SEMESTER - III			
Core VII: Computational Biology			
Code : 17PZOC31	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 5**

Objectives

- To provide mathematical foundation to build analytical skills.
- To make the student competent in the applications of information science in bioscience.
- To gain an insight about the molecular databases

Unit I **Biostatistics –Descriptive Statistics**

Introduction – measures of central tendency - arithmetic mean, geometric mean, harmonic mean, median and mode – measures of dispersion – range, quartiles, mean deviation, standard deviation, standard error and coefficient of variation – measures of skewness and kurtosis – stem and leaf diagram - box plot.

Unit II **Inferential Statistics**

Theoretical probability distributions - binomial - Poisson – normal distribution – hypothesis testing procedure – student's t- test – chi – square test – goodness of fit and contingency tables – ANOVA – assumptions - types - one way and two way.

Unit III **Correlation and Regression**

Computation and interpretation of correlation coefficient – Karl Pearson's correlation coefficient – Spearman's rank correlation coefficient – regression – types – regression lines and their properties – fitting linear regression equations and forecasting – relationship between correlation and regression coefficients.

Unit IV **Computer Applications**

Graphical presentation of statistical data – MS Excel – spread sheet – data entry and creation of graphs – statistical packages –GENSTAT STATISTICA and SIGMAPLOT – statistical calculation –SPSS package – Principal Component Analysis(PCA).

Unit V **Bioinformatics**

Basic concepts and scope - nucleicaid database - GENBANK and EMBL – protein sequence database - NBRF – PIR and SWISSPROT - database similarity searches – BLAST and PSI – BLAST algorithms – derivation and searching molecular phylogenetic analysis – basic and functional genomics of bacteria and human.

Books for Reference.

1. Jerrold H.Zar.1984 Biostatistical Analysis, 2nd edition, Prentice -Hall International Edition. USA
2. Snedecor, G.W. and Cochran, 1989. W.G. Statistical Methods ,(8th edition) Affiliated East West Press, New Delhi,.
3. Gurumani, N.2005. An Introduction to Biostatistics, MJP Publishers,2nd edition, Triplicane, Chennai-5
4. Agarwal, S.K.2008. Bioinformatics, APH Publishing Corporation, New Delhi.
5. Peter Norton 2009. Introduction to Computers, 6th edition, Tata McGraw Hill, New Delhi.
6. Thiagarajan, B.andPa.Rajalakshmi 2009. Computational Biology,MJP publishers, Chennai .

7.Rajadurai, M.2010. Bioinformatics – A Practical Manual, PSB Book Enterprises, Chennai.

PRACTICALS

Hrs/ Week : 2

1. Computation of mean, median, mode, variance, standard deviation, standard error and coefficient of variation for biological variables.
2. Display of data through stem and leaf diagram.
3. Test of significance using student's t – test.
4. Test of goodness of fit of data with the aid of chi- square test.
5. Analysis of variance of molluscan shells
6. Correlation coefficient between height and weight of students and length and width of leaves.
7. Fitting regression equations for two variables and prediction of values.
8. Creation of graphs using MS-Excel
9. Statistical calculation using SPSS software package.
10. EMBL database - Print out.

SEMESTER – III			
Core VIII: Biotechnology			
Code : 17PZOC32	**Hrs / week : 6**	**Hrs / sem : 90**	**Credits : 5**

Objectives

- To study the potential benefits of biotechnology
- To familiarize with basic concepts of nanotechnology
- To understand the application of biotechnology in industries

Unit I **Cloning and Screening**

Definition – scope – vectors - properties of good vector-cloning and expression vectors-E.coli vector- screening of recombinants - pBR 322 - bateriophage – Lambdaphage - M13 – cosmid – plasmid- shuttle and yeast. - Integration of DNA insert with the vector-Introduction of vector into suitable host.

Unit II **Animal Cell and Organ Culture**

Cell culture - culture media - initiation of cell culture - evolution of continuous cell lines – large scale culture of cell lines- stem cell culture – organ culture - somatic cell fusion- hybridoma technology – In- *vitro* fertilization- embryo transfer - transgenic animals- fish, sheep and mice.

Unit III **Microbial Biotechnology and Human Welfare**

Microbial biotechnology- Isolation and improvement of microbial strains – micro organism used in alcohol production –alcoholic beverages-wine,beer,whisky-uses of alcohols. cloned genes and production of chemicals-human peptide hormones - insulin–vaccine for hepatitis B – rabies – polio - small pox – malaria - foot and mouth disease viruses - disease prevention - gene therapy - DNA finger printing.

Unit IV **Enzyme andIndustrial Biotechnology**

Methods of enzyme production – immobilization of enzymes - enzyme engineering-application of enzymes.single cell protein- mushroom culture – techniques-advantages and nutritive value. Bio gas production – anaerobic digestion-solubilization-acidogenesis-methanogenesis- mechanism of methane production

Unit V Nanotechnology

Nanomaterials, synthesis of nanoparticles: RF plasma, chemical methods, thermolysis, nanobiosensor, nanofluids, nanocrystals in biological detection - synthesis of nanodrugs- nanomedicine.

Books for Reference

1. Dubey.R.C. 2006. A Text Book of Biotechnology, 4th edition S.Chand& Company Ltd,New Delhi.
2. Singh.B.D.2005. Biotechnology.Revised edition. KalyaniPublishers,New Delhi.
3. Kumaresan V. 2009 Biotechnology. Saras Publication
4. Rema.L.P. 2007.Applied Biotechnology.MJPPublishers,Chennai.
5. Satyanarