Assimilation of Mineral nutrients and Role of secondary metabolites, Nitrogen fixation: importance and biological nitrogen fixation, Nitrate assimilation and Ammonium assimilation, Sulphur assimilation, Secondary metabolites: types, role in plant defense system

Unit-IV: Plant Growth Regulators: Physiological role of growth regulators: Auxins, Gibberellins, Cytokinins, Ethylene, ABA, Signal Transduction of Plant hormones, Plant photoreceptors- Phytochrome, Cryptochrome, Phototropins- their function in plant growth and development

Unit-V: Plant Development: ABC model of Flowering: Microsporogenesis and development of male gametophyte, Megasporogenesis and development of female gametophyte, Embryo and endosperm, double fertilization & triple fusion, Sexual incompatibility, Polyembryony and apomixis,

Reference Books

- 1 Taiz, L. and E. Zeiger. 2002. Plant Physiology. 3rd Edition. Sinauer Associates, Inc., Sunderland, MA. 690 pp.
- 2 Devlin, R. N. and Witham, F. H. (1983). Plant Physiology. CBS Publishers, Delhi.
- 3 Salisbury, F. B. and Ross, C. W. (1992). Plant Physiology, 4th Edition Wadsworth Publication California, USA.
- 4 Noggle, G.R. and Fritz G.J. (1983) Introductory Plant Physiology. 2nd edition, 2010

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	2	4	5	4	4	5
CO2	4	5	5	2	5	5	5	4	4	5
CO3	5	5	4	2	5	5	5	5	4	4
CO4	5	5	4	4	4	2	4	5	4	4
CO5	4	4	5	5	5	4	5	4	4	2

- 3 Note related: 1
- From What Related: 2
- Neutral: 3
- Moderately Related: 4
- Highly Related: 5

CE- 301 B	ANIMAL PHYSIOLOGY AND DEVELOPMENT	5CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Understanding on gametogenesis and the mechanism fertilization, cleavage and gastrulation.
2. Familiarized with formation of three Germ Layers in Frog and Chick
3. Understanding on the phenomenon of regeneration in amphibian and also able to explain concept of model organism used in Ageing study.
4. A solid foundation on the physiology of Circulation, excretory and respiration in mammal and able to Understand the phenomenon of muscle contraction.
5. Understanding on the properties, nature, classification, regulation of hormones along with their disorders.

Unit-I: System Physiology (Cardio Vascular System, Respiratory System, Excretory System), ABO System and RH system, Blood Coagulation, Blood volume regulation, Generation and Propagation of cardiac impulses, Cardiac cycle and its regulation, Pulmonary ventilation, Gas exchange, Transport of O₂ and CO₂, Dissociation curves, Neural and Chemical regulation of respiration, anatomy of Kidney, Mechanism of Urine formation, Regulation of water balance, acid-base balance

Unit-II: System Physiology (Nervous System, Muscle Contraction) Structural Adaptation, Structure and function of neuron ion channels, Generation and propagation of Action potential, Synapse and Synaptic transmission, Neurotransmitters, Physiology of Skeletal Muscle contraction, Twitch Fatigue, energetics of muscle contract, Basic concept of environmental stress and strain, stress resistance, stress tolerance, Stress avoider, Acclimation and acclimatization, Homeostasis mechanism, Adaptation to osmotic stress and oxygen deficient stress

Unit-III: Endocrinology: Endocrine glands: Structure and functions of pituitary, thyroid, adrenal, pancreas and gonads, Hormone: Properties, chemical nature and classification, Feed-back mechanism of hormone action: Hormone receptors, thyroxine and steroid hormone action, Hormonal disorders

Unit-IV: Gametogenesis and Early Development: Spermatogenesis, Oogenesis, External fertilization in Sea urchin: Recognition of gametes, acrosomal reaction, prevention of polyspermy, Activation of Egg Metabolism, Fusion of gametes, Cleavage: types, Pattern and Influence of yolk in cleavage, Types of cell movements during gastrulation, Development of Frog and Chick upto formation of three Germ Layers

Unit-V: Morphogenesis: Axes and pattern formation in Drosophila (Anterior-posterior axis, Dorsal-ventral polarity), Metamorphosis of anuran tadpoles, Regeneration in Amphibia, Ageing: concept, model organism and theories

Reference Books

1. Developmental Biology by Scott F. Gilbert, Michael J. F. Barresi, OUP USA Publications.
2. Key Experiments in Practical Developmental Biology by Manuel Mari-Beffa, Jennifer Knight.
3. Guyton and Hall Textbook of Medical Physiology, Saunders Publication
4. Essentials Of Animal Physiology By SC Rastogi, New Age International Publication
5. Endocrinology by M.E. Hadley and J.E Levine Pearson Education India

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	2	4	5	4	4	5
CO2	4	5	5	2	5	5	5	5	4	5
CO3	5	5	4	2	4	5	5	5	5	5
CO4	2	2	4	4	4	2	4	5	5	5
CO5	4	4	2	5	5	4	5	4	4	5

HC 303	Practical related to paper HC-301, HC- 302 and CE-301 A/B, CE-	6CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Knowledge on performing experiments related to immunology and antigen-antibody interactions.
2. Familiarized with describing the methodology involved in genetics and its analysis.
3. Able to performing experiments involved in plant physiology and development.

4. Knowledge on performing experiments involved in animal physiology and development.
 5. Updated current knowledge regarding research methodology and bio-statistics.
1. Detection of antibody by using ELISA
 2. Detection of specificity of antibody by WESTERN BLOT
 3. Problems on Mendelian Genetics (Sex-linked Characters).
 4. To demonstrate the effect of Auxin on rooting/abscission/apical dominance
 5. Study the dynamics of growth.
 6. Delaying of leaf senescence by application of Cytokinin
 7. Study of permanent embryological slides
 8. Determination of catalase activities
 9. Extraction and separation of chlorophyll pigments from leaves
 10. To determine the chlorophyll a/chlorophyll b ratio in C3 and C4 plants
 11. Identification and comment on embryological slides of amphioxus, frog, chick
 12. Study of blood parameters
 - Blood group studies
 - Haemoglobin content by Sahli's Haemoglobinometer
 - RBC count by Haemocytometer
 - WBC count by Haemocytometer
 13. Digestion of starch by salivary amylase (Effect of pH and Temperature)
 14. Problems related to mean, median, mode, SD, SE, ANOVA and Co-relation.
 15. Testing the difference between two samples by t-test.
 16. Testing the difference between expected value and observed value by chi-square test.
 17. Testing interaction of factors by F-test.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	2	4	5	4	4	5
CO2	4	5	5	2	5	5	5	5	4	5
CO3	5	5	4	2	5	5	5	5	4	4
CO4	5	5	4	4	4	4	5	5	4	4
CO5	4	4	5	5	5	4	5	4	4	5

CE 302A	RESEARCH METHODOLOGY	5 CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Developed ability to demonstrate methods appropriate to research aims and objectives.
2. A solid foundation on the limitations of the particular research methods
3. Familiarized with qualitative and quantitative data analysis.
4. Developed advanced critical thinking skills.
5. Understood ability to relate the principal concepts of bio-statistics

Unit-I: Research fundamental, Research Meaning, Objectives, motivation of research. Types of research: Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual, and Empirical research. Significance of research. Research methods versus Research methodology. Research and scientific method.

Unit-II: Research process: Steps of research process, criteria of good research. Research design: Meaning, need, features of good research design. Data collection: Primary and secondary data collection: Method of data collection, schedules and questionnaire.

Unit-III: Population, Sample, Steps in sampling design, Census versus sampling methods. Probability and non-probability sampling, Different types of sampling methods: Simple random sampling, stratified random sampling, Cluster sampling, Purposive sampling. Measurement of scales, sources of error in measurement, test of sound measurement.

Unit-IV: Bio-statistics Introduction, application, uses and limitations. Diagrammatic presentation of data: Bar diagrams, Pie diagram, Frequency distribution, Measures of central tendency: mean, mode, median. Dispersion: Range, Standard deviation, Coefficient of variation.

Unit V-: Correlation: correlation coefficient, Properties of correlation coefficient. Regression: Regression coefficients, regression, Test of hypothesis: test of significance, null hypothesis, alternative hypothesis, Type I and Type II errors, *t*-tests (For single mean and for two means), chi-square test (test of goodness of fit and test of independence).

Reference Books:

- 1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
- 2) Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
- 3) Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
- 4) Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	2	4	5	4	4	5
CO2	4	5	5	2	5	5	5	4	4	5
CO3	5	5	4	2	5	5	5	5	4	4
CO4	5	5	4	4	4	2	4	5	4	4
CO5	4	4	5	5	5	4	5	4	4	2

CE 302B		WASTE MANAGEMENT	5 CH	100 MARKS
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Course Outcomes:

After reading this paper, students should have:

1. Learned basic concepts of different types of waste management, beginning from source generation to waste disposal in a system of municipality organizational structure.
2. Developed understanding on various technological applications for processing of waste and their disposals in various ways.
3. Acquired knowledge on waste to energy productions in the perspectives of sustainable development.
4. Applied basic concepts in hazardous waste management and integrated waste management for urban areas.
5. Acquired knowledge on waste characterization and its management practiced in various cities of India.

Unit-I: Waste: Introduction, types of waste, solid, liquid, gaseous, degradable, non-degradable, biodegradable, hazardous and non-hazardous waste. Sources of waste, impact of waste on environment and human health

Unit-II: Solid waste: Definition, Classification, Origin/source and characterization, Disposal methods of solid waste, Landfill, Incineration, Composting and Vermiculture, Municipal Solid Waste Management

Unit-III: Liquid Waste: Introduction, source, composition, characteristics, collection and transport and safe disposal methods. Food waste: Meaning, composition, source, adverse impact on mankind, its' safe disposal and management.

Unit-IV: Definition of bio-medical waste Biomedical Waste and its Management: characterization, source, types, quantity, segregation, treatment and disposal. E-waste: composition, sources, E-waste generation at global and national level; Management of E-waste Recycling and disposal strategies, Radioactive waste: Disposal strategies and Management

Unit-V: Plastic waste generation, sources, adverse impact on environment, animals; man Management of plastic waste. Waste management: Principle of 3Rs of waste management, Refuse, Recycle and Reuse

Reference Books:

1. Aradhana Salpekar- Solid waste pollution, Jnanada Prakashan, New Delhi.
2. Solid Waste management in Developing countries - Indian National Scientific.
3. Miliary Theiren and Samuel A. Solid waste management- George Tehobanaglou.
4. WHO manual on solid waste management.
5. Charles A Wentz (1996). Hazardous waste management. McGraw-Hill International Edition.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	4	4	2	5	4	4	5
CO2	5	5	4	4	5	5	4	4	4	5
CO3	5	4	5	5	4	5	4	2	4	4
CO4	5	4	4	2	5	4	2	5	4	4
CO5	4	5	5	4	5	4	5	2	4	4

SEMESTER IV

HC401	SUBJECT OVERVIEW	5 CH	100 MARKS
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Course Outcome:

After reading this paper, students should have:

1. Developed the concept of review writing.
2. Understanding regarding development of proposal and research writing.

3. Achieved a new area of interest for research.
4. Innovative idea in research topic to contribute for mankind.
5. Followed the research ethics while carrying out research work.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	4	4	4	4	4	4	2	2	4	4
CO2	4	2	4	5	4	2	5	4	5	5
CO3	4	4	5	4	2	2	4	4	4	4
CO4	4	2	4	4	4	4	2	5	5	5
CO5	2	4	4	2	4	4	4	2	5	5

HC402	SEMINAR	5CH	100 MARKS
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Course Outcome:

After reading this paper, students should have:

1. Developed the concept of presentation in public
2. Prepared a good comparative data on the research field.
3. Prepared well explainable power point presentation.
4. Prepared concise and comprehensible presentation.
5. Presented their research findings.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	4	2	2	4	2	4	2	2	4	4
CO2	5	4	5	5	5	2	5	4	5	5
CO3	4	4	5	4	5	2	4	4	4	4
CO4	4	2	4	4	4	4	2	4	4	5
CO5	2	4	4	2	4	4	4	2	5	5

- 3 Note related: 1
- From What Related: 2
- Nutral: 3
- Moderately Related: 4
- Highly Related: 5

SEMESTER-IV

HC403	DISSERTATION	5 CH	100 MARKS
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Course Outcome:

After reading this paper, students should have:

1. Developed experimental and practical knowledge in lab and field research work.
2. Carried out a coordinated research work.
3. Developed the concept of writing a proposal for research.
4. An idea about exposure to industrial domain.
5. Carried out efficient research using various instruments.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	4	2	4	2	2	4	4
CO2	4	4	4	5	4	2	5	4	5	5
CO3	5	4	2	4	5	2	4	4	4	4
CO4	4	2	4	4	4	4	2	5	5	5
CO5	2	4	4	2	4	4	4	2	4	4

CE401	Dissertation evaluation	5 CH	100 MARKS
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Course Outcome:

After reading this paper, students should have:

1. Developed the concept of public speaking and presentation.
2. Presented their research findings.
3. Developed skill for Sequential compilation of obtained research data.
4. Analysed data using different biostatistical tools.
5. Developed mental flexibility at par with the ongoing research studies.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	4	2	2	4	2	4	2	2	4	4
CO2	2	4	5	5	5	2	5	4	5	5
CO3	4	4	2	4	2	2	4	4	4	5
CO4	2	2	4	4	4	4	2	4	4	5
CO5	5	4	4	2	4	4	4	2	4	5