

**A.VEERIYA VANDAYAR MEMORIAL
SRI PUSHPAM COLLEGE (AUTONOMOUS)**

POONDI-613 503, THANJAVUR (DT)



SYLLABUS

M.Sc., Zoology

(From 2020 - 2021 onwards)



**A. VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE (AUTONOMOUS), POONDI, THANJAVUR DISTRICT
CBCS SYLLABUS – FOR M.Sc. ZOOLOGY STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020- 2021 ONWARDS
PG AND RESEARCH DEPARTMENT OF ZOOLOGY**

M.Sc. ZOOLOGY

Old S.No.	Semester	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
					C.I.A.	E.E.	Total	C.I.A.	E.E.	Total		
1.	I	Core	20P1ZOC1	Biology of Invertebrates and Chordates	25	75	100	10	30	50	6	5
2.		Core	20P1ZOC2	Cell and Molecular Biology and Biophysics	25	75	100	10	30	50	6	5
3.		Core	20P1ZOC3	Microbiology	25	75	100	10	30	50	6	4
4.		Core	20P1ZOCP1	Practical I ((Invertebrate and Chordate, Cell and Molecular Biology and Microbiology)	40	60	100	16	24	50	6	4
5.		Major Elective-I	20P1ZOEL1A 20P1ZOEL1B 20P1ZOEL1C	A) General and Human Genetics B) Genomics and Proteomics C) General & Microbial Genetics	25	75	100	10	30	50	6	4
6.	II	Core	20P2ZOC4	Developmental Biology and Bio-Techniques	25	75	100	10	30	50	5	5
7.		Core	20P2ZOC5	Environmental Biology and Conservation	25	75	100	10	30	50	5	4
8.		Core	20P2ZOC6	Biotechnology	25	75	100	10	30	50	5	4
9.		Core	20P2ZOC7	Endocrinology	25	75	100	10	30	50	4	4
10.		Core	20P2ZOCP2	Practical II (Developmental Biology, Bio-Techniques, Biotechnology and Environmental Biology)	40	60	100	16	24	50	6	4
11.		Major Elective-II	20P2ZOEL2A 20P2ZOEL2B	A) Cell and Tissue culture B) Wild Life Management	25	75	100	10	30	50	5	4
12.		Extra Credit	-	MOOC (Massive Open Online Course)	-	-	-	-	-	-	-	-
13.		Core	20P3ZOC8	Immunology	25	75	100	10	30	50	5	4
14.		Core	20P3ZOC9	Animal Physiology and Bio-Chemistry	25	75	100	10	30	50	5	5
15.		Core	20P3ZOC10	Clinical Biochemistry	25	75	100	10	30	50	5	4

LIST OF CORE OPTIONS

S.No.	Semester	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
					C.I.A.	E.E.	Total	C.I.A.	E.E.	Total		
1.	I	Core -Option	20P1ZOCO1	Cancer and Stem Cell Biology	25	75	100	10	30	50	---	---
2.	II	Core - Option	20P2ZOCO2	Toxicology	25	75	100	10	30	50	---	---
3.	III	Core-Option	20P3ZOCO3	Conservation Biology	25	75	100	10	30	50	---	---
4.	IV	Core-Option	20P4ZOCO4	Pharmacology	25	75	100	10	30	50	---	---

M. Sc ZOOLOGY SYLLABUS (2020 – 2021)

NATURE OF COURSES	TOTAL NO. OF COURSE	TOTAL MARKS	TOTAL CREDITS
Core	17	1700	72
Elective	03	300	12
E.D.C.	01	100	---
Project	01	100	04
Comprehensive Test	01	100	02
Communicative Skill and Personality Development (N.S)	---	---	---
Extra Credit – Online Course MOOC	---	---	---
Total	23	2300	90

GRADING OF COURSE PERFORMANCE (10 POINT SCALE)

Aggregate Marks	Grade	Grade point
96 and above	S+	10
91-95	S	9.5
86-90	D++	9.0
81-85	D+	9.0
76-80	D	8.0
71-75	A++	7.5
66-70	A+	7.0
61-66	A	6.5
56-60	B	6.0
50-55	C	6.5

Comprehensive Knowledge Test: Objective type question pattern with 100 compulsory questions carrying 100 marks to be answered in 3 hours with 2 Credits. The portion is entire core courses.

Field visit and Internship: In first and third semester, students will be required to identify and comment upon specimen of Zoological interest microscopic preparations, pertaining to types and examples studied under classification. A record of laboratory work and a report on local field trip should be maintained and submitted.

Educational Tour: In Fourth semester, Students have to submit a report on the educational tour on places of the Zoological interest should be maintained and submitted at that time of practical examination for valuation.

MOOC: Massive open online course is introduced in the second and third semester as an extra credit course from this academic year 2020-2021. Students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves.

Field Visit / Hands on training programme having minimum 15 hours of contact time as Extra Credit course is introduced for I year PG students to gain experiential learning.

Evaluation of the field visit report will be held at the end of II Semester.

Components of Evaluation

Internal Marks	-	40
External Marks	-	60
Total	-	100

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THANJAVUR DIST.**

**Question Pattern for UG and PG Programmes for students to be admitted during
2020 – 2021 and afterwards**

Total Marks: 75

QUESTION PATTERN

**SECTION – A
(Question 1 to 10)**

10 x 2 = 20 Marks

1. Short Answer Questions
2. Two Questions from each units (All are answerable)

**SECTION – B
(Question 11 to 15)**

5 x 5 = 25 Marks

1. 5 Paragraph type questions with "either / or" type choice.
2. One question from each unit of the Syllabus.
3. Answer all the questions.

**SECTION – C
(Question 16 to 20)**

3 x 10 = 30 Marks

1. 5 Essay type questions – any three are answerable.
2. One questions from each unit of the Syllabus.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1ZOC1	Core – BIOLOGY OF INVERTEBRATES AND CHORDATES	6	5
Objectives: <ul style="list-style-type: none"> ➤ To understand the morphology and functional anatomy of both invertebrates and chordates in a comparative aspects. ➤ To know the biological aspects of minor phyla in detailed way. ➤ To study the types of fossils and their phylogenic relationship with higher group of animals. ➤ To study the external features inner anatomical features in a comparative manner with Chordate animals. ➤ To study the evolution of chordate species. 				

Unit I

Hrs.18

Important human parasites and vectors. Life cycle and biology of plasmodium, Wuchereria, Schistosoma and Leishmania, vectors of human diseases – Mosquitos, flies, ticks. Transmission and control measures.

Unit II

Hrs.18

Locomotion in Protozoa, skeleton system in Porifera, Polymorphism and metagenesis in cnidaria, parasitic adaptations in helminthes, coelom and metamerism in annelids, Larvae of crustaceans, Respiration in Arthropods(Prawn, Cockroach, Scorpion) Torsion in Mollusca and larval forms in Echinoderms.

Unit III

Hrs.18

General organization and phylogeny of Rotifera, Chaetognatha, Ectoprocta – Entoprocta, Phoronida. Study of Invertebrate fossils – Trilobites, ammonoids, Living fossils- Peripatus, Limulus, Nautilus, Vertebrate fossil – Archaeopteryx – Sphenodon.

Unit IV

Hrs.18

Comparative study of digestive, respiratory, circulatory and urinogenital system of Invertebrates and Chordates (Earthworm, Cockroach, Freshwater Mussel, Frog, Calotes and Rabbit).

Unit V

Hrs.18

Parental care in fishes and amphibians – Mesozoic Reptiles - Migration of birds – Primitive mammals – Monotremes and Marsupials.

Course Outcomes

After completion of this course, students will be able to

- UnderstandTheAnatomyOfInvertebratesAndChordates.
- Gain Awareness on the ImportanceOf HumanParasitesAndVector.
- EquipWithIndepth Knowledge InPaleontology.
- CompareDigestive,Respiratory,CirculatoryAndUrinogenitalSystemOf InvertebratesAndChordates
- GainKnowledgeOn ParentalCareInFishes,AmphibiansAndMigrationOfBirds.

Reference:

1. Ekambaranathanayyar, 1993 – Out line of Zoology – Vol -I & II, S.Viswanathan (Printers & Publication) Pvt. Ltd, Chennai.
2. Hyman, L.H. The invertebrates, Vol 3 to 6 – McGraw Hill Book Co., London.
3. Kotpal, R.L. Minor Phyla, Rastogi Publishers, Meerut.
4. Mooe, R.C. Lallicker and A.G. Fisher (1952) “” Invertebrate Paleontology”. McGraw Hill book Co., New York.
5. Woods, H. (1961) Paleontology – InvertebrataCombridge University Press.
6. Hyman L.H. (1967) Compaative Vertebrate anatomy. McGraw Hill BookCo. New Delhi.
7. Parker and Haswell (1967), Text Book of Zoology Vol-I and Col-II.
8. Newmann, W.H. (1961) Phylum Chordate. The University of Chicago Press. Chicago
9. Romer, A.S (1960) Vertebrate Paleontology, University of Chicago Press, Chicago.
10. Yong, J.Z. (1962) The life of vertebrates, Oxford University Press. London.
11. Colbert, E.H. (1970) Evoluton of vertebrates. John Wiley and Sons, New York.

Web Link:

<https://www.syllabusfinder.com/university-of-toronto/eeb266-introduction-to-animal-biodiversity---invertebrates-fall-2014> (Toronto University, Canada)

<https://fas.calendar.utoronto.ca/course/eeb266h1> (Toronto University, Canada).

<https://www.syllabusfinder.com/university-of-toronto/eeb263-comparative-vertebrate-anatomy-fall-2014> (Toronto University, Canada)

<https://www.syllabusfinder.com/static/syllabus/EEB263-Comparative-Vertebrate-Anatomy-Fall-2014.pdf>(Toronto University, Canada)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1ZOC2	Core – CELL AND MOLECULAR BIOLOGY AND BIOPHYSICS	6	5

Objectives:

- To understand, the working mechanisms of the different Cytological instruments and their applications in cell study.
- To study the cellular interaction, cell signaling mechanisms
- To study the ultra-structure of different cell organelles in a detailed way.
- To study the molecular aspects of Nucleus, Nucleolus, Chromosomes of prokaryotes and Eukaryotes and to study the process of cell division and protein synthesis.
- To study the Biophysics with reference to the Law of Thermodynamics, UV radiation.
- To understand the Osmo-ionic diffusion of molecules in to the cells.
- To understand the Tyndall effect and their application in Radiobiology.

Unit-IHrs.18

Structure of Prokaryotic cell (Bacteria) and Eukaryotic cell (animal) - Structure and functions of cell organelles – Mitochondria, ER, Golgi complex, Lysosome, Peroxisomes, Centrioles, Ribosomes, Nucleus and Nucleolus. Structure and organization of chromosomes; Giant chromosome, Polytene and lamp brush chromosome.

Unit-IIHrs.18 Cell Signaling and Cell-Cell interaction: Signaling transduction, Extra cellular signaling-Between organisms, Classification of Cell Signaling – Hormones, Neurotransmitters, Cytokines-Signaling receptors – Signaling pathways- Intra and Inter species signaling-computational models.

Unit- IIIHrs.18

Cancer biology – Genetic rearrangement of progenitor cells, oncogenes, tumour suppressor genes, cancer and the cell cycle – virus induced cancer, metastasis, interaction of cancer cells with normal cells; Apoptosis and cancer: Diagnosis cancer, mechanism of Apoptosis.

Unit-IVHrs.18

Biophysics – Light – wave length – photoelectric effect – Biophysical Aspects of Vision, Thermodynamics laws – free energy – Natural radiation – properties – Photodynamic sensitization – effects of UV light and ionizing radiation and X-ray diffraction, fluorescence.

Unit-VHrs.18

Diffusion – Principles of diffusion and osmosis - methods of Transport phenomenon - determination of osmotic pressure.

Colloids: Sol/gel changes – Tyndall effect.

Isotopes: Methods of study, Geiger – Muller Counter.

Radiation Biology – Principle and application in laser technique in biology – Radioactive isotopes and half-life of isotopes, effect of radiation on biological systems, Autoradiograph.

Course Outcomes

After completion of this course, students will be able to

- Understand The Working Mechanisms Of The Cytological Instruments
- Learn The Cellular Interaction And Cell Signaling Mechanisms
- Acquire The Knowledge On Ultra-Structure Of Different Cell Organelles
- Gain Awareness On The Effect Of UV Radiation.
- Understand The Principle And Application In Laser Technique In Biology

Reference:

1. De Robertis, R.O.P and De. Robertis, E.M.F. (1980) Cell and Molecular Biology, Holt Saunders imitational Edn, Japan.
2. DePraw, E.L (1960) Cell and Molecular Biology, Academic Press, New York.
3. Gieses, A.C. (1957) Cell Physiology, W.E. Saunders Co., Threadgold, L.T. (1975). The ultra-structure of the animal cell, Pergmann Press, New York.
4. Brude Alberts, Bennis – bray Lewis, Martin Raff Kiety – Rovers and James D. Wastern (1963). Molecular Biology of the cell, Garland Publishing Inc, New York and London.
5. Ackerman, E. (1962). Biophysical science, Prentice Hall. Casey, E.J. Biophysics Concepts and mechanisms.
6. Epstein, J.F. (1963) Biophysics – Selected topics, Addition, Wesley Publishers Co. Thayen, J., Biophysical technique – Chapman and Hall.

Web Link:

<http://www.lifesciences.nus.edu.sg/modules/lsm/LSM1106.pdf> (NUS)

<https://www.physics.nus.edu.sg/~Biophysics/BiophysicsSyllabus.html> (NUS)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1ZOC3	Core – MICROBIOLOGY	6	4
Objectives: 1.To know the scope of Microbiology, 2.To learn the techniques on the isolation of Microbes.. 3.To study the role of microbes in Industry. 4.To study the role of microbes in Environment. 5.To analyse the Pathogens and their treatment in human diseases				

Unit I **Hrs.18**

Introduction and Scope of Microbiology – Classification of microorganisms – Prokaryotes and Eukaryotes – Ultrastructure and organization of Virus (Bacteriophages), Bacterial cell, Fungal cell and Yeast. Growth kinetics of bacteria. Methods and isolation of microbes, Preservation and identification of Microbes. Preparation of culture media and culture methods for bacteria, algae, fungi and virus and maintenance of pure culture.

Unit II **Hrs.18**

Types of Food and microbial contamination, poisoning and spoilage – sources, symptoms and prevention of food borne infections – Bacterial and fungal toxins – methods of detection and detoxification – Food sanitation in food manufacturing industries and safety measures.

Unit III **Hrs.18**

Biogeo-chemical role of microbes in nitrogen, carbon and phosphorous cycle-Biofertilizer-Bacteria – Phosphobacteria, mass culture techniques of Cyanobacteria, Mycorrhizae, Azolla – Anabaena sp., –biomining and bioleaching. Microbial biopesticides and biodegradation of herbicides and pesticides – Xenobiotics and recalcitrants.

Unit IV **Hrs.18**

Microbiology of water – Methodology of bacterial analysis industrial and municipal effluences Eutrophication. Microbiological sewage water purification methods – Role of microorganisms in oil pollution-soil pollution and water pollution-control microbes as indicator of pollution – Environmental impact and assessment.

Unit V **Hrs.18**

Pathogen, Pathogenesis, Clinical conditions, diagnosis, Epidemiology, Chemotherapy and prevention of the following diseases in Man : Bacterial disease : Pneumonia, Diphtheria, Rheumatic fever, Whooping cough, Tuberculosis, Meningitis, Botulism, Typhoid Cholera, Gonorrhea, Plague and leprosy, Viral diseases – Influenza, Measles, Mumps. Chicken Pox, hepatitis, Poliomyelitis, Rabies, Japanese encephalitis, Yellow fever and HIV infection (AIDS).

Course Outcomes

After completion of this course, students will be able to

- ClassifyTheMicroorganisms AndLearnMicrobialTechniques.
- UnderstandTheFoodContaminationByMicroorganism,DifferentMethods Of Detoxification And Food Sanitation In FoodManufacturingIndustries.
- GainKnowledgeOnBio-Geo CycleOfMicroorganismsInTheEnvironmentAnd RoleOf Biofertilizer.
- Understand The Microbiology Of Water And Methodology OfSewageTreatment InIndustrialAndMunicipalEffluents.
- FocusTheKnowledgeOnPathogenesisAndDiagnosisOf Various Microorganisms.

Reference:

1. Pelzer, M.J., R.D. Reind and ECS. Chan, Microbiology (McGraw Hill)
2. Purohit, S.S, Microbiology, Fundamentals and Applications (Agro botanical Publications).
3. Patel, A.H. Industrial Microbiology (Tata McGraw-Hill).
4. Ross, F.C., Introductory Microbiology (Bell and Howell Company, London)
5. Dubey, R.C. Microbiology, S. chand Co., New Delhi.

Web Link:

<https://catalog.slu.edu/courses-az/bchm/> (Saint Louis University)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20PIZOCP1	Core –PL-I-INVERTABRATES AND CHORDATA, CELL AND MOLECULAR BIOLOGY AND MICROBIOLOGY	6	4

Objectives:

1. To know the internal organs of the Invertebrata and chordate animals.
2. To know the cells of Buccal smear, Blood smear and cell divisions.
3. To study the preparation of microbial culture medium and isolation of microbes.

DISSECTIONS

Invertebrates and Chordates:

Dissection of Nervous and Reproductive Systems of Prawn (or) Squilla, Pila (or) Ariophanta.

Dissection of Circulatory, Nervous and Reproductive Systems of Fish, Calotes and Rat.

MOUNTINGS

Parapodia of Neries – Mouthparts of Honey bee and Cockroach – Aristotle’s lantern and Pedicellariae of sea Urchin-Brain of fish and Rat.

IDENTIFICATION OF INVERTEBRATE AND CHORADATE SPECIMENS

Trypanosoma, Physalia, Tape worm, Round worm, Nereis, Peripatus, King crab, Octopus, Sea cucumber, Sea urchin, Phylogenetic relationship of Trochophore, Veliger, Pluteus larve. Minor phyla forms: Rotifera, Chaetognatha. Chordate Specimens: Narcine, Echeneis, Diodon, Ostraction, Tetrodon, Hippocampus, Synapta, Periophthalmus, Rhacophorus, Ichthyophis, Najanaja, Viper, Draco, Chaemeleon, Pyrinosoma, Uromastix, Bat. Study of Invertebrate and Vertebrate fossils.

CELL AND MOLECULAR BIOLOGY

Micrometry - Study of Buccal smear-Blood smear in Frog and Man-Mitosis stages in Onion root tips-Meiosis stages in grass-hopper testes.

MICROBIOLOGY

1. Sterilization of Glasswares and culture media, preparing and dispensing culture media
2. Microbiological instruments and equipments
3. Culture Techniques : Streak plate and Pour plate
4. Bacterial and Fungal colony Counting and staining
5. Fermentation techniques
6. Isolation of microbes from spoiled food – Wheat, Milk, Cereals, Bread

A record of laboratory work and a report on local field trip should be maintained and submitted at the time of practical examination for valuation.

Course Outcomes

After completion of this course, students will be able to

- Identify The Invertebrate And Chordate Specimens
- Develop Skills In Significance Of The Internal Organs Of The Invertebrate And Chordate Animals.
- Prepare The Cells Of Buccal Smear, Blood Smear And Cell Divisions (Mitotic And Meiotic).
- Learn Microbial Culture Techniques.
- Learn Skills in identification of invertebrate and chordate specimens

Reference:

1. Hyman L.H. (1967) Comparative Vertebrate anatomy. McGraw Hill Book Co. New Delhi.
2. Parker and Haswell (1967), Text Book of Zoology Vol-I and Vol-II
3. De Robertis, R.O.P. and De Robertis, E.M.F. (1980) Cell and Molecular Biology, Holt Saunders International Edn, Japan.
4. Pelzer, M.J., R.D. Reind and ECS. Chan, Microbiology (McGraw Hill)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1ZOEL1A	Major Elective – I A) GENERAL AND HUMAN GENETICS	6	4
Objectives: <ol style="list-style-type: none"> 1.To learn the General Principles and application of genetics in Human. 2.To understand, the genetic inheritance of blood groups, chromosomal and extra chromosomes in animals and man. 3.A thorough study on genes and their mutational effect at molecular level. 4.To study the human genetics with reference to their behavior genetic engineering and genetic counseling. 				

Unit I

Hrs.18

Introduction to Principles of Genetics: Mendelism- Mendel and his experiments, Law of segregation, Law of independent assortment; Chromosomal basis of segregation and independent assortment. Extensions of Mendelism -Allelic variation and gene function- Dominance relationships, basis of dominant and recessive mutations; Multipleallelism, allelic series.

Unit II

Hrs.18

Genotype and phenotype:Effect of the environment on phenotype development- Penetrance and expressivity, phenocopy; lethal and sub lethal mutations; Gene interactions and modifying genes; Pleiotropy; Polygenic inheritance; Multifactorial inheritance.

Unit III

Hrs.18

Linkage and crossing over – Types of crossing over; Genetic and Physical mapping; heredity and environment (twin studies) – ABO and Rh type of Blood groups – Erythroblastosisfoetalis.

Unit IV

Hrs.18

Mutation: Fine structure and functions of gene – Methods of gene transfer – transformation, conjugation, transduction, and sexduction – Structural and numerical alteration of chromosomes - Deletion, duplication, inversion, translocation, ploids and their genetic implication; Hardy Weinberg’s law.

UnitV

Hrs.18

Human Genetics: Pedigrees- gathering family history, pedigree symbols, construction of pedigrees; Monogenic traits - Autosomal inheritance-dominant and recessive; Sex-linked inheritance- dominant and recessive; Sex-limited and sex-influenced traits; Y-linked; Mitochondrial inheritance.

Course Outcomes

After completion of this course, students will be able to

- Identify The Invertebrate And Chordate Specimens
- Develop Skills In Significance Of The Internal Organs Of The Invertebrate And Chordate Animals.
- Prepare The Cells Of Buccal Smear, Blood Smear And Cell Divisions (Mitotic And Meiotic).
- Learn Microbial Culture Techniques.
- Learn about Human Genetics

References:

1. Atherly *et al.* 1999. The Science of Genetics. Saunders. 1999
2. EJ Mongia and AP Mongia. Basic Human Genetics
3. Fairbanks *et al.* 1999. Genetics Wadsworth.
4. Gardner *et al.* 1999. Principles of Genetics. John Wiley.
5. Snustad *et al.* 1998. Principles of Genetics. Wiley and sons.
6. Griffiths *et al.* 2004. An Introduction to Genetic Analysis Freeman.
7. Snustad *et al.* 1998. Principles of Genetics. Wiley and sons.

Link:

<https://canvas.harvard.edu/courses/1069/assignments/syllabus> (Harvard University)

<https://www.mcgill.ca/gradapplicants/human-genetics-0> (McGill University)

<https://genetics.rutgers.edu/academics/undergraduate/syllabi> University of Washington

<https://www.umgc.edu/academic-programs/course-information.cfm?course=biol220>

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1ZOEL1B	MAJOR ELECTIVE – I B) GENOMICS AND PROTEOMICS	6	4
Objectives: <ol style="list-style-type: none"> 1. To learn the Genome mapping, assembly and comparison 2. To understand, Sequence based approaches and Microarray based approaches 3. A thorough study on Proteomics. 4. To understand, Protein-protein interactions and Applications of proteomics. 				

Unit I: Genome mapping, assembly and comparison.Hrs 18

Genome mapping, Genome sequencing. Base calling and assembly programs, Genome annotation: Gene ontology, Automated genome annotation, Annotation of hypothetical proteins and Genome economy. Comparative genomics: Whole genome alignment, Finding a minimal genome, Lateral gene transfer, Within-genome approach and Gene order comparison. Genome diversity: taxonomy and significance of genomes – bacteria, yeast and *Homo sapiens*.

Unit II:Functional Genomics.

Hrs 18

Sequence based approaches: EST, EST index construction and SAGE. Microarray based approaches: Oligonucleotide design, Data collection, Image processing, Data transformation and normalization. Comparison of SAGE and DNA Microarrays and their applications.

Unit III: Strategies in ProteomicsHrs 18

2D-PAGE, Mass spectrometry, protein identification through database searching, Differential in-gel electrophoresis and Protein Microarrays. Post translational modification: Prediction of disulphide bridges and Identification of posttranslational modifications in proteomics analysis. Protein sorting.

Unit IV.:Protein-protein interactions.Hrs 18

Prediction of protein-protein interactions: prediction interactions based on domain fusion, predicting interactions based on gene neighbors, predicting interactions based on sequence homology, predicting interactions based on phylogenetic information and prediction interactions using hybrid methods.

Unit V Applications of proteomics.

Hrs 18

Medical proteomics-disease diagnosis: Biomarkers, Biomarker discovery using 2DGE and mass spectrometry and Biomarker discovery and pattern profiling using protein chips. Pharmaceutical proteomics-drug development: The role of proteomics in target identification, Proteomics and target validation, Proteomics in the development of lead compounds and Proteomics and clinical development.

Course Outcomes

After completion of this course, students will be able to

- Acquire Knowledge On Mendelian Principles,
- Gain Awareness on the Effects Of Gene Interactions And Mutations.
- Understand On the Hardy – Weinberg Law.
- Explore The Human Genetics And Its Significance.
- Gain Knowledge On Applications of proteomics.

References

1. Xiong J. (2006). Essential bioinformatics. Cambridge, UK: Cambridge University Press.
2. Goodman N. (2002). Biological data becomes computer literature: New Advances in Bioinformatics. Curr. Opin. Biotechnol. 13: 68-71.
3. Hagen J.B. (2000). The origin of bioinformatics. Nat. Rev. Genetics. 1: 231-236.
4. Apweiler R. (2000). Protein sequence databases. Adv. Protein Chem. 54: 31-71.
5. Hughes A.E. (2001). Sequence databases and the internet. Methods Mol. Biol. 167: 215- 223.
6. Stein L.D. (2003). Integrating biological databases. Nat. Rev. Genet. 4: 337-45.
7. Batzoglou S. (2005). The many faces of sequence alignment. Brief. Bioinformatics. 6: 6- 22.
8. Xiang X. (1994). On global sequence alignment. Comput. Appl. Biosci. 10: 227-235.
9. Pearson, W.R. (1996). Effective protein sequence comparison. Methods Enzymol. 266: 227
10. Spang R. and Vingron M. (1998). Statistics of large scale sequence searching. Bioinformatics. 14: 279-284.
11. Mullan L.J. (2002). Multiple sequence alignment- The gateway to further analysis. Brief. Bioinform. 3: 303- 305.

Web Link:

<https://myplan.uw.edu/course/#/courses/GENOME372?states=N4Ig7gDgziBcLADrgJYDsAmB7MAJApigOYAWALsrAIwAMdANMmOtmAApZQpkpZqU0AviEFA>
(University of Washington)
<https://myplan.uw.edu/course/#/courses/GENOME373> (University of Washington)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1ZOEL1C	Major Elective – I C) GENERAL AND MICROBIAL GENETICS	6	4
Objectives: To learn the General Principles and application of genetics in Microbes. To understand, the genetic inheritance of Blood groups, chromosomal and extra chromosomes in animals and man. A through study on genes and their mutational effect at molecular level. to understand, the genetic natural and their molecular transfer mechanism in Bacteria, Virus and Fungi.				

Hrs 18

Principles of Genetics - Concept of gene and Genetic Code; Mendel and his experiments, Dominant and recessive Epistasis Multiples factor inheritance – Skin colour in Man. co-co – dominance-pleiotropism – Lethal genes in Man and Mice.

Unit IIHrs 18

Mutation at molecular level, Genetic structure of population –Hardy – Weinberg’s law and its Application – Fine structure and Functions of Gene.

Unit IIIHrs 18

ABO and Rh type of blood groups – Erythroblastosisfoetalis, Linkage and crossing over and mapping of chromosome, Non-disjunction-Free Martin, sex linked inheritance in Drosophila and Man –Y-linked inheritance – Barrbody, Extrachromosomal inheritance – Kappa particles.

Unit IVHrs 18 Nature of genetic material in Virus, Bacteria, fungi - Structure and Life cycle of Bacteriophages –Genetic recombination in bacteria, Gene mapping in bacteria – Genetic engineering using bacterial system.

Unit VHrs 18

Regulation of gene expression in microbes – Mechanism of transcription and translation. Operons-regulation at the level of DNA – Antisense DNA and RNA-RNA Polymerase – RNA processing –Capping and Polyadenylation, Ribozymes, Post translational regulation, signal sequences and protein transport.

Course Outcomes

After completion of this course, students will be able to

- Acquire The Knowledge On Mendelian Principles,
- Gain Awareness on the Effects Of Gene Interactions And Mutations.
- Understand The Hardy -Weinberg Law.
- Explore On The Molecular Transfer Mechanism In Bacteria, Virus And Fungi.
- Understand In The Regulation Of Gene Expression In Microbes

Reference:

1. Dobzhansky, T. principles of genetics, McGraw Hill Book Co Ltd, New Delhi.
2. Norman, V. Rothwell, Human genetics – Prentice Hall of India Pvt Ltd – New Delhi.
3. Strickberger, Genetics, Collier Mc Milton. Dania and Harper-General MicroBiology.
4. Jenkins, J.B. Human Genetics, The Benjamin Cumming Publishing Co.
5. Anita Rozar -2002. Practical methods for Environmental Microbiology and Biotechnology, Krishna Prakasam Media (P) Ltd., Meerut.
6. Lewin. B., (1997). Genes VI. Oxford University Press. Oxford.
7. David Freifelder (1991). Microbial genetics-Narasa Publishing House, New Delhi.

Web Link:

<https://canvas.harvard.edu/courses/1069/assignments/syllabus> (Harvard University)

<https://www.mcgill.ca/gradapplicants/human-genetics-0> (McGill University)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20PIZOCO1	Core Optional -CANCER AND STEM CELL BIOLOGY	6	5

Objectives:

1. To know the regulation of eukaryotic cell cycle.
2. To know the cancer biomarkers
3. To study the cell signaling in cancer cell lines.
4. To know diagnosis and treatment.
5. To know the concept of stem cells and treatment.

UNIT I

Hrs18

Regulation of the Eukaryotic cell cycle, Cell birth, Lineage and cell death. Cancer/ oncogenes, Cancer biomarkers, Cellular morphology, Primary and established cell lines, Kinetics of Cancer cell growth, Genetics of cancer cells. Cancer stem cell culture and their applications. Cell culture based vaccines. Cancer proteomics.

UNIT II

Hrs18

Cell Signalling in Cancer Cell lines: Cancer cell lines : MCF-7, HeLa, HepG2, A549 and ZR771. Signaling at the cell surface, Types of signaling pathways that control gene activity, Integration of signals and gene controls. Moving proteins into membranes and organelles, Vascular traffic, secretion and endocytosis, Metabolism and movement of lipids.

UNIT III

Hrs18

Etiology, epidemiology, diagnosis and treatment of Breast, Lung, colo-rectal, blood, endocrine cancers. Current scenario of RNAi technology in cancer medicine. Role of gene therapy in cancer treatment.

UNIT IV

Hrs18

Stem cell concept – Properties of stem cell – Types of stem cell embryonic stem cell – Adult stem cells – Problem of differentiation. Differentiation status of cells – Primordial germ cell - Skin cell - Gastrointestinal cells – Embryonic stem cell differentiation as a model to study Hematopoietic and endothelial cell development.

UNIT V

Hrs18

Stem cell location and Classification – Neural stem cells – Stem cell niches – Germ line Epithelial and Epidermal and neural niches. Uses of Stem cells - Human stem cells – Renewal of stem cells- Stem cells and Tissue engineering – Embryonic stem cells and Gene therapy - Therapeutic cloning. Ethical and Social consideration of Stem cell research.

Course Outcomes

After completion of this course, students will be able to

- UnderstandTheVarious TheoriesOf DevelopmentOfAnimals.
- GainKnowledgeOnParthenogenesis.
- UnderstandThe EmbryonicOrganizers
- UnderstandTheImportantHormonesInRelationToGrowthAndMetamorphosisOf Amphibian.
- KnowThe Biotechniques ForThePreparationOfPermanentSlides
- Develop Skills On Chromatography And ElectrophoreticTechniques

REFERENCE :

1. KursadTurksen 2002. Embryonic Stem Cells Method and Protocols.Humana press.
2. Russell Korobkin and Stephen R. Munzer 2007. Stem Cell Century, Law and Policy for a Breakthrough Technology, Yale University Press.
3. Robert Lanza 2005. Essential of Stem cell Biology.Elsevier press.
4. Robert Lanza, 2004. Hand Book of Stem Cells Volume 1&2, Elsevier press.

Web Link:

<https://www.duke-nus.edu.sg/education/our-programmes/phd/ibm-phd/specialty-tracks/cancer-and-stem-cell-biology> (National University of Singapore, Singapore)

<http://www.nus.edu.sg/nusbuletin/duke-nus-medical-school/graduate-education/curriculum-information-phd-programme/> (National University of Singapore, Singapore)

<https://www.a-star.edu.sg/News-and-Events/a-star-news/news/press-releases/singapore-scientists-uncover-how-neural-stem-cells-are-activated-intrinsically-by-spindle-matrix-proteins> (National University of Singapore, Singapore)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	20P2ZOC4	Core – DEVELOPMENTAL BIOLOGY AND BIO-TECHNIQUES	5	5

Objectives:

1. To know organization and nature of aquatic and terrestrial animals in relation to egg activation during fertilization – cleavage and gastrulation.
2. To study the Embryonic organizers, nature of genetic information during cell differentiation
3. To understand the important hormones in relation to growth and metamorphosis in amphibian and other important animals.
4. To know the Biotechniques for the preparation of permanent slides Homogenize, Chromatography, Electrophoresis, etc.

Unit I

Hrs.18

Scope of embryology – Gametogenesis, Types of Egg, Egg polarity and Symmetry – Organisation of egg Cytoplasm. Egg activation during fertilization – Cleavage: patterns of Cleavage - Transplantation studies on nuclei of cleavage cells - Gastrulation – Morphogenetic movements - Metabolism during gastrulation – Activity of Genes during gastrulation- parthenogenesis.

Unit II

Hrs.18

Embryonic Induction and Competence: Gene action in cell determination and differentiation – Nature of genetic information and its utilization during cell differentiation – Control of gene expression during development – Influence of cytoplasm on differentiation, Organizers – Classical experiments on Organizers. Nuclear factors in development.

Unit III

Hrs.18

Hormones: Influence of Hormones on growth and metamorphosis of amphibians- Regeneration – Regenerative ability in various animals – Types of regeneration – stimulation and suppression of regeneration – Polarity and Gradients in regeneration- Super regeneration in Mammals- Hormones role in sexual cycles in Mammals- Placenta in Mammals.

Unit IV

Hrs.18

Biotechniques: Cell fractionation techniques – Homogenization – Homogenizer. Centrifugation – Principle, types of centrifuges. Cell and tissue preparations for microscopic studies – Fixatives, stains. Microtechnique -Preparation of permanent slides for whole mounts and tissue sections.

Unit V

Hrs.18

Separation techniques– Chromatography: principles, Column Chromatography, Paper Chromatography, Thin Layer Chromatography (TLC) and Gas Liquid Chromatography (GLC)- Electrophoresis: Principle, Agrose Gel Electrophoresis (AGE) and Polyacrylamide Gel electrophoresis (SDS- PAGE).

Course Outcomes

After completion of this course, students will be able to

- Understand The Various Theories Of Development Of Animals.
- Gain Knowledge On Parthenogenesis.
- Understand The Embryonic Organizers
- Understand The Important Hormones In Relation To Growth And Metamorphosis Of Amphibian.
- Know The Biotechniques For The Preparation Of Permanent Slides
- Develop Skills On Chromatography And Electrophoretic Techniques.

Reference:

1. Bodemer, C.W. (1968) Modern embryology, Holt Rinebert Winston, New York.
2. Balinsky, B.L. (1981) An introduction to Embryology, V. Edn. Saunders Co., Philadelphia.
3. Willer, B.H. Oppenheimer. J.M, (1964) Foundations of Experimental Embryology, Prentice Hall.
4. Rough, R. (1945) Experimental Embryology, Burgess Minneapolis
5. Needham, J (1958) a History of embryology, II Edn. University Press, Cambridge.
6. Berrill, N.J. (1961) Developmental biology TMH Edn., New Delhi.
7. Gry, P. (1958) Hand book of Basic Micro techniques McGraw Hill, New York.
8. Weesner, Principles of Microtechniques.
9. Baker, J.F. (1958) Hand book of Basic Microtechniques, McGraw Hill, New York.
10. T. Plummer, Introduction of Practical Bio-chemistry.
11. Oser (1968). Hawk's Physiological chemistry.
12. SCOTT F. GILBERT Swarthmore College and The University of Helsinki
"DEVELOPMENTAL BIOLOGY NINTH EDITION" Companion Website
www.devbio.com

Web Link:

<https://as.nyu.edu/content/dam/nyuas/biology/documents/Biol.UA26DevelopmentalBiology.pdf> (developmental biology - new York university).

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	20P2ZOC5	Core - ENVIRONMENTAL BIOLOGY AND CONSERVATION	5	4
Objectives: <ol style="list-style-type: none"> 1. To know the ecosystems of terrestrial and water in a comparative manner. 2. To study the various Biotic community and Biodiversity. To know the survey of natural resources and conservation and management. 3. To study the Air pollution, various pollutants – effects of ozone – green house effect and Noise pollution. 4. To know the water resources and its management. To study various water pollution and prevention an control of water pollution. 5. To study the radiation ecology – space ecology – Exobiology – hazards of space travel. 				

Unit I

Hrs.18

Introduction: Dynamics of Ecosystem – Terrestrial forest - grassland, salt marsh - cropland and aquatic ecosystems; food chain – food web. Ecological pyramids – primary and secondary production – Energy flow in an ecosystem.

Unit II

Hrs.18

Population Ecology: Concept of population and meta-population; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density-dependent; limits to population growth; deterministic and stochastic models of population dynamics; ruderal, competitive and stress-tolerance strategies.

Unit III

Hrs.18

Community Ecology: Discrete versus continuum community - a view; community structure and organization: physiognomy, sociability, species associations, periodicity, biomass, stability, keystone species, ecotone and edge effect, species interactions, ecological succession: primary and secondary successions, climax community concepts, ecological niche; types of niche, impacts of biological invasion on ecosystem and communities.

Unit IV

Hrs.18

Ecological Pollution: Sources and effects Air Pollution - Water pollution – Thermal and Nuclear pollution - Prevention and control of pollution. **Social Issues and the Environment:** Solid waste Management: Role of an individual in prevention of pollution. Disaster management. Water management, rain water harvesting, watershed management; Wasteland reclamation – Public awareness.

Unit V

Hrs.18

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. - Biogeographical classification of India; Values of biodiversity; India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of

wildlife, man-wildlife conflicts. Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Course Outcomes

After completion of this course, students will be able to

- Gain Knowledge On Environmental Ecosystem.
- Learn The Biotic Community And Biodiversity Of Animals.
- Gain Knowledge Of Environmental Pollution.
- Equip With An In Depth knowledge On Population Ecology And Community Ecology.
- Learn The Biodiversity and its conservation

Reference:

1. Dowd swell, W.H. An introduction to Animal Ecology, Melthuen, London.
2. Odum, E.P. 1953. Fundaments of Ecology. W.B. Saunders, Philadelphia.
3. Mellarnby, K., The Biology of Pollution.
4. Dash, M.C., Fundamental of Ecology
5. Krishnamurthy, K.V. 2003 Text book of Biodiversity, Science publishers Inc,

Web Link: <https://canvas.harvard.edu/courses/63059/assignments/syllabus> (Harvard University)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	20P2ZOC6	Core - BIO-TECHNOLOGY	5	4
Objectives: <ol style="list-style-type: none"> 1. To study the concept and scope of Biotechnology and techniques in Biotechnology. 2. To understand the recombination DNA technology. 3. To aware the programs of cell culture, preparations hormones and vaccines, engineered Hb, transgenic animals and Human genome project. 4. To study the Bioprocess Technology and their application 				

Unit I

Hrs.18

Concepts and scope of Biotechnology – Gene cloning – the basic steps – various types of restriction enzymes – DNA ligase – cDNA – transformation – Selection of recombinants. Gene probe – DNA finger printing – RFLP –PCR technique – Genomic library – Blotting techniques – Southern blotting – Northern blotting and Western blotting.

Unit II

Hrs.18

Plasmid biology – cloning vector Bacteria(PBR322. BAC), Cloning vector for yeast (YEP, YIP and YAC) - Cloning vector for virus (SV40) – MAC - Gene transfer techniques.

Unit III

Hrs.18

Animal Cell culture: Organ culture – Whole embryo culture- Embryo transfer – In vitro fertilization (IVF) technology – Dolly – embryo transfer in human. Transgenic Mice. Human gene therapy – Cryobiology- Labelling DNA Gene Probe molecules

Unit IV

Hrs.18

Bioprocess and applications – Fermenters, their design and types – Down stream process – Recovery of Fermented products - Survey and uses of enzymes in industries – Isolation and purification of enzymes – Enzyme Immobilization techniques – Commercial production of single cell protein (SCP) – Primary metabolites – Ethanol, Vitamins ;Secondary Metaolites – Penicillin.

Unit V

Hrs.18

Bioremediation: Hydrocarbons – Industrial wastes – Heavy metals– bioleaching – biomining – biofuels. Microbiological degradation of Xenobiotics.Applications of biotechnology in agriculture, medicine and food science.Genetically modified microorganism (GMO'S) – Regulations in Biotechnology - Biosafety – Contaminents and IPR.

Course Outcomes

After completion of this course, students will be able to

- LearnTheConcept AndTechniquesInBiotechnology.
- UnderstandThe RecombinationDNATechnology.
- Acquire Knowledge on The ProgramsOfCellCulture, Hormones,Vaccines,TransgenicAnimalsAndHumanGenomeProject.
- DevelopSkillsIn BioprocessTechnologyAndTheirApplications.
- Acquire Knowledge on Bioremediation

Reference:

1. Dubey, R.C.-A text Book of Biotechnology, S. Chand and Co., Ltd., New Delhi. 1996.
2. Gupta, P.K. – Biotechnology and genomic, Restage Publications, Meerut 2004.
3. Rebert F. Weaver – Molecular Biology II Edn., Tata McGraw-Hill, New Delhi.
4. D. Balasubramanian et al – Concepts in Biotechnology
5. Link, E.R. and Pastenak – J.J. Molecular biotechnology
6. Putohit, S.S. –Biotechnology Fundamentals and Application-Agrobios, Jothpur-2005.
7. Alberghina – Protein Engg. In Industrial Biotechnology – New Era Books, Bangalore.
8. Molecular Biology and Biotechnology 5th Edition: John M Walker
9. School of Life Sciences, University of Hertfordshire, Hatfield, Hertfordshire AL10 9AB, UK
10. Fundamentals of Applied Microbiology, Second Edition, AlexanderN.Glazer University of California, Berkeley, HiroshiNikaido University of California, Berkeley

Web Link:

<https://canvas.harvard.edu/courses/63078/assignments/syllabus> (Harvard University)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	20P2ZOC7	Core - ENDOCRINOLOGY	4	4
Objectives: 1. To make the students to learn the objectives and scope of comparative Endocrinology. 2. To know the anatomy, morphology and histology of endocrine tissues of vertebrates, crustacean and insect endocrine organs and their functions.				

UNIT-I: Introduction to endocrinology

Hrs.18

Introduction, objectives and scope of endocrinology - concepts of hormone secretion; classification of hormones, characteristics of hormones ; Hormone receptors and mechanism of hormone action.

UNIT-II: Pituitary and thyroid glands

Hrs.18

Pituitary gland - characteristics, structural organization - hormone secretion and its functions - Hypothalamic control. Thyroid gland - structural organizations, metabolic effects of thyroid - effects of thyroid on reproduction – parathyroid: structure and functions.

UNIT-III: Pancreas and adrenal glands

Hrs.18

Structure of pancreas, pancreatic hormones and their functions. Structural organizations of adrenals, functions of cortical and medullary hormones.

UNIT-IV: Reproductive endocrinology

Hrs.18

Structure of mammalian testis and ovary - male and female sex accessory organs - hormones of testis and ovary - estrous and menstrual cycle - hormones of pregnancy and parturition - Hormonal control of lactation.

UNIT-V: Insects and crustacean endocrinology

Hrs.18

Concepts of neurosecretions - endocrine systems in crustaceans - endocrine control of moulting and metamorphosis - neuroendocrine system in insects - endocrine control of moulting - metamorphosis and reproduction.

Course Outcomes

After completion of this course, students will be able to

- Understand The Concepts Of Hormone Action.
- Know The Mechanism Of Hormone Action.
- Gain knowledge on The Effects Of Pituitary And Thyroid Hormones In Pregnancy.
- Realize The Role Of Hormones In Metamorphosis.
- Gain knowledge on hormonal imbalance

Reference

1. Haris, G.W. and B.T. Donovan. 1968. The Pituitary Gland. S. Chand and Co.,
2. Bentley, P.J. 1985. Comparative vertebrate endocrinology, Second Edition, Cambridge University Press. Cambridge.
3. Mac Hadley. 1992. Endocrinology, 3rd Edition. Prentice - Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.
4. Ingleton, P.M. and J.T. Bangara. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.
5. Turner, C.D. and J.T. Bangara. 1986. General endocrinology. Saunders

Web Link:<https://canvas.harvard.edu/courses/63071/assignments/syllabus> (Harvard University)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	20P2ZOCP2	Core -PL- DEVELOPMENTAL BIOLOGY, BIOTECHNIQUES, ENVIRONMENTAL BIOLOGY, BIOTECHNOLOGY & ENDOCRINOLOGY	6	4

Objectives:

- A. Study and mounting of chick embryos – study of Amphioxus and Frog.
- B. MICRO TECHNIQUES : To know the slide preparation of Tissues, Organs and whole mount of invertebrate larvae.
- C. To learn the Techniques in Biotechnology
- D. To study about the dissolved O₂, pH, CO₂, Salinity in water samples, identification of plankton and animal relationship with suitable examples.

A.DEVELOPMENTAL BIOLOGY

Study of mounting of developmental stages – CHICK 24, 36, 48, 72, and 96 hours, developmental stages of Amphioxus and Frog, Metamorphosis of Tadpole larvae.

B. BIOTECHNIQUES

Micrometry, fixation, embedding, serial sections, cytological staining, mounting of tissues, organs, embryos and whole mounts of invertebrates larvae.

Chromatography – Circular Paper Chromatography.

C.ENVIRONMENTALBIOLOGY

1.Measurement of Physico-chemical parameters in aquatic environment.

- a.Salinity
- b.Dissolved oxygen
- c.Free Carbon-di-oxide, carbonates and bicarbonates.
- d.pH (using pH paper or pH meter or Lovidbond comparator)

2.Study of examples illustrating animal associates.

D.BIOTECHNOLOGY

1. Separation of proteins by SDS and PAGE electrophoresis.
- 2.Isolation of plasmid and genomic DNA.
- 3.Southern blotting.
- 4.Instrument and Equipments-Centrifuge, PCR, BOD incubator, Densitometer, Chromatogram, Transilluminator, Electrophoretic apparatus .

E.ENDOCRINOLOGY

1. Glucagon Stimulation Test (in suspected hypoglycemic disorders)
2. Insulin Stimulation Test (Insulin Tolerance Test)
3. Thyrotropin Releasing Hormone (TRH) – Test

Course Outcomes

After completion of this course, students will be able to

- Develop Skills In Mounting Of Blastoderm Techniques.
- Equip With Separation And Blotting Techniques.
- Acquire Skills In Histological And Histochemical Techniques.
- Know The Animal Association
- Estimate The Physicochemical Parameters.

Reference:

1. Turner, C.D. and J.T. Bangara. 1986. General endocrinology. Saunders
2. Gupta, P.K. – Biotechnology and genomics, Restage Publications, Meerut 2004.
3. Balinsky, B.L. (1981) An introduction to Embryology, V. Edn. Saunders Co., Philadelphia.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	20P2ZOEL2A	Major Elective – II A) CELL AND TISSUE CULTURE	5	4
Objectives: <ol style="list-style-type: none"> To know the plant cell, aseptic Techniques, callus induction. To know about Micro propagation. To know cell culture Manipulation. To know the principles of cell and Tissue Culture. To know Tissue Culture Techniques. 				

Unit -IHrs. 18

History of plant and animal cell – laboratory organization – aseptic techniques – nutritional requirements and culture media – Types of cultures – solid – liquid – stationary – agitated – batch cultures – Organogenesis – Callus induction – Caulogenesis – Rhizogenesis techniques of hairy root production.

Unit- IIHrs. 18

Micro propagation – mass production of plantlets – Hardening and mist chambers – transplantation to field – techniques for Maintaining plantlets in the field – somatic embryo genesis – induction of haploids and triploids – techniques of overcoming incompatibility barriers – embryo rescue protoplast and pansexual hybridization – exploitation of Somaclonal and Gametoclonal variations.

Unit –IIIHrs. 18

Mass culture of Cells – Manipulation of cell line selection – immobilization of cells and its application – synchronization of cell cultures and cell division – production of secondary metabolites – biotransformation – Induction of cell line mutants and mutations – cryo preservation - germplasm conservation and establishment of gene banks – synseed technology.

Unit- IVHrs. 18

Principles of Cell and Tissue Culture, Advantages and disadvantages of tissue culture methods – cell markers: role of molecular markers in crop and farm animal improvement – types of cells – Primary and established cell lines – Kinetics of cell growth – genetics of cultured cells. Application of animal cell culture for *in vitro* testing of drugs; Use in gene therapy, cloning for production of transgenic animals, cloning for conservation.

Unit –VHrs. 18

Techniques of Cell and Tissue Culture : Sources of cells – techniques of cell culture, Mechanical, biochemical and types of animal cells – culture procedures – preparation of animal materials – primary culture, cell lines and cloning – Slide and coverslip cultures, washing and feeding, double coverlid cultures, text tube culture – Organ culture – whole embryo culture – specialized culture techniques – cell synchronization – measurement of cell death – stem cell culture and transplantation.

Course Outcomes

After completion of this course, students will be able to

- KnowThePlantCellCultureAnd Callus Induction.
- GainKnowledgeOnCultureAnimal Cells InArtificialMedia.
- Realize TheAnimal Cells InCulture,GrowthOf CellLines.
- AcquireSkills In Recombinant Dna Technology, GeneticManipulationsAndIn AVarietyOf IndustrialProcesses.
- Learn the Techniques of Cell and Tissue Culture

Reference

1. Kalyan Kumar De, 1992, Plant Tissue Culture, New Central Book Agency, Calcutta.
2. D.C.Daring and S.J.Morgan, 1994, Animal Cells, Culture and Media, BIOS Scientific Publishers Limited.
3. Robert N. Trigiano, Dennis J.Gray, 1996, Plant Tissue Culture Concept and Laboratory Excurses. CRC Press London.
4. Ann Harris, 1996, Epithelial Cell Culture, Cambridge University Press.
5. P.S.Srivasta, 1998, Plant Tissue Culture an Molecular Biology, Narosa Publishing House, New Delhi.
6. David W. Galbraith, Hans J. Bohnertan Don p. Bourque, 1995, Methods of Plant Cell Biology, Academic Press, New York.
7. Jennie P. Mathur and David Barnes, 1998, Methods in Cell Biology, Volume 57: Animal Cell Culture Methods Academic Press.
8. John H.Dods and Lorrin W. Roberts, 1995, Experiments in Plant Tissue Culture, Cambridge University Press, USA.
9. M-M-Ranga, 2000, animal Biotechnology, Agro bios (India).
10. Plants, Genes and Crop Biotechnology 2nd Edition by Chrispeels, M.J. &Sadava D.E. American Society of Plant Biologists, Jones and Bartlett Publishers, USA (2003).
11. Butler, M “Mammalian Cell Biotechnology- A Practical Approach,” IRL Oxford University Press (1991)

Web Link:

https://link.springer.com/chapter/10.1007/978-94-009-4396-4_6 (DNA Plant Technology Corporation, Cinnaminson, USA)

<https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/cell-genetics>
<https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1>

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	17P2ZOEL2B	Major Elective – II B) WILDLIFE MANAGEMENT	5	4
Objectives: <ol style="list-style-type: none"> 1. Know the wild life – Tourism foreign exchange. Important wildlife sanctuaries of the world. 2. To know the wild life in India such as wild life resources and sanctuaries. 3. To know the behavior of grazers (Elephants) carnivores (Lion) and primates (Orange, chimps and Gorillas). 4. To study the behavior and migration of Birds – various Bird sanctuaries Bird watching, Fishing etc. 5. To know the wild life activities-By filming, Videography and documentation and wild life protection acts and laws-wild life conservation. 				

Unit I Hrs 18

Wild Life:

Introduction Scope for the study of wildlife resources and forestry. Wild life Tourism. Foreign exchange and revenue from Wildlife Tourism – Employment prospects. Important wildlife sanctuaries of the world. Need for the production and conservation and conservation of wildlife and endangered species. Red databook.

Unit II Hrs 18

Wild Life in India:

Important wildlife game reserves and sanctuaries in India, Gir Lion forest, Jim Corbett Tiger reserve, Kasiranga Sanctuary, Point Calimere, Bharatpur Kaledeo bird sanctuaries, Rann of Kutch, Mudumalai, Karkudi and Wynad sanctuaries and their wildlife species – endangered species.

Unit III Hrs 18

Ethology of Animal Behaviour

Grazers – Elephant – herds, their behaviour, family hierarchy, feeding, reproduction, and migration, Carnivores – Lions – family life, hunting behavior and feeding, mating and reproduction, hierarchy, Primates – larger primates – Orange, Chimps and Gorillas and group behavior.

Unit IV Hrs 18

Bird Watching as hobby – equipment needed for Bird watching, -Important migratory birds of India, checklist of birds, Migratory behavior, and influencing factors. Fishing and sport / game fishes. Point Calimere, Vedanthagal, Muthupert, Bharatpur and other bird sanctuaries.

Unit V Hrs 18

Wildlife watching and tours as hobby and research. Wildlife filming. Videography and documentation. Silent Valley Project, Wildlife parks. Zoos, Treatment of animals in captivity and circuses. Wildlife conservation measures – Wildlife Protection Acts and Laws, World Wildlife conservation and funding agencies and programmes (WWF). Tiger projects (UNEP), ICUN (International Union for conservation of Nature and Natural Productively).

Course Outcomes

After completion of this course, students will be able to

- KnowTheWildlifeResourcesInWorld.
- ExploreTheKnowledgeOnSanctuariesAndEndangeredSpeciesInIndia.
- AwareOnTheAnimalBehavior.
- AcquireSkillsInBirdWatching.
- DevelopSkillsInWildlifeConservation.

Reference:

1. The International wild life encyclopedia. Eds. MouriceBurton and Robert Burtons.
2. Insearch of Wild India (1982) By Charlie – Pye Smith, North, South Productions. Publishers, BoxtreeLtd.
3. Insearch of Wild India (1982) By Charile – Pye Smith, North, South Productions, Publishers, Boxtree Ltd.
4. The International wild life Encyclopedia. Eds. Mourice and Robert Burtons.
5. Mammalogy (1972), Terry Vaughan, A., W.B. Saunders Company. London.
6. Encyclopedia of Animal World. Vol. I-XX, By Smith, North, South Productions, Publishers, Boxtree Ltd.
7. Birds of India and Pakistan (1978), By Salim Ali, Hindustan Publishers, New York.
8. Animal Behaviour, Times Illustrated World of Science, Time Life Asia.
9. Encyclopedia of Animal World, Vol.I-XX, By stargazers – Tatis, Bay Books, Sydney.

https://www.warnell.uga.edu/sites/default/files/inline-files/Curriculum_FISHWILD_2.pdf (UGA university, Georgia)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	20P2ZOCO2	TOXICOLOGY	6	5

Objectives:

1. To know the scope of toxicology
2. To study the classification of toxicology.
3. To know the toxicological testing methods.
4. To know the environmental toxicology
5. To know the biomonitoring of toxic chemicals

Unit- I Introduction and scope

Hrs18

Introduction – Scope of Toxicology. Disciplines of Toxicology. Goals of Toxicology.

Unit II Toxicological testing methods & Classification of toxicants

Hrs18

Acute and chronic , Risk and Hazard, Bioassays. Determination of LC50 and LD 50
Chemical Pesticides- Types – Uses

Unit III Route of exposure & persistence of toxicants

Hrs18

Absorption – Distribution – Excretion. Factors affecting toxicity of Xenobiotic chemicals. Fate of Pesticide residues. Fate of heavy metals. Fate of toxicants in the atmosphere

Unit IV Environmental toxicology & effect of xenobiotics

Hrs18

Toxicants in the Environment: Atmosphere- Ozone Depletion- Photochemical smog, Acid rain, Global warming; Hydrosphere- Eutrophication; Lithosphere- Biodegradable wastes. Mechanism of Toxicants: Bioaccumulation, Biotransformation and Biomagnification

Unit V Biomonitoring of toxic chemicals & safety evaluation of toxicants

Hrs18

Risk and safety analysis: Margin of safety, Therapeutic index, Ideal therapeutic index.– Cumulative toxicity. Calculation of safe level. Specific toxicity studies: Carcinogenicity, teratogenicity, in-vitro, mutagenicity tests.

Course Outcomes

After completion of this course, students will be able to

- Understand the Scope of toxicology and its impact on environment
- Know about classification and methods of toxicology.
- Develop skill on toxicological testing methods.
- Learn about the Mechanism and implementation of Toxicants
- Understand the Biomonitor of environmental toxicology
- Understand the Scope of toxicology and its impact on environment
- Know about classification and methods of toxicology.
- Develop skill on toxicological testing methods.
- Learn about the Mechanism and implementation of Toxicants
- Understand the Biomonitor of environmental toxicology

References

1. Regulatory Toxicology- Shayne C Gad
2. Goodman and Gilman's : The Pharmacological Basis of Therapeutics, edited by Alfred Goodman Gilman, Theodore W. Rall, Alan S Nies, and Palmar Taylor
3. Clinical Pharmacology by D.R. Laurence and P.N. Benett
4. The toxicologist's pocket handbook, Michael J derelanko 2nd Ed, 2008, CRCpress
5. Relevant OECD, ICH, SCHEDULE Y guidelines
6. Modern Medical Toxicology-VV Pillay, Jaypee Publishers, 4th Ed.

Link:

<https://canvas.harvard.edu/courses/8161/assignments/syllabus> (Harvard University)

<https://envsci.rutgers.edu/academics/envsci/syllabi/375%20407%20Environmental%20Toxicology%20VanOrden.pdf>

<https://www.uu.se/en/admissions/master/selma/kursplan/?kpid=39471&kKod=1BG209>

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3ZOC8	Core – IMMUNOLOGY	5	4
Objectives: <ol style="list-style-type: none"> 1. To study the structure and functions of Lymphoidal organs. 2. To study the types of Antigens and Immunoglobulins. 3. To study the detection methods of Antigen- Antibody reactions. 4. To learn the techniques in organ transplantation 5. To know the common, Auto Immune diseases. 				

Unit I

Hrs.18

Immunity: Kinds of Immunities – Innate immunity- Acquired immunity:-Natural-Active. An overview of immune system:-Lymphoidal organs – Primary **Lymphoidal organs:** Thymus- Bone marrow- Bursa of Fabricus. Secondary Lymphoidal organs – Spleen- Lymph nodes- Payer’s patches. Immune cells: Types- B-cell development-T-cell development.

Unit II

Hrs.18

Antigens and immunoglobulins: Types of Antigens-immunoglobulins: Classification of immunoglobulins- IgG, IgM, IgA, IgD and IgE- Basic structure of a immunoglobulin- General functions of immunoglobulins- Biosynthesis of Immunoglobulins:Theories of Antibody formation. **Immune response:-**Primary and secondary immune response-Cell Mediated Immunity- Antigen presentation and processing- Killer Lymphocytes- Lymphokines-Lymphotoxins-Cytokines- Interferon.

Unit III

Hrs.18

Antigen – Antibody Interactions: Characteristics feature of Ag – ab reaction- Precipitation-Agglutination- Opsonisation- Cytolysis- Flocculation- Complement fixation. Histocompatibility (MHC) Hypersensitivity:- Type I- Anaphylactic Hypersensitivity- Type II- Antibody- dependent cytotoxic hypersensitivity- Type III- Immune complex mediated hypersensitivity- Type IV-Cell mediated hypersensitivity – Type V-Stimulated hypersensitivity- Immune tolerance.

Unit IV

Hrs. 18

Common Autoimmune Diseases:- Thrombocytopenia-Thyrotoxicosis- Addison’s diseases RheumatoidArthritis- Autoimmune haemolyticaemia.

Immunotechniques:- ELISA- HLA Typing-VDRL Test-Immunoelctrophoresis- Radioimmunoassay - ABO Blood typing- Hybridoma technology.

Unit V

Hrs.18

Transplantation:- Types of graft – Graft acceptance- Graft rejection- Types of allograft rejection- Prevention of allograft rejection.

Tumour Immunology:-Types of Tumour-Tumour antigens-Immune response to tumour-Immune surveillance-Factors involved in tumour immunity.

Course Outcomes

After completion of this course, students will be able to

- Compare And Contrast The Innate And Adaptive Immunity And Also Be Aware Of Different Vaccination.
- Understand The Roles Of Immunoglobulins And Immune Cells In Immunological Responses
- Know The Characteristics Of Antigen-Antibody Interactions And Different Types Of Allergic Reactions.
- Realize The Adverse Effect Of Immune System Causing Autoimmune Diseases And Apply The Basic Techniques For Identifying Antigen-Antibody Interactions
- Understand The Roles Of Immune System In Protection Against Tumor And Realize The Stages Of Transplantation

Reference :

1. IMMUNOLOGY – Jean Francois Bach (1982) 6th Edition Wily Medical Publications, New York.
2. IMMUNOLOGY – An Introduction (1984) – By Tizard Saunders College Publishing
3. Structure and Function of Antibodies (1977) Glynn. L and Steward M.W. John Wiley and sons, New York.
4. ESSENTIALS OF IMMUNOLOGY (1984) Hidemann W.H. Elsevier Publication, Oxford.
5. IMMUNOLOGY – An Introduction (1984) 6th Edition Wiby Medical Publications, New York.
6. Stucture and Function of Antibodies (1977) Glynn, L and Steward M.W. JohyWiley Sons, New York.

Web Link:

<https://medicine.nus.edu.sg/mbio/doc/modules/LSM3223.pdf> (NUS)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3ZOC9	Core -ANIMAL PHYSIOLOGY AND BIOCHEMISTRY	5	5
Objectives: <ol style="list-style-type: none"> 1. To study the physiology of Nutrition, Respiration, and circulation. 2. To learn the physiology of Excretion, Muscular coordination. 3. To know the physiology of nervous coordination, Sensors exhibition 4. To know the biochemistry of water and minerals. 5. To study the Enzymes and their kinetics and the role of Nucleic acid. 				

Unit I

Hrs.18

Nutrition: Structure and functions of digestive organs of man - Respiration : Types of respirations, respiratory pigments in Animal – Transport of O₂ and CO₂ in man – Respiratory quotient – Circulation : Chemistry of Blood coagulation – Types of transport mechanisms – Structure and physiology of mammalian heart – blood pressure – pacemaker, Regulatory mechanisms.

Unit II

Hrs18

Excretion: Excretion in relation to different habitat – Excretory Structure and Physiology of detoxification pathways of Ammonia in Man– Regulation of nitrogen excretion. Osmo-ionic Regulations Osmoregulations in freshwater, marine and estuarine fishes. Thermo regulation in animals. Muscles : Types - ultra structure – Properties – Mechanisms of muscle contraction – chemistry, Energetics and Regulation of Muscle contraction – Electric organs and Bioluminescence.

Unit III

Hrs.18

Nervous co-ordination: Structure and types of neuron, transmission of nerve impulse – Synapses – Reflex action – Animal behavior and learning.

Receptors: Photo, Chemo and Mechano receptor of man.

Chemical co-ordination: Reproductive cycle in Mammals – hormonal regulation of ovulation, implantation. Gestation and Lactation. Family planning.

Unit IV

Hrs.18

Biochemistry: Water, pH, buffers and Minerals –classification of carbohydrates, proteins and fat and their metabolism.

Unit V

Hrs.18

Enzymes: Classification of enzymes, enzymes kinetics –Mechanism of enzyme action – regulation of enzymatic activity – Co-enzymes – Isoenzymes – functions of enzymes - Energy rich compounds and their roles, Nucleic acids: DNA and RNA.

Course Outcomes

After completion of this course, students will be able to

- LearnThePhysiologyOfNutrition,Respiration,AndCirculationOf HumanBeings.
- LearnThePhysiologyOfExcretionAndMuscularCoordinationOfMan
- UnderstandThePhysiologyOfNervousCoordinationAndSenseOrgansOf Animals
- UnderstandTheBiochemistryOfMuscleTissues.
- Gain information aboutClassification of enzymes

Reference:

1. Hoar, S.W., 1978. General and comparative Physiology, Prentice Hall, London, New York.
2. Prosser, O.D. and Brown, A.F. (Jr), 1961. Comparative Animal Physiology, W.B. Saunders Co., New York, London.'
3. Verma, P.S., Tyagi, B.S, and Agarwal, Animal Physiology, Saras Publications, S. Xhand and Co., New Delhi.
4. AmbikaShanmugam, Biochemistry for medical students.
5. David T. Plummer, An introduction to Practical Biochemistry, Tata McGraw Hill Publishing Co-Ltd., New Delhi.
6. Richard W. Hill Michigan State University Gordon A. Wyse University of Massachusetts, Amherst Margaret Anderson Smith College “ANIMAL PHYSIOLOGY THIRD EDITION”.

Web Link:

https://www.uwosh.edu/facstaff/kurtzc/document_files/S18%20319%20syllabus.pdf

(University of Wisconsin-Oshkosh, America).

[https://courses.kaust.edu.sa/StudentCourses/GetPdf?fileName=2018-Spring-B_101-](https://courses.kaust.edu.sa/StudentCourses/GetPdf?fileName=2018-Spring-B_101-00074120.pdf&isExternal=False)

[00074120.pdf&isExternal=False](https://courses.kaust.edu.sa/StudentCourses/GetPdf?fileName=2018-Spring-B_101-00074120.pdf&isExternal=False)(King Abdullah University of Science Technology, Saudi Arabia).

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3ZOC10	Core -CLINICAL BIO-CHEMISTRY	5	4
Objectives: <ol style="list-style-type: none"> 1. To study the lab setup and safety measures 2. To learn about the metabolic disorders 3. To study about the disorders of kidney and liver 4. To know about the hormonal imbalances. 				

Unit –I

Laboratory setup and safety

Hrs.18

Requirements of setting up of clinical laboratory, SI units in clinical laboratory, Collection preparation, preservation, and handling of clinical samples, quality control, Safety measures in clinical laboratory. Formulation of clinical and diagnostic kits, Safety aspects

Unit –II

Metabolic disorders

Hrs.18

Disorders of Carbohydrate Metabolism – Diabetes mellitus, glucose and galactose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.

Disorders of Lipid metabolism – Plasma lipoproteins, cholesterol, triglycerides & phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia.

Unit - III

Hrs.18

Inborn errors of Metabolism-Disorders of amino acid metabolism – Phenylalanaemia, homocystinuria, tyrosinemia; Disorders of nucleic acid metabolism- Disorders in purine/pyrimidine metabolism

Impact of Hormonal imbalances: GH, TSH, ACTH, FSH, LH, Testoteran, Oestrogen.

Unit - IV

Hrs.18

Disorders of liver and kidney – Jaundice, fatty liver, normal and abnormal functions of liver and kidney. Inulin and urea clearance. Digestive diseases – Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea- Electrolytes and acid-base balance – Regulation of electrolyte content of body fluids and maintenance of pH. Disorders of acid-base balance and their respiratory and renal mechanisms

Unit - V

Hrs.18

Neurological and psychiatric disorders: Symptoms, diagnosis and treatment of Schizophrenia, Alzheimer's disease, Wernicke-Korsakoff syndrome, dementia, Wilson's disease, antipsychotic drugs – anti depressants.

Ageing- Physiological and biochemical changes in ageing. Different theories of ageing, importance of superoxide dismutase in ageing, plasticity and regeneration

Course Outcomes

After completion of this course, students will be able to

- UnderstandTheRequirements OfLaboratorySetup.
- AwareThe SafetyMeasuresOf Laboratory.
- ExploreTheDisordersOfBiomolecules
- Realize TheImportanceOf LiverAndKidney
- AwareOnNeurological AndPsychiatricDisorders.

Reference:

1. Burger, A., Med. Chem.
2. Wilson and Gisvold, Organic Med. Pharmaceutical Chem.
3. Ariens, Drug Design, Academic press, NY,1975.
4. Allan Gen, Clinical Biochemistry, 1995.
5. John W. Baynes. Med H.Dominick

Web Link:

<https://www.medsci.uu.se/education/courses/course-syllabus/?kpid=34117&lasar=&typ=2>

<https://www.uu.se/en/admissions/master/selma/kursplan/?kKod=3KK014&lasar=>

(Uppsala University, Sweden)

[https://makautwb.ac.in/syllabus/BSc%20\(Medical%20Lab%20Technology\)28.02.2018.pdf](https://makautwb.ac.in/syllabus/BSc%20(Medical%20Lab%20Technology)28.02.2018.pdf)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3ZOC11	Core – NANOTECHNOLOGY	4	4

Objectives:

1. To know about the Nanotechnology.
2. To learn about the nanoparticles and targeted drug delivery.
3. To learn the improved diagnostic products and techniques.
4. To study about the applications of nanomaterials.

UNIT I Hrs.12

Principles of Nanobiotechnology- Introduction to nanotechnology-History of nanotechnology-Classification of Nanomaterials- Properties of Nanomaterials- Surface to volume ratio-An overview of applications of nanomaterials.

UNIT IIHrs.12

Synthesis of Nanomaterials:- Top-down techniques-Ball milling- Combustion synthesis-Nanolithography:-Photolithography-Electron beam lithography. Bottom-up techniques:- Soft chemical method - Sol-gel method.

UNIT IIIHrs.12

Fullerenes-Carbon nanotubes:- Types of Carbon nanotubes - Single walled carbon nanotubes and Multi walled carbon nanotubes- Synthesis of Carbon nanotubes- Plasma arc-discharge method- Properties of Carbon nanotubes and biological applications.

UNIT IVHrs.12

Analytical equipments:- Surface morphology:-Scanning Electron Microscope(SEM)-Scanning Tunneling Microscope(STM)-Transmission Electron Microscope(TEM)- Atomic force microscope(AFM)-Compositional analysis:- Energy Dispersive X-ray Analysis(EDAX)-Fourier Transform Infrared spectroscopy(FTIR)-Optical characterization-UV-vis-NIR double beam spectrophotometer.

UNIT- VHrs.12

Biomedical applications of nanomaterials – Targeted drug delivery, Cancer therapy:-Targeted chemotherapy-Radiation therapy-Thermotherapy-Immunotherapy-Gene therapy.Tissue engineering, Biosensing and Bioimaging.

Course Outcomes

After completion of this course, students will be able to

- UnderstandTheClassificationOfNanostructuredMaterials
- FabricateTheNanomaterialsUsingVariousTechniques
- CompareAndContrast TheTypesOfFullerenes
- Understand The Principle And Mechanism Of AnalyticalEquipments
- RealizeThe ApplicationsOfNanomaterialsInBiologicalSystem

Reference:

1. Claudio Nicolini, Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd. 2009.
2. O. Skoseyov, Ilan Levy, Nanobiotechnology – BioInspired Devices and Materials of the Future, Humana Press Inc, 2008.
3. N. Yao and Zhong Lin Wang, Handbook of Microscopy for Nanotechnology Kluwer Academic Publishers, 2005.
4. Nanotechnology – N. Arumugam – Saras Publications.
5. Introduction to Nanotechnology – Neal Lane and James R. Heath.
6. K. Ravichandran, K. Swaminathan, P.K. Praseetha and P. Kavitha- Introduction to Nanotechnology, JAZYM Publications, 2019

Web Link:

https://ivle.nus.edu.sg/lms/public/view_moduleoutline.aspx?CourseID=0472F682-E536-4631-9250-7ACC4F67E670&ClickFrom=StuViewBtn (NUS)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3Z0CP3	Core -PL-ANIMAL PHYSIOLOGY, BIO-CHEMISTRY, IMMUNOLOGY& CLINICAL BIOCHEMISTRY	6	4

Objectives:

1. To learn the physiology of proteins, carbohydrates lipids.
2. To study the concentrate of the sugar, Glycogen, aminoacids, Salt in selective species.

ANIMAL PHYSIOLOGY AND BIOCHEMISTRY

1. Determination of chemical nature of tissues –proteins, carbohydrates and lipids.
2. Estimation of blood sugar/Glycogen in muscles.
3. Chromatographic analysis of amino acids.
4. Estimation of chlorides in biological samples.
5. Salt-loss and Salt-gain in Crab.
6. Quantitation estimation of ammonia and urea.
7. Estimation of oxygen consumption in fish.
8. Study of cardiac cycle of frog and its response to temperature
9. Effect of salinity on oxygen consumption of crab
10. RBCs in different vertebrates and in different physiological condition.

IMMUNOLOGY

1. Dissection of Lymphoid organs in Rat.
2. Inoculation of Antigens and observation of Blood parameters.
3. Immuno Electrophoresis(demonstration).

CLINICAL BIOCHEMISTRY

1. Estimation of Haemoglobin in blood samples
2. Estimation of Bile pigments
3. Estimation of Creatinine
4. Estimation of triglycerides, steroid

Course Outcomes

After completion of this course, students will be able to

- Gain knowledge on EstimateBio-Molecules.
- Develop Awareness OnTheRoleOf ChlorideAndSugar InAnimals.
- UnderstandThePhysiologicalStressInAnimals.
- KnowTheStructureOfLymphoidalOrgansAndImmuno-Electrophoresis.
- EquipWithClinicalAnalysisOf HumanSamples.

Reference:

1. Experimental physiology – S.C. Rastogi.
2. Lab Manual in Biochemistry – K. Jayaraman.
3. Biochemical methods By S.Sadasivam and A.Manickam.
4. ELIZA as a Diognostic Tool – S.Ialakshi, S. Mohan (eds).
5. Methods in biotechnology-Schmauder, New Era Books, Bangalore.
6. Basic SeparationTechniques in biochemistry by R.O.Okotore.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3ZOEDC	EDC-CLINICAL LAB TECHNOLOGY	4	--
Objectives: <ol style="list-style-type: none"> To study the various sterilization techniques. To know the disposal of waste. To identify the blood group and urine sugar. To identify the bacteria and fungus. To know the various diagnostic equipment. 				

Unit I

Hrs.12

Scope and study of Clinical Technology. Sterilization – Methods of Sterilization – Dry heat method – Wet heat method – Chemical method of sterilization – Disposal of hospital wastes and infected material - Disinfection laboratory glassware and equipments.

Unit II

Hrs.12

Composition of blood – ABO blood typing – Rh blood typing – Blood cells counting – Total erythrocyte count, total WBC count and differential count – Sugar level in Blood – Hypoglycemia, Hyperglycemia conditions. Composition of urine – Physical characters of urine – Method of urine analysis for sugars.

Unit III

Hrs.12

Analysis of Semen, Sputum and stool, Identification of blood parasites, Bacterial culture by NA medium, Fungal culture by PDA medium, Histological study of cells – Histological procedure for the preparation of tissue slides.

Unit IV

Hrs.12

Diagnostic equipments – ECG, EEG, Colorimeter, pH meter, PCR, laminar airflow, Binocular microscope and Incubator.

Unit V

Hrs.12

Immuno techniques – ELISA, HLA typing, VDRL Test.
Viral , bacterial and fungal diseases
First aid- definition; Types and applications

Course Outcomes

After completion of this course, students will be able to

- UnderstandTheSignificanceOfHospitalWasteDisposal Methods.
- GainKnowledgeOnBloodAndUrineAnalysis.
- AcquireKnowledgeOnMicrobialCultureTechnique
- Gain knowledge on OnHistologicalSlidePreparation.
- OperateTheDiagnosticEquipments.
- UnderstandThe importance of ImmuneTechniques.

References:

1. Medical Laboratory Technology (1994) (4th edition), By RamikSood, Jaypee Brother Medical Publishers (P) Ltd., New Delhi 110 002.
2. Medical Laboratory Technology, K.M. Samuel.
3. Clinical Pharmacology (1987), by Dr. Lawrance and P.N. Bennett (Sixth Edition), ELBS, English Language Book Society, Churchil Livingstone, England.
4. District Laboratory Practice in Tropical countries, part I, By MouicaCheesbrough, Cambridge Las Priced Edition, Cambridge University Press, Cambridge, U.K.
5. Basic Clinical Paraitology (1993), w.Harold Brown and A. Franklin Neva (5th edition), Prntice Hall Internation Edition.
6. Biological Chemistry – Leringer.
7. Human Physiology by Pearse.
8. The Biology of Animal Paraistes (1984), Cheng, T.Toppan C9 Ltd., Japan.
9. Medical Laboratory Technology: A procedure manual for routine diagnostic tests Volume – I-II By Kanai, L.Mukherjee, Tata McGraw – Hill Publishers, New Delhi.
10. Basic Clinical Paraitology 5thEdn, Harrold, W.Harold Brown and A. Franklin Neva- prentice Hall Internation Editions, U.S.A.

Web Links:

https://www.sunydutchess.edu/academics/catalog/current/courses/medical_laboratory_tech/index.pdf(Dutchess Community College, New York).

<https://www.sunydutchess.edu/academics/catalog/current/programs/medicalandalliedhealth/mlt.pdf>(Dutchess Community College, New York).

[https://makautwb.ac.in/syllabus/BSc%20\(Medical%20Lab%20Technology\)28.02.2018.pdf](https://makautwb.ac.in/syllabus/BSc%20(Medical%20Lab%20Technology)28.02.2018.pdf)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P2ZOCO3	CORE OPTIONAL - CONSERVATION BIOLOGY	----	----
Objectives: <ol style="list-style-type: none"> 1. To know the Biodiversity; Species Concepts; Animal Diversity. 2. To know the loss of animal diversity, status of species 3. To study the tools in animal conservation 4. To know the animal laws and policies in India 				

Unit I Hrs 18

Biodiversity; Species concepts; Animal diversity Biodiversity- Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - Animal diversity: (Distribution, inventory, species richness) - Biodiversity Hotspots – Biodiversity index: Alpha, Beta and Gamma diversity

Unit II

Hrs 18

Loss of Animal Diversity, Status of Species: Status of species: IUCN Red list (Assessments and methodologies) - Status of Indian animals. Extinctions: Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Modern and local extinctions - threats to wildlife (examples)- Habitat loss, degradation and fragmentation. Threats to animal diversity in India.

Unit III Hrs 18

Conservation tools in animal conservation: Conservation biology - In situ and Ex situ conservation of Indian animals (Case studies) - Population management - Project Tiger and Elephant - Captive breeding program - Successes and failures of conservation actions in India (Case study) -Tools in Conservation: Interpretation of various data on wildlife - GIS - remote sensing - Landscape model – PVA and CAMP processes.

Unit IV Hrs 18

Animal laws and policies in India; Economics of Biodiversity Conservation:

Wildlife (Protection) Act of India - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity, International Trade in endangered species - Zoo policy- Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation.

Unit V Hrs 18

Conservation education and Awareness:Wildlife / Animal magazines, Wildlife, nature, environment games (examples) – Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India – Role of Biotechnology in conservation and peoples participation in conservation – Eco tourism

Course Outcomes

After completion of this course, students will be able to

- know the types of Biodiversity
- aware the Methods of estimating loss of biodiversity
- explore on the sustainable management of Biodiversity
- understand on the importance of Conservation
- realize the role of Biotechnology in conservation

References:

1. R. B. Primack 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. G. K. Meffe and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
3. B. Groom bridge 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. R. A. Mittermeier, N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA
5. M.E. Soule 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.

Web Link:

- https://www.brown.edu/Research/Sax_Research_Lab/Documents/Syllabus/Revised_Course_Syllabus_-_Biol_1470_-_Fall_2009%5B2%5D.pdf (Florida Univeristy)
- https://qcnr.usu.edu/wild/courses/syllabi/Syllabus_for_Undergrad_46002016.pdf
- <https://www.amherst.edu/academiclife/departments/courses/0910S/BIOL/BIOL-48-0910S/syllabus>
- <https://www.uu.se/en/admissions/master/selma/kursplan/?kKod=1BG318>
- https://biology.njit.edu/sites/biology/files/lcms/docs/biol_375-S17_0.pdf
- <https://canvas.disabroad.org/courses/1366/assignments/syllabus> (Harvard UNiversity)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	20P4ZOC12	Core – GENERAL AND APPLIED ENTOMOLOGY	6	5
Objectives: <ol style="list-style-type: none"> To Study the taxonomy of Insects. To study the Morphology of Insects. To know the Anatomy and Physiology of Insects. To know the insect Ecology and their welfare aspects. To study the Biology and Bionomics of insects and Integrated Pest management. 				

Unit I **Hrs.18**

Taxonomy: Classification of insects upto orders with South Indian examples – Bionomics of Aptergotes -Orthoptera, Diptera, Hemiptera, Coleoptera and Hymenoptera.

Unit II **Hrs.18**

Morphology: Modifications in Integument, Head, antennae, Mouthparts, Thorax, abdomen, wings, Legs, and external genitalia of Insect.

Unit III **Hrs.18**

Anatomy and Physiology: General organization and physiology of digestive, respiratory, circulatory, excretory, nervous and reproductive systems of insects. Insect hormones and metamorphosis - pheromones.

Unit IV **Hrs.18**

Insect Ecology : Hibernation, Aestivation, Diapause and Migration.

Social Behaviour : Isoptera and Hymenoptera.

Insects Of Medical and Veterinary Importance: Vectors of Diseases – Mosquito – bedbug, fleas and housefly.

Culture Techniques: Sericulture, Apiculture, and Lac culture.

Unit V **Hrs.18**

Biology and Bionomics of Pests Of Crops: Sugarcane, Paddy and Pest of stored products - pests of common fruits and vegetables, Pest Management: Mechanical, Chemical, Biological and Intergrated Pest management (IPM) and Biotechnological Pest Management

Course Outcomes

After completion of this course, students will be able to

- Develop Skills In Taxonomy, Morphology, Anatomy And Physiology Of Insects
- Learn The Insect Pests And Their Control Measures
- Realize The Economic Importance Of Insects As Vectors, Pollinators, Predators & Parasites
- Acquire Skills In Rearing Of Silkworm, Honeybee And Lac Insect
- Gain knowledge on The Integrated Pest Management.

Reference:

1. Manim, M.S., 1973 General Entomology, Oxford and IEM, London.
2. A.D.Imms and Richards, General Entomology, Vol.1 & II, English Language Book Society (ELIBS), London.
3. Chapman, Insect Structure and function.
4. Snodgrass, Morphology of Insects.
5. Fox and Fox, General Entomology.
6. Wigglesworth, W.B., Physiology of Insects.
7. Rockstein, M. Physiology of Insects, Vol.1 – 111, Year Volumes, Academic Press London.
8. Fox and Fox, General Entomology.
9. Novak, V.J.A., Insect Hormones, Chapman Halls, London.
10. Vincent and Wigglesworth, Insect Hormones, Freeman and Co. Inn. Franchises.
11. Economic Entomology – Vasantha Rao David.
12. Chapman RF. 1998. Insects: Structure and Function. ELBS Ed., London.
13. Triplehorn CA & Johnson NF. 1998. Borror and DeLong's Introduction to the Study of Insects. 7th Ed. Thomson/ Brooks/ Cole, USA/Australia.
14. Ross, H.H., Ross C.A. & Ross J.R.P., Text book of Entomology, Ed. 4. John Willey & Sons, New York

Weblink:

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(Texas A&M University, Texarkana).

https://sciences.ucf.edu/biology/wpcontent/uploads/sites/87/2018/08/eny4004_syllabus_2018_edit1.pdf (university of Central Florida, America)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	20P4ZOC13	Core - RESEARCH METHODOLOGY	6	4
Objectives: <ol style="list-style-type: none"> 1. The course aims to train students in the statistical analysis and presentation of the data with the interpretation based on the already existing literature. 2. To write report / thesis / dissertation and or for publications in appropriate research journals. 3. The aim of the paper thus is to lay a strong foundation for the student for thesis writing, editing, analysis and interpretation of the generated data with hands on experience with model sums. 				

Unit I

Hrs.24

Data Collection and analysis: Collection of data- sampling methods: random sampling, stratified random sampling diagrammatic representation: Bar, Pie diagrams; graphic representation- Histogram, frequency polygon; Measures of central tendency: Arithmetic mean, median & mode - direct methods and model sums; Measures of dispersion: standard deviation – standard error – coefficient of variation: elucidation with model sums.

Unit II

Hrs.24

Statistics – Correlation and Regression: Types of Correlation and Karl Pearson's correlation coefficient: model sums with elucidation; Regression analysis: Regression line, Regression equations, model sums with elucidation; comparison between correlation and Regression.

Unit III

Hrs.24

Statistics – Significance of test and comparison: probability- Theorems: Addition and Multiplication – Patterns of distributions: Poisson, Normal and Binomial; Test of significance - Comparison of means: Chi square test, student t test, ANOVA, model sums on one way ANOVA with interpretation of data – Use of statistical softwares.

Unit IV

Hrs.24

Reporting and thesis writing: Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance –steps involed in the thesis preparation. Oral and Poster presentation for conference. Standard of research journals: refereed journals, Steps involved in manuscript preparation, impact factor, citation index, H-index. Information retrieval: access to archives and databases. Plagiarism.

Unit V

Hrs.24

Research ethics: Ethical issues -ethical committees - Commercialization – Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material.

Course Outcomes

After completion of this course, students will be able to

- Develop knowledge On Various Kinds Of Research, Objectives OfDoingResearch,ResearchProcess,ResearchDesignsAndSampling.
- Gain BasicKnowledgeOnQualitativeResearch Techniques
- Gain Adequate Knowledge On Measurement & Scaling TechniquesasWellAs TheQuantitativeData Analysis
- Have Basic Awareness Of Data Analysis-And Hypothesis TestingProcedures
- IdentifyAppropriateResearchTopicsParameters
- Gain knowledge to WriteAResearchReportAndThesis
- Gain knowledge to WriteA ResearchProposal(Grants)

Reference:

1. Davis, G.B. and C.A. Parkar 1997, Writing the doctoral dissertation. Barons Educational series, 2nd edition. Pp 160. ISBN : 0812098005.
2. Duncary, P. 2003. Authoring a Ph.D. thesis: how to plan, draft, write and finish a doctoral dissertation. Plagrove Macmillan, Pp 256. ISBN 1403905843.
3. Saxena, S. 2001, MS office, Vikas Publishing House Pvt. Ltd. New Delhi 110014.
4. Snedecor, G.W. and W.G. Cochran, 1978. Statistical methods. Oxford and IBH Publishing Co Pvt. Ltd.
5. Sokal, R.R. and F.J. Rohlf, 1981. Biometry. W.H. Freeman, New York.
6. Zar. J.H. 1996. Biostatistical analysis. Prentice Hall, Upper Saddle River, New Jersey, USA.
7. Biostatistical Analysis, Zar (2004).

Note:

1. Central University of Punjab, Amirtha University - Unit – IV and V
2. University of Kerala - Unit – I, II, III

Web Link:

<http://courses.aiu.edu/RESEARCH%20METHODOLOGY.html>

<https://www.liverpool.ac.uk/translational-medicine/departmentsandgroups/molecular-and-clinical-cancer-medicine/methodology-course/> (Atlantic Internal University)

<http://yukiyanai.github.io/teaching/methodology/docs/syllabus-methods-2017spring.pdf>

https://shmzlab.jp/Lecture/University/ResearchMethodology/Lecture/160114Lec01_Introduction&Syllabus.pdf

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	20P4ZOCP4	PRACTICAL – IV GENERAL & APPLIED ENTOMOLOGY AND RESEARCH METHODOLOGY	6	4
Objectives:				
<ol style="list-style-type: none"> To study Internal systems of the insects. To study the Techniques of mounting of mouth parts and wings. To study the biology and Bionomics of insect. To study the methods involved in writing a research paper. 				

A – Entomology

Mounting of Mouth parts, Wings and external genitalia of common insect.

1. Collection and identification of insects of economic importance. Preparation of key for classification of insects up to orders with examples.
2. Dissection of digestive, nervous and reproductive systems of insects of representative orders (Orthoptera, Hemiptera, Coleoptera, Lepitoptera) Endocrine system of Cockroach.
3. Ligature experiments to demonstrate the role of hormones in mounting and metamorphosis. Demonstration of allocate in cockroach.
4. Demonstration of the role of cubucula lipids, in prevention and evaporation. Demonstration of the functioning of Malpighian tubules,
5. demonstration of insect with reference to temperature,
6. demonstration of efficacy commonly used pesticides, demonstration of LD₅₀ for the common insecticide concentrations.

B – Research Methodology

1. Prepare flat file in NCBI, DDBJ & EMBL format for the given query sequence.
2. Search for similar DNA sequence of the query DNA using BLAST.
3. Retrive a query sequence from NCBI and predict the secondary structure of the query using PDB & PEP TOOL.
4. Retrive any five microbial gene sequence from any DNA data bank and using the server 123 Genomics and malign programfound in 123 genomics construct a phylogenetic tree.
5. Methods involved in writing a research paper.
6. Presentation of a research paper.

C – Field Work Report

A record of lab workand report on field trip (places of zoological interest) should be maintained and submitted at the time of practical examination for valuation.

Course Outcomes

After completion of this course, students will be able to

- LearnTheInternal SystemsOf TheInsects.
- DevelopSkillsOnTheTechniquesOfMountingOfMouthPartsAndWings.
- KnowThe BiologyAndBionomicsOfInsect.
- Realize TheImportanceOf Insects
- Have Basic Awareness Of Data Analysis-And Hypothesis TestingProcedures
- UnderstandTheMethodsInvolved InWritingA ResearchPaper

Reference:

1. Laboratory Manual of Entomology – Alkaprakash.
2. Zar. J.H. 1996. Biostatistical analysis. Prentice Hall, Uppar Saddle River, New Jersey, USA.
3. Biostatistical Analysis, Zar (2004).

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	20P4ZOEL3A	Major Elective - III A) ESTUARINE BIOLOGY AND AQUACULTURE	6	4
<ul style="list-style-type: none"> ➤ To study the Biology of the Estuarine biotic community. ➤ To understand the present status of Aquaculture in India. ➤ To Study the Engineering and culture aspects of Aquaculture system. ➤ To know the induced breeding and pathology of cultivable species 				

Unit I

Hrs.15

Estuary : Definition – Classification – Estuaries of India – physico-chemical and biological characteristics of Estuaries – Primary and Secondary productivity of Estuary – Estuarine fishery resources of India. Estuarine circulations- estuarine zonation- lagoons. Sedimentation- origin and physical properties of sediments, Mangroves : Ecology and adaptations of mangrove – Mangrove fauna and flora – Conservation of mangroves.

Unit II

Hrs.15

Estuarine animals, environmental factors - Significance of biorhythms. Physiology of osmoregulation - ions in body fluids - mechanism of regulation - Adaptation Estuarine finfishes - Finfishes and shellfish-Environmental impact.

Unit III

Hrs.15

Aquaculture: Scope and definition; origins and growth of aquaculture; biological and technological basis; Traditional, extensive, semi - intensive and intensive culture; monoculture, polyculture, composite culture, mixed culture, monosex culture; cage culture, pen culture, raft culture, race way culture, culture in recirculatory systems; warm water and cold water aquaculture; sewage – fed fish culture, integrated fish farming. site selection – pond construction –Pond maintenance, Fertilization, weed control, water quality management – control of predatory organisms.

Unit IV

Hrs.15

Major cultivable species for aquaculture; A knowledge of inland water bodies suitable for culture in India. 2. Culture of Indian Major Carps: exotic carps of Fish, Preparation and Management of Indian major carp culture ponds – nursery, rearing and production ponds. Integrated fish farming. Culture of Giant fresh water prawn, Culture of tiger shrimp, Culture of brackish water fish – Culture of ornamental fishes.

Fish Nutrition: Nutritional Bioenergetics - Natural food. Supplementary feeds, Feed additives. Feeding strategies and Feed evaluation-Feed conversion efficiencies and ratios. Feed storage methods.

Unit V

Hrs.15

Fish Processing, HACCP and marketing. preservation of gametes, genetic selection and hybridization – pathology – parasitic infection – Diseases of fish and prawns and their control

measures. Different organizations and institutes involved in fisheries and aquaculture research and development – FAO, ICLARM, NACA, SEAFDEC, INFOFISH, BOBP. Coastal zone management and CRZ.Regulation of coastal aquaculture and coastal aquaculture authority.Indian Fisheries ACT.

Course Outcomes

After completion of this course, students will be able to

- Understand The Classification Of Estuaries And Importance Of Mangrove In India.
- Know The Present Status Of Aquaculture In India.
- Understand The Techniques For Fin Fish And Shell Fish Culture.
- Apply The Hypophysation Techniques For Induced Breeding.
- Understand The Fish Disease Management.
- Gain knowledge On The Regulation Of Coastal Aquaculture

Reference:

1. Borja A., and Perez, F.J.V., 2000. A marine Biotic Index to establish the ecological quality of soft-bottom benthos within European estuaries and coastal environments. *Marine Pollution Bulletin*, V.40.
2. Kennish, M.J., 1994. *Practical handbook on estuarine and marine pollution*. Elsevier.
3. *Estuarine Hydrography and Sedimentation*, 1980 – Dyer, K.R., Cambridge University Press.
4. ADCP (Aquaculture Development & Co-ordination Program). 1980. *Fish Feed Technology*. ADCP/REP/80/11 FAO
5. Cyrino EP, Bureau D & Kapoor BG. 2008. *Feeding and Digestive Functions in Fishes*. Science Publ.
6. Halver JE & Tiews KT. 1979. *Finfish Nutrition and Fish feed Technology*. Vols. I, II Heenemann, Berlin.
7. Hertrampf JW & Pascual FP. 2000. *Handbook on Ingredients for Aquaculture Feeds*. Kluwer.
8. ICAR. 2006. *Hand Book of Fisheries and Aquaculture*. ICAR.
9. C.M.F.R.I. *Coastal Aquaculture – Marine Prawn culture*.
10. V.C. Jhingarn and Gopalakrishnan Ray, P. and Ghosh, A., *Methodology for survey of brackish water areas V. in India, for coastal – Aquaculture Indopacific fish Council, 14th session*.
11. T.A. Aanson and Goodwin, H., *Shrimp and prawn farming in the Hemisphere*, Dordrecht, Authchinson and Rea, Ind., Pennsylvania.
12. T.A. Qureshi and N.A. Qureshi, *Indian Fishes*, Brig, Brothers, Sullania Road, Bhopal, India.
13. Donald, McLusky, *Ecology of Estuaries*, Heinemann publications Glasgow and London.
14. Barton Lias, *Estuarine Chemistry*.
15. Kennedy, *Estuarine Perspective*.

Web Link:

<https://agris.fao.org/agris-search/search.do?recordID=US880018188> (University of Washington)
<https://www.springer.com/gp/book/9781468487381>

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	20P4ZOEL3B	Major Elective - III B) FISHERIES SCIENCE	6	4
Objectives: <ol style="list-style-type: none"> 1. The aim of the paper is to understand the morphology, classification and identification of fishes and the fisheries and fishery resources of India. 2. Moreover information about the biology of the fishes goes a long way in managing the fishery resources and their sustainable utilization. 3. As fishes constitute perishable commodity, preservation and processing are also quite essential. 				

Unit I 18Hrs

General morphology and outline classification of fishes - major groups of fishes and their characteristics - morphometric and meristic characters of elasmobranchs and teleost fishes. Basic anatomy of fish - digestive, circulatory, respiratory, nervous and reproductive systems. Food and feeding habits, maturity, fecundity, spawning and survival of Indian fishes.

Unit II 18Hrs

Length-weight relationship and factors influencing growth condition, age determination Theory of fishing, unit stock, recruitment, growth, mortality, migration, fish tagging and marking

Unit III 18Hrs

Fishery zones and type of fisheries in India. Riverine, Estuarine, Coldwater, Reservoir and Pond fisheries. Present status and scope of inland capture fisheries. Present status and scope of marine capture fisheries - crustaceans (prawn/shrimp, lobster and crabs), Molluscs (clam, cockle, mussel, oyster, cephalopods) and fishes - their fishery characteristics, distribution and importance.

Unit IV 18Hrs

Methods of surveying the fishery resources - acoustic method, aerial method, survey of fish eggs and larvae, analyzing population features - growth mortality selection.

Unit V 18Hrs

Principal methods of exploitation of fishes - indigenous and modern gears and crafts. Principal methods of fish preservation and processing in India Types of spoilage, causative factors - marketing and economics.

Course Outcomes

After completion of this course, students will be able to

- Acquire Knowledge In General Morphology Of Fishes
- Know The Importance Of Length-Weight Relationship
- Understand Fishery Zones And Type Of Fisheries In India
- Develop Skills In Methods Of Surveying The Fishery Resources
- Acquire Skills In Methods Of Fish Preservation And Processing

REFERENCES:

1. Day, F. 1981. Fishes of India, Vol.I and Vol. II. William Sawson& Sons Ltd., London.
2. Jhingran, C.G. 1981. Fish and Fisheries of India. Hindustan Publishing Co., India.
3. Maheswari, K. 1993. Common fish diseases and their control. Institute of Fisheries Education,
4. Santhanam,R. 1980. Fisheries Science.Daya Publishing House, New Delhi.
5. Yadav, B.N. 1997. Fish and Fisheries.Daya Publishing House, New Delhi
6. FAO Volumes for fish identification.
7. Bal D.V. and Rao, K.V. 1990. Marine Fisheries of India. Tata McGraw Hill Publishing Co. Ltd., New York.
8. Biswas, K. P. 1996. A Text Book of Fish, Fisheries and Technology.Narendra Publishing House, Delhi.
- 9.Srivastava, C.B.L. 1999. Fish Biology.Narendra Publishing House, Delhi

Web Link :

1. <http://www.fish.kagoshima-u.ac.jp/efish/ipl/syllabus/UPV.pdf>
2. <https://ched.gov.ph/wp-content/uploads/2017/10/Sample-Curricula-Bachelor-of-Science-in-Fisheries.pdf>

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	20P4ZOEL3C	MAJOR ELECTIVE – III C) BIO-INFORMATICS, INTELLECTUAL PROPERTY RIGHTS AND NANOTECHNOLOGY	6	4
Objectives: <ol style="list-style-type: none"> 1. To know the ultra structure of Prokaryotic and Eukaryotic cellular organisms. 2. With the help of instruments, to know the basic principles of protein. 3. To know the principle and applications of bioinformatics. 4. General aspects of patenting. 5. To know about Nanotechnology. 				

Unit-I **18Hrs**
 Cell structure, Ultra structure and genomic organization of Prokaryotes and Eukaryotes Cellular Organisms. Chromosome and chromatin structure.

Unit-II **18Hrs**
 Protein confirmation – Predication of Protein structure – fold recognition, comparative modelling (homology), Basic principles of X – ray diffraction studies, NMR, Mass spectroscope in identifying protein confirmation.

Unit -III **18Hrs**
 Basic concepts of Bioinformatics, sequence Databases, sequence formats – Gene basic - use of databases biology, Sequence databases, Sequence Analysis – Search for homologous sequence for BLAST and FASTA programs. Protein and Nucleic acids, Structural comparisons.

Unit- IV **18Hrs**
 History of intellectual property rights. Trade related aspects of intellectual property rights. A general account of patenting- India and TRIPs, Copy right and commercialization - Environmental impact-Ethical issues and ethical committees. Geographical indications.

Unit- V **18Hrs**
 Nano biotechnology – Basic principles and scope of Nanotechnology –Protein and DNA based nanostructure. Use of DNA in nano-mechanics and computing. Structural and Brownian assembly – Molecular manufacturing – Decisive military capabilities – Molecular mills – in the fields of agriculture, Medicine -Applications of Nanotechnology.

Course Outcomes

After completion of this course, students will be able to

- GainTheKnowledgeOnVariousDatabasesInRelatedWithProteinAndNucleicAcid Sequences.
- KnowledgeOnTheGene Sequencing.
- UnderstandTheTradeRelatedAspectsOfIntellectualPropertyRights
- FabricateTheNanomaterialsUsingVariousTechniques
- RealizeThe ApplicationsOfNanomaterialsInBiologicalSystem

REFERENCES:

1. Sequence Analysis primer by M Gribskov, J. Devercux (1989) Stockton Press.
2. Nucleic acid and protein sequence analysis, A practical approach by MJ Bishop and C.J. Ramslings (1987) IRL Press.
3. Information theory and living system by L.I. Garfield, (1992), Columbia University Press.
4. Glossary of Biotechnology and Nanobiotechnology – Narendhra Publications.
5. Molecular databases for for protein and structure studies by Sillince, J.A. and Sillince M (1991) Springer Verlag.
6. Biotechnology Fundamentals and Application – S.S.Purohit, Agrobios, India
7. Nanotechnology – A gentle introduction to the next big idea, Ratner – Tamil Nadu Book House.
8. Information of Biostatitics by Sokal and Rhld (1973) Toppan Company, Japan
9. Biotechnology expanding horizons. B.D. Singh. Kalyani Publishers

Web Link:

<http://www.nus.edu.sg/nusbulletin/faculty-of-science/undergraduate-education/degree-requirements/bachelor-of-sciencebachelor-of-science-hons-programme-requirements-b-sc-b-sc-hons/computational-biology/>
<https://ttic.uchicago.edu/~jinbo/TTIC31050-2014.htm> (University of Chicago)
https://www.suniv.ac.in/upload/Syllabus-for-MTech-Nanoscience_NEW.pdf

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	20P4ZOCO4	PHARMACOLOGY	6	5

Objectives:

1. This subject will provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs.
2. In this subject, apart from general pharmacology, drugs acting on autonomic nervous system, cardiovascular system, central nervous system, blood and blood forming agents and renal system will be taught. In addition to theoretical knowledge, the basic practical knowledge relevant to therapeutics will be imparted.

UNIT I

Hrs 18

Drugs acting at Synaptic and neuro effector junctional sites- Drugs acting at Synaptic and neuro effector junctional sites- Autonomic & Somatic nervous systems. . Muscarinic receptor agonists & antagonists. Anticholinesterases. Agents acting at Neuro Muscular Junction and autonomic ganglia. Sympathomimetic drugs, Catecholamines and Adrenergic antagonists.

UNIT II

Hrs 18

Drugs acting on the Central Nervous System.- Neurotransmission and CNS. Drugs used in the treatment of Anxiety & Psychosis , Depression & Mania , Epilepsy , Migraine , CNS degenerative disorders , Parkinson's Disease and Pain ; Drug addiction, dependence and abuse.

UNIT III

Hrs 18

Drugs affecting renal and cardiovascular function.- Drug-induced renal disorders. Diuretics, Drugs used in the treatment of Myocardial Ischemia - Hypertension - CHF - Hyperlipidemia – Arrhythmias.

UNIT IV

Hrs 18

Drugs acting on the blood & blood forming organs- Hemopoietics, Plasma expanders, Thrombolytics, Anticoagulants, Antihemorrhagics, Antiplatelet Drugs, Blood Substitutes, Aspirin, Vitamin K

UNIT V

Hrs 18

Dermatological pharmacology, Vitamins, Chelating agents: Chelation therapy- Pharmacogenetics: Inter racial and individual variability in drug metabolism.

Course Outcomes

After completion of this course, students will be able to

- Learn the classification, pharmacodynamic and pharmacokinetic aspects of drug.
- Realize adverse effects, uses, dose, route of administration, precautions, contraindications
- Know the effects of drugs on autonomic nervous system, cardiovascular system, central nervous system
- Gain the knowledge in dermatological pharmacology and pharmacogenetics
- Know the Drugs action on the blood & blood forming organs.

References

1. Regulatory Toxicology- Shayne C Gad
2. Goodman and Gilman's : The Pharmacological Basis of Therapeutics, edited by Alfred Goodman Gilman, Theodore W. Rall, Alan S Nies, and Palmar Taylor
3. Clinical Pharmacology by D.R. Laurence and P.N. Bennett
4. The toxicologist's pocket handbook, Michael J derelanko 2nd Ed, 2008, CRCpress
5. Relevant OECD, ICH, SCHEDULE Y guidelines
6. Modern Medical Toxicology-VV Pillay, Jaypee Publishers, 4th Ed.

Web Link:

<https://medicine.nus.edu.sg/medphc/education/medical.html> (National University of Singapore, Singapore)

<https://www.bath.ac.uk/courses/undergraduate-2020/pharmacology/bsc-pharmacology/>
(University of Bath, UK)

COMMUNICATION SKILL AND PERSONALITY DEVELOPMENT

SEMESTER	SUBJECT CODE	TITLE	HOURS OF TEACHING/ WEEK	NOOF CREDITS
IV	20P4-CPD	Communication Skill and Personality Development	1	

COURSE OBJECTIVES:

- To cultivate positive personality traits for successful life.
- To groom Winning Attitude among the learners.
- To assist the learners to identify their own potential and realize their aspirations.
- To enable a holistic development.
- To facilitate optimum means of improving personal performance.

UNIT 1

1. Personality- Definition.
2. Determinants of Personality.
3. Perceptual Process.
4. Personality Traits.
5. Developing Effective Habits.
6. Self Esteem (Freud and Erikson).
7. Self Appraisal and Self Development.
8. Dos and Don'ts to develop positive self esteem.
9. Interpersonal Relationship.
10. Difference between Aggressive, Submissive and Assertive behaviour.
11. Mind Mapping, Competency Mapping, 360 degree assessment.
12. Presentation Skills – Opening, ending, Handling nerves, Handling audience, Power Storytelling, Visual aids, Question and answer session

UNIT 2

1. Projecting Positive Body Language.
2. Conflict Management.
3. Change Management.
4. Stress Management.
5. Time Management.
6. Goal Setting.
7. Assertiveness and Negotiating Skill.
8. Problem Solving Skill.
9. Decision Making Skills.
10. Leadership Qualities of a Successful Leader.
11. Attitudes – Positive Attitudes.
12. Public Speaking – Engaging, Connecting, and Influencing the audiences.
13. Employability Skill – Group Discussion, Interview Questions, Psychometric analysis.

COURSE OUTCOMES:

After completion of the course, Students will be able to:

- Gain self confidence and broaden perception of life.
- Maximize their potential and steer that into their career choice.
- Enhance one's self image & self esteem.
- Find a means to achieve excellence and derive fulfilment.

References:

Hurlock.E.B (2006) : Personality Development, 28th Reprint. New Delhi: Tata McCraw Hill.
Stephen.P.Robbins and Timothy. A.Judge (2014) : Organisation Behaviour.16th Edition.Prentice Hall.

Andrews, Sudhir. How to Succeed at Interviews. 21st (rep) New Delhi.Tata McGrew Hill
1988.

Lucas, Stephen. Art of Publication. New Delhi. Tata McGrew Hill. 2001.

Kumar, Pravesh. All about Self Motivation. New Delhi. Goodwill Publication House. 2005.

EXTRA DISCIPLINARY COURSES

Sl. No.	Subject Code	Title of the Paper	Department
1.	20P3HYEDC	INDIAN ADMINISTRATION	History
2.	20P3ECEDC	ISSUES IN INDIAN ECONOMY	Economics
3.	20P3TAEDC	<i>தமிழ்மொழி வரலாறு</i>	Tamil
4.	20P3ENEDC	SHAKESPEARE STUDIES	English
5.	20P3CMEDC	ENTREPRENEURIAL DEVELOPMENT	Commerce
6.	20P3MAEDC	APPLICABLE MATHEMATICAL TECHNIQUES	Mathematics
7.	20P3PHEDC	FUNDAMENTALS OF NANOTECHNOLOGY	Physics
8.	20P3CHEDC	CHEMISTRY IN EVERY DAY LIFE	Chemistry
9.	20P3BOEDC	MEDICAL BOTANY AND PHARMACOGNOSY	Botany
10.	20P3MBEDC	MUSHROOM TECHNOLOGY	Microbiology
11.	20P3ZOEDC	CLINICAL LAB TECHNOLOGY	Zoology
12.	20P3BTEDC	RECENT TRENDS IN BIOTECHNOLOGY	Biotechnology
13.	20P3CSEDC 20P3ITEDC	E-LEARNING TECHNOLOGIES	Computer Science
14.	20P3LSEDC	DOCUMENTATION CENTERS IN INDIA	Library and Information Science

Semester	Course Code	Title of the Course	Hours of Teaching /Week	No. of Credits
III	20P3HYEDC	Extra Disciplinary Courses – Indian Administration	5	--

Objectives:

1. To know the evolution of Indian Administration.
2. To prepare the students for the competitive examination.
3. To give up-to-date knowledge on Indian administration.
4. To trace economic planning of India, through which the students may get practical knowledge on budget, etc.
5. To expose the state administration and the latest issues like Lok Ayukt and LokPal through which the students may get awareness about the latest issues.

Unit I

Hrs 15

The evolution of Indian administration: Structure and Functions–Mauryan and Mughal legacy; British Indian system: Company’s experiments–Warren Hastings, Lord Cornwallis, Lord Hastings and Lord Dalhousie; Administrative consolidation since 1861 – Famine policy – Financial, Police and judicial administration.

Unit II

Hrs 15

Indian Administration since 1950: Parliamentary Democracy–Federation–Structure of Central Administration–Central Secretariat–Cabinet Secretariat, Ministries–Department of Boards.

Unit III

Hrs 15

Machinery for planning: Plan formulation at the National level – National Development Council – Planning Commission – Public undertaking – Controls of Public expenditure.

Unit IV

Hrs 15

State Administration–Executives–Secretariat–Chief Secretary–Directorates–District and Local Administration–District Rural Development Agency–Special development programmes.

Unit V

Hrs 15

Center-State relations – Public services – Police and Judicial administration – Lok Ayukt – Lok Pal – issues on Indian administration – Integrity in administration – Administrative reforms.

General References:

1. Altekar, A.S., State and Government in Ancient India, 1958.
2. Bhambri, C.H., Public Administration in India.
3. Vidya Bhushan, Indian Administration, Delhi, 2000.
4. Vishnoo Bhagawan & Vidhya Bhushan., Indian Administration, New Delhi, 1996.

Course Outcome: The students have clearly understood about the evolution of Indian Administration, State and Central administration, police and judicial administration, Centre State relations, etc.

Semester	Subject code	Title of paper	Hours of Teaching / Week	No. of Credit
III	20P3ECEDC	Extra Disciplinary Courses – Issues in Indian Economy	4	-

Objective:

- This Elective paper is offered to the Non-Economics Students to make them familiar with the recent trends in Indian Economy. The syllabus is framed accordingly with the Civil Service Examination.

Course Outcomes

- To understand the status of Indian economy before the reforms
- To assess the rationale of introducing reforms in India
- To familiarize with the package of LPG
- to get insight on the recent trends in EXIM policy

Unit I

Hrs 15

Economic development and growth – determinants of growth and development – Market Economy – Indian Economy – a shift from mixed economy to Market economy – Reform measures introduced in India – First and second generation reforms – (Brief outline)

Unit-II

Hrs 15

Economic reforms in India – background, rationale – implementation – Trade policy – Industrial policy – exchange rate and capital market reforms

Unit-III

Hrs 15

Dis-investment of public enterprises – rationale – changing profile of PSUs comparison of public and private sector

Unit-IV

Hrs 15

Privatization – Meaning and scope – Globalization – impact on India – foreign capital – Types FDI and FII, Policies and pattern.

Unit-V

Hrs 15

Foreign Trade – Exim Policies – Recent exim policy – BOP- Trends in BOP – Economic reforms and BOP.

References:

- Uma kapila – Indian Economy (Issues in Development and Planning and Sectoral aspects) Fifth Edition, 2006-07, Academic Foundation, New Delhi
- Datt Rudder & Sundharam K.P.M. – Indian Economy (2007)
- Misrapuri – Indian Economy

Semester	Subject Code	Title of the Paper	Hours of Teaching/Week	No. of Credits
III	20P3TAEDC	கூடுதல் சிறப்புப் பாடம்: தமிழ்மொழி வரலாறு	4	-

கூறு: 1 இந்திய மொழிக் குடும்பங்கள்

நேரம்: 12

இந்தோ ஆரிய மொழிகள் - ஆஸ்டிக் மொழிகள் - சீன திபெத்திய மொழிகள் - திராவிட மொழிக் குடும்பம் - டாக்டர் கால்டுவெல், திராவிட மொழிகளின் சிறப்பியல்புகள் - தென் திராவிட மொழிகள் - தென் திராவிட மொழிகளில் தமிழ் - நடுத்திராவிட மொழிகள் - வட திராவிட மொழிகள்.

கூறு: 2 தமிழ்

நேரம்: 12

தமிழ் என்பதன் வடிவம் பற்றியும் பொருள் பற்றியும் பல்வேறு செய்திகள் - பெயரெச்சங்கள் - வினையெச்சம் - சங்க இலக்கியத்தில் வினையெச்சங்கள் - தொல்காப்பிய உரைகாரர்களும் வினையெச்சங்களும்.

கூறு: 3

நேரம்: 12

தமிழ் எழுத்தின் தோற்றமும் வளர்ச்சியும் - ஆய்வெழுத்து இராசியெழுத்து, நாள், எழுத்து - ஓவியம், பாளை ஓடுகள், இலங்கை முத்திரை முதலானவற்றில் காணப்படும் உருவ எழுத்துகள் - வட்டெழுத்து, பண்டைத் தமிழ் எழுத்து. தமிழ்மொழி வரலாறு: தமிழின் தொல் வரலாறு, தமிழ்மொழி வரலாறு - பழந்தமிழ்க் காலம், இடைத்தமிழ்.

கூறு: 4

நேரம்: 12

தொல்காப்பியமும் ஒலியியலும் - தொல்காப்பியமும் சொல்லியலும் - தமிழ் ஒலிகளின் பிறப்பு விளக்கம் - புணர்ச்சி வகை. தமிழ் உருபனியலும் தொடரியலும் - தலைமை இலக்கணக் கூறுகள் - தொடரமைப்பு இலக்கணம். பெயர்த்தொடர் அமைப்புகள்: மொழியின் பெருமை - எழுத்தும் பேச்சும் - கிளை மொழிகள் தோற்றம் - இலக்கியக் கிளைமொழி- வட்டாரக்கிளை மொழிகள்.

கூறு: 5

நேரம்:12

தமிழ் வளர்ச்சி - தமிழ் ஆட்சிமொழி வரலாறு - தமிழ் கல்விமொழி வரலாறு - கலைச் சொல்லாக்கம் - அறிவியல் தமிழ் வளர்ச்சி-உலகத் தமிழ் மாநாடுகள்- உலக அரங்கில் தமிழ் - தமிழ் அமைப்புகள்- உலகத் தமிழாராய்ச்சி நிறுவனம் - தமிழ்ப்பல்கலைக் கழகம்-செம்மொழி ஆய்வுமையம் - அயல் மாநிலங்களில் தமிழ்.

பார்வை நூல்கள்:

1. தமிழ் வரலாறு - தேவநேயன். ஞா.
2. தமிழ் மொழி வரலாறு - பரிதிமாற்கலைஞர்
3. பழந்தமிழ் - இலக்குவனார் . சி
4. தமிழ் வரலாறு - குணா
5. தமிழ் மொழி வரலாறு - தமிழ் வளர்ச்சி இயக்ககம்
6. ஆட்சித் தமிழ் - புதுவை மொழியியல் பண்பாட்டுக் கழக வெளியீடு
7. இந்திய ஆட்சிப்பணி வழிகாட்டி - முனைவர் ரெ. குமரன்.
8. உலகத்தமிழ் மாநாடுகள் - சாலை இளந்திரையன்
9. தாய்மொழியில் படிக்க வைப்போம் - NCBH வெளியீடு.
10. தமிழ் ஆட்சி மொழி வரலாறு - தமிழ்ப்பல்கலைக்கழகம்.
11. தமிழ் ஆட்சிமொழி வரலாறு - தெ.பொ.மீ.
12. தமிழ் மொழி வரலாறு - சக்திவேல்

Semester	Course Code	Title of the Course	Hours of Teaching / Week	No. of Credits
III	20P3ENEDC	Extra Disciplinary Course - Shakespeare Studies	4	

Objective

- To initiate the non English majoring students to study Shakespeare's plays, and his sonnets.

Outcome

- Gaining appreciative and analytical understanding of Shakespeare's dramas and sonnets.
- Achieving potentiality to situate and relate Shakespeare's wisdom in various current disciplines and media cultures.
- Obtaining a profound perspectives on handling racism, class divisions, gender roles, crime, love, war, death betrayal, hope, loyalty etc., derived from the works

Unit – I

Shakespeare's Sonnets 1, 18, 29, 33, 35, 65 and 130

Unit – II

The Merchant of Venice

Unit – III

Henry IV, Part I

Unit – IV

Othello

Unit – V

Antony and Cleopatra

References:

- Bates, Jonathan. *The Genius of Shakespeare*. London: Picador, 1997.
- Leishman, J.B. *The Theme and Variation in Shakespeare's sonnets*. London: Routledge, 2005.

Semester	Subject Code	Title of the paper	Hours of Teaching/ Week	No. of Credits
III	20P3CMEDC	Entrepreneurial Development	4	-

Objective:

- To make the students to become a successful entrepreneur and to know the process involved in entrepreneurship.

Course Outcome:

- Learn the incentives and subsidies provided to budding entrepreneurs and Become familiar with institutions offering various forms of assistances.

Unit - I

Entrepreneurship - Nature and Characteristics of an Entrepreneur - Difference between Entrepreneur and Manager - Qualities, Types, and Functions of an Entrepreneur - Role of Entrepreneur in Economic Development.

Unit - II

Business Ideas - Sources of Idea - Idea Processing and Selection - Start up Process - Project Identification and Selection - Project Formulation - Project Appraisal.

Unit - III

Factory Design and Layout - Importance - Factors affecting Factory Design - Factory Layout - Objectives - Types - Consideration in Designing Layout - Design Requirements.

Unit - IV

Institutions Assisting to Entrepreneurs - NSIC - SIDCO - SSIB - DIC - TIIC - KVIC - TCO - ITCOT - Commercial Banks and New Entrepreneurial Development Agency.

Unit - V

Entrepreneurship Development Programmes - Need - Objectives - Institutional efforts in Developing Entrepreneurship - Evaluation of EDPs - Problems in the conduct of EDPs - Suggestions to make EDPs effective - Planning EDPs - Role of SISI, SIPCOT and SIDBI - Recent Development in Small Enterprises in India - Government rules and regulations - Rural Entrepreneurship - Need for Rural Entrepreneurship Problems - SHGs and Rural Development - MUDRA Banking /MSME Loans.

Text book:

1. C.B.Gupta., N.P.Srinivasan, (2018), Entrepreneurial Development, Sultan Chand & Sons, New Delhi.

Reference Books

1. Khanka S.S., (2019) Entrepreneurial Development, S.Chand & Co, New Delhi.
2. Saravanavel, P. (2016), Entrepreneurial Development, Principles, Policies and Programmes, Ess Pee Kay Publishing House, Tanjore.
3. Renu Arora, Sood S.K., (2018) Fundamentals of Entrepreneurship and Small Business, Kalyani Publications, Ludhiana.
4. Jayashree Suresh, (2019) Entrepreneurial Development, Margham Publications, Chennai.

Semester	Subject Code	Title of the Paper	House of Teaching / Week	No. of Credits
III	20P3MAEDC	Extra Disciplinary Course- Applicable Mathematical Techniques	4	-

Objectives:

- To discuss various methods of Interpolation

Out comes:After studying this course the student will be able to

- Student will demonstrate the ability to solve financial math problem.

Unit I

12 Hrs

Interpolation with unequal intervals: Newton's divided difference formula - Lagrange's interpolation formula and inverse interpolation. (Only simple Problems)

Unit II

12 Hrs

Assignment problems

Unit III

12 Hrs

Replacement problems (Only simple Problems)

Unit IV

12 Hrs

Decision Analysis

Unit- V

12 Hrs

Game Theory

Text Book:

1. For unit I, **Numerical Methods** – P. Kandasamy, K. Thilagavathy, K. Gunavathy, S.Chand
2. For units II to V, **Operation Research 12th Edition 2004**:KanthiSwarap, P.K. Gupta and Manmohan, Sultan Chanda and sons, New Delhi.

Unit I	:	Chapter - 8 (Sec: 8.5, 8.7)
Unit II	:	Chapter - 11 (Sec: 11.1 to 11.4)
Unit III	:	Chapter - 18 (Sec: 18.1 to18.3)
Unit IV	:	Chapter - 16 (Sec: 16.1 to 16.5)
Unit V	:	Chapter - 17 (Sec: 17.1 to 17.6)

General Reference:

1. S.S. Sastry *Introductory Methods of Numerical Analysis* Prentice Hall of India 2000.
2. H.A. Taha *Operation Research* Prentice Hall of India 1995.

Semester	Subject Code	Title of the paper	Hours of Teaching / Week	No. of Credits
III	20P3PHEDC	Extra Disciplinary Course- Fundamentals of Nanotechnology	4	-

Unit – I Introduction to Nanotechnology

Nanotechnology – Definitions - History of nanotechnology – Nanomaterials: classification – zero, one and two dimensional nanomaterials – Classification based on the composition of materials (metal, semiconductor, ceramic, polymeric and carbon-based nanomaterials) - Properties of nanomaterials – Surface area to volume ratio (S.A/V) – Quantum dots - Challenges in nanotechnology.

Unit – II Preparation Methods

Top-down and Bottom-up approaches – Top down methods: Ball milling - Electron beam lithography – Advantages – Limitations. Bottom-up methods: Vacuum evaporation - Sputter deposition process - Laser ablation – Advantages – Limitations.

Unit – III Fullerenes

Fullerenes – Types of fullerenes – Bucky ball/Buckminster fullerene - Carbon nano tubes (CNTs) - Single walled CNTs – Multi walled CNTs – Differences – mechanical and electrical properties of CNTs - preparation of CNTs – Plasma discharge method – Applications.

Unit – IV Characterization Techniques

Construction, working principle, merits and demerits of X-ray diffractometer - Scanning Electron Microscope (SEM) – Atomic Force Microscope (AFM) - UV-Vis–NIR double beam spectro photometer – Energy dispersive X-ray analysis (EDAX) .

Unit – V Applications

Nanoelectronics – Nanophotonics – Nanomaterials in energy conversion and storage – Nanomaterials as antibacterial agents – Nanomaterials as photocatalysts – Nanomaterial in industrial applications – Bio-medical applications : Targeted drug delivery – Nanomaterial based radiation therapy – Photodynamic therapy (PDT) – Bio imaging.

Books for Study

1. K. Ravichandran, K. Swaminathan, P.K. Praseetha, P. Kavitha, Introduction to Nanotechnology, JAZYM publications.
2. M.Ratner.et al., Nanotechnology; A Gentle intro Practices – hall ISBN 0-13-101400-5, 2003.
3. Nanotechnology; Basic Science and Emerging Technologies, CRC Press

Books for Reference

1. Charles P.Poole Jr and Frank J.Owens. "Introduction to Nanotechnology" Wiley, 2003.
2. A. S. Edelstien and R.C. Cornmarata, Nanomaterials; synthesis, Properties and Applications, 2ed, Iop (U.K), 1996.

Semester	Subject code	Title of the paper	Hours of Teaching/Week	No. of Credits
III	20P3CHEDC	Extra Disciplinary Course - Chemistry in Every Day Life	4	

OBJECTIVES

Students learn about the scientific and chemical principles underlying in everyday life.

- Students learn about the cleaning agents and water chemistry,
- Students understand about the food chemistry,
- Students shall learn about the cosmetic and their effect in health aspects
- Students shall know about the green chemistry and their significance for clean environments
- Students learn about the nano technology and their importance.

Unit-I

Cleaning agents - manufacture and uses of soaps, detergents, baking powder, shampoo, washing powder and bleaching powder **Water** – uses of water Characteristics' of water, soft water and hard water - removal of hardness – ion exchange method. Reverse osmosis method, Water pollution, causes and prevention.

Unit-II

Food – importance – spoilages – causes, preservation – additives – colouring and flavouring agents, beverages. Soft drinks aerated water – manufacturing – mineral water. Fruits, vegetables, dairy product – storage, preservation. Minerals in food and anti oxidants. Preparation of fruit Jam and pickle.

Unit-III

Cosmetics – Face powder – constituents, uses – side – effects. Nail polish, hair dye – composition and side effects. Tooth powder – lotions. Preparation of phenyl, liquid blue and incense sticks.

Unit-IV

Basic concepts of Green chemistry and its significance in day to day life. Polymers – Classification – Types of polymerization – plastics – classification – types of plastics – PVC, Teflon, PET, Bakelite – Rubber – Natural and synthetic – Buna rubber, Butyl Rubber. Vulcanization of rubber, neoprene rubber, Plastic pollution and prevention.

Unit-V

Basic concepts of Nano Technology and its importance in day to day life.

Dyes – importance of food colours – PFA (Prevention of Food Adulteration Act) Natural dyes – Synthetic Classification importances – Uses of the following Synthetic dyes - Direct dyes, acid dye, Basic dye, mordant dye, Reactive dye, Disperse dye, Fastness – Light and Washing. Application of dyes in food, paper, plastic and lather.

COURSE OUTCOME:

- Students should able to learn about the cleaning agents and water chemistry,
- Students should able to understand about the food chemistry,
- Students should able to learn about the cosmetic
- Students should able to know about the green chemistry
- Students should able to learn about the nano technology

References:

1. Norrish Shreave. R. and Joseph A. Brink Jr Chemical Process Industries, McGraw Hill, Industrial Book Company London 1978.
2. Brain A.C.S. Reinhold, Production and properties of Industrial chemicals 11th Ed, John Wiley & Sons, New York.
3. Burgh, A. Fermentation Industries, Inter science, 4th Ed, 1983, A *Inter science*, New York.
4. Ramani,V. Alex, Food Chemistry(2009),MJP publishers.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3BOEDC	Extra Disciplinary Course – Medicinal Botany and Pharmacognosy	4	-

Objectives

- ❖ To enable the students to identify local medicinal plants.
- ❖ To enable the students to prepare herbal medicines for curing human ailments.
- ❖ To impart knowledge to students on Botany and Phyto chemistry of medicinal plants.

Unit I

Medicinal Botany: Definition, Introduction, History, – Classification – Common medicinal plants cultivation, storage, collection and habitats of medicinal plants (*Catharanthus, Coleus, Aloe*) – Importance of medicinal plants.

Unit II

Indian systems of medicine – AYUSH - Siddha, Ayurveda, Homeopathy and Unani – Indigenous medicinal plants – Useful parts – Chemical constituents – medicinal uses – medicinal plant drugs.

Unit III

Herbal medicines for human ailments – Heart, kidney, liver, eye, skin, hair, stomach problems, diabetics, blood pressure, headache, cough, cold, fever, digestive problems, joint pains and wounds.

Unit IV

Pharmacognosy – History, Introduction, commercial drugs, crude drugs – classification of drugs – Chemistry of drug and drug evaluation of natural products.

Unit V

Drug adulteration and detection – Substitution – Detection of Adulterations – Elementary knowledge on alkaloids and flavonoids – Preparation of herbal oil, herbal tooth powder, herbal soup, herbal immune boosters.

Books for Reference

- Kumar, N.C., (1993). An introduction to Medical Botany and Pharmacognosy.
- Shah, S.C. and Quadry (1990). A text book of Pharmacognosy.
- Nadkarni, (1981). Indian MateriaMedica.
- Jain, S.K., (1980). Indian Medicinal Plants.
- Balu, S., Murugan, R. and Pandiyan, P., (2005). Herbal Technology.

Outcome

After completion of this course, students would be able to

- Understand the various Indian system of medicine
- Learn about the vital role of herbal medicines for human ailments
- Outline and classify the crud drugs
- Trained about drugs adulteration and direction

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3MBEDC	Extra Disciplinary Course – Mushroom Technology	4	-

Objectives

- ❖ To know the various types of edible mushroom and their nutritional value.
- ❖ To understand the methods of cultivation of mushrooms.
- ❖ To know the types of food prepared from mushroom and their importance in human health.
- ❖ Marketing of mushrooms in India and abroad.
- ❖ Mushroom cultivation unit visit- mandatory –Neighbouring District –one day.

Unit I

Introduction – history – scope of edible mushroom cultivation – Types of edible mushrooms available in India – *Calocybeindica*, *Volvariellavolvacea*, *Pleurotuscitrinopileatus*, and *Agaricusbisporus*.

Unit II

Pure culture – preparation of medium (PDA and Oatmeal agar medium) sterilization – preparation of test tube slants to store mother culture – culturing of *Pleurotusmycelium* on petriplates, preparation of mother spawn in saline bottle and polypropylene bag and their multiplication.

Unit III

Cultivation Technology: Infra structure – Mushroom bed preparation – paddy straw, sugarcane thrash, maize straw, banana leaves. Factors affecting the mushroom bed preparation – Low cost technology. Composting technology in Mushroom production.

Unit IV

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

Unit V

Food Preparation – Types of food prepared from mushroom; Soup, Cutlet, Omlette, Samosa, Pickles, Curry – Research Centres – National level and Regional level – Cost benefit ratio – Marketing in India and abroad, Export value.

Books for Reference:-

- Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayaranjan, R., (1991). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
- Swaminathan, M., (1960). Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No.88, Mysore Road, Bangalore 560 018.
- Tewari, Pankaj Kapoor, S.C., (1988). Mushroom Cultivation, Mittal Publications, Delhi.
- Nita Bahi (1984-1988). Handbook of Mushrooms, II Ed, Vol. I & II.
- Paul Stamets, J.S and Chilton J.s (2004). Mushroom cultivation. A practical guide to graining mushroom at home Agarikon Press.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3ZOEDC	Extra Disciplinary Course – Clinical Lab Technology	4	-

Objectives:

1. To study the various sterilization techniques.
2. To know the disposal of waste.
3. To identify the blood group and urine sugar.
4. To identify the bacteria and fungus.
5. To know the various diagnostic equipment.

Unit I

12 Hrs

Scope for study of Clinical Technology. Sterilization – Methods of Sterilization – Dry heat method – Wet heat method – Chemical method of sterilization – Disposal of hospital wastes and infected material - Disinfection laboratory glassware and equipments.

Unit II

12 Hrs

Composition of blood–ABO blood typing–Rh blood typing–Blood cells counting – Total erythrocyte count, total WBC count and differential count – Sugar level in Blood – Hypoglycemia, Hyperglycemia conditions. Composition of urine – Physical characters of urine–Method of urine analysis for sugars.

Unit III

12 Hrs

Analysis of Semen, Sputum and stool, Identification of blood parasites, Bacterial culture in NA medium, Fungal culture in PDA medium, Histological study of cells – Histological procedure for the preparation of tissue slides.

Unit IV

12 Hrs

Diagnostic equipment and apparatus – ECG, EEG, Colorimeter, pH meter, PCR, laminar airflow inoculation chamber, Binocular microscope and Incubator.

Unit V

12 Hrs

Immuno techniques – ELISA, HLA typing, VDRL Test.

Viral , bacterial and fungal diseases, First aid- definition and types and applications

Reference:

1. Medical Laboratory Technology (1994) (4th edition), By Ramik Sood, Jaypee Brother Medical Publishers (P) Ltd., New Delhi 110 002.
2. Medical Laboratory Technology, K.M. Samuel.
3. Clinical Pharmacology (1987), by Dr. Lawrance and P.N. Bennett (Sixth Edition), ELBS, English Language Book Society, Churchil Livingstone, England.
4. District Laboratory Practice in Tropical countries, part I, By Mouica Cheesbrough, Cambridge Las Priced Edition, Cambridge University Press, Cambridge, U.K.
5. Basic Clinical Paraitology (1993), W.Harold Brown and A.Franklin Neva (5th edition), Prntice Hall Internation Edition.
6. Biological Chemistry – Leringer.

7. Human Physiology by Pearse.
 8. The Biology of Animal Parasites (1984), Cheng, T. Toppan C9 Ltd., Japan.
 9. Medical Laboratory Technology: A procedure manual for routine diagnostic tests Volume – I-II By Kanai, L. Mukherjee, Tata McGraw – Hill Publishers, New Delhi.
 10. Basic Clinical Parasitology 5th Edn, Harrold, W. Harold Brown and A. Franklin Neva-prentice Hall International Editions, U.S.A.
-

Web Links:

https://www.sunydutchess.edu/academics/catalog/current/courses/medical_laboratory_tech/index.pdf (Dutchess Community College, New York).

<https://www.sunydutchess.edu/academics/catalog/current/programs/medicalandalliedhealth/mlt.pdf> (Dutchess Community College, New York).

[https://makautwb.ac.in/syllabus/BSc%20\(Medical%20Lab%20Technology\)28.02.2018.pdf](https://makautwb.ac.in/syllabus/BSc%20(Medical%20Lab%20Technology)28.02.2018.pdf)

Course Outcome

- Prepare the way for basic idea of various aseptic technique.
- Understanding the significance of waste disposal.
- Knowledge on Blood grouping and Blood sugar & urine sugar level.
- Gaining knowledge on culture of Bacteria, fungi and expertise on histological slide preparation.
- Operation technique of Diagnostic apparatus.
- Understanding for various immune techniques.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3BTEDC	Extra Disciplinary Course – Trends in Biotechnology	4	-

Objectives:

1. To study the concept and scope of Biotechnology.
2. To Understand r-DNA Technology.
3. To aware the programmes of cell culture, preparations of hormones and vaccines, transgenic animals and human genome project.
4. To study the Bioprocess technology and their applications.
5. To study the Environment Biotechnology and aware the biodiversity and their conservation.

Unit I

Hrs12

Biotechnology – Introduction and Scope of Biotechnology – Gene Cloning, Cell –free protein production – Production of Health care Products, Medical and Forensic application (RFLP, RAPD, DNA finger printing). Applications of PCR and LCR in disease diagnosis.

Unit II

Hrs12

Nuclear transplantation, Transgenic Animals Development and uses – mice, goat, fish and sheep. Tendered meat production. Transgenic Plant: Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Transgenic plant with vitamin A, Gene Production of therapeutic antibodies and edible vaccine.

Unit III

Hrs12

Bioprocess technology – Scope – Fermentor –Bioprocess products: Organic acids – Citric acid, Lactic acid, acetic acid. Antibiotics – Wide and Narrow specxtrum antibiotics. Aminoacids – Glutamic acid, Lysine, Isoleucine, Aspartic acid and Proline. Production of SCP. Enzyme Production – Amylase, Pectinase and Cellulase. Dairy products and Biofuel production.

Unit IV

Hrs12

Biofertilizers – N₂ fixing microbes (Azolla, Azatobacter, Azospirillum) for use in Agriculture – A. tumifasciens for crop improvement – Biopesticides. Biopolymer and its Application – Biosensor and its application – Bioleaching- Biomining – Biotechnology in oil recovery – Bioremediation of Xenobiotics – superbug – its application. Biodegradation.

Unit V

Hrs12

Regulations of Biosafety: possible dangers of GEO, Biohazards of rDNA technology. National and International biosafety guidelines, Primary and secondary containments and implementation. Web based information of biosafety on GMO.

Reference:

1. Dubey, R.C. – A Text Book of Biotechnology, S. Chand & Co., Ltd, New Delhi, 1996.
2. Gupta, P.K. – Elements of Biotechnology, Rastogi and Co., Meerut, 1994.
3. Kumar, H.F. A text book on Biotechnology, Affiliated East & West Press Pvt., Ltd, N-Delhi.
4. D.Balasubramanian *et. al.*, - Concepts in Biotechnology.
5. Singh, R.S. – Introductory Biotechnology, Central book deport, Allahabad.
6. Primrose, R. – Molecular Biotechnolgy, ASM Press.
7. Lick, E.R. and Pastenak – J.J. Molecular Biotechnology.
8. Ignachimuthu – Plant biotechnology, Oxford IBH Publishers, New Delhi.
9. Ranga – Fishery Biotechnology.
10. Primrose, R. – Molecular Biotechnology, ASM Press.
11. Purohit – A Text Book of Biotechnology, Agrobions, Jodhpur.

Semester	Subject code	Title of the course	Hours of Teaching/ Week	No. of Credits
III	20P3CSEDC/ 20P3ITEDC	Extra Disciplinary Course- E-Learning Technologies	4	-

Objective

- To learn the various E-learning approaches and components.
- To understand the types of design models of E-Learning.
- To explore the models for E-learning courseware development.
- To learn about E-learning authoring tools.
- To know about evaluation and management of E-learning solutions.

UNIT I INTRODUCTION

Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Basics of Design Thinking.

UNIT II DESIGNING E-LEARNING COURSE CONTENT

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

UNIT III CREATING INTERACTIVE CONTENT

Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware Development Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool

UNIT IV LEARNING PLATFORMS

Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

UNIT V COURSE DELIVERY AND EVALUATION

Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning – Course Evaluation.

REFERENCES:

1. Clark, R. C. and Mayer, R. E, "eLearning and the Science of Instruction", Third Edition, John Wiley, 2016.
2. Means, B., Toyama, Y., and Murphy, R, "Evaluation of Evidence – Based Practices in Online Learning: A Meta – Analysis and Review of Online Learning Studies", Centre for Learning Technologies, 2010.
3. Crews, T. B., Sheth, S. N., and Horne, T. M, "Understanding the Learning Personalities of Successful Online Students", Educause Review, 2014.
4. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Riley Media, 2011.
5. Madhuri Dubey, "Effective E – learning Design, Development and Delivery", University Press, 2011.

Course Outcomes:

On completion of the course, the students will be able to:

- Distinguish the phases of activities in the models of E-learning.
- Identify appropriate instructional methods and delivery strategies.
- Choose appropriate E-learning authoring tools, Create interactive E-Learning courseware, Evaluate the E-learning courseware, Manage the E-learning courseware.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	20P3LSEDC	Extra Disciplinary course Documentation Centers in India	4	-

Objectives:

- To promote and support adoption of standards in library operations.
- To coordinate with other regional, national & international network for exchange of information and documents

Unit I

Components of information systems-Libraries, Documentation centers, Information centers.

Unit II

Data banks, Information analysis centers, Referral centers, Clearing Houses, Reprographic and translation centers-Their function and services.

Unit III

National Information systems: DESIDOC, NASSDOC, SENDOC, NISCAIR and INFLIBNET.

Unit IV

Information Aggregators, Databases Proquest, EBscohost, J-gate, POPLINE, Shodhganga, NDL,.

Unit V

Information products and series – Newsletters, House Bulletins in – house Journals, state of art reports, digest and Technical Digest.

Outcome:

The students shall be able to:

- Know the standards in library operations.
- Understand the regional, national & international network for exchange of information and documents

Reference:

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3. Karts Henry F, DBS Computer, New Delhi, McGraw Hill, 2000.
4. Raghu Ramakrishnan, DBMSS, New Delhi, McGraw Hill, 2000.
5. Gangadharaiah G, Management of Information Products and Services in University Libraries, Common Wealth, New Delhi, 2012.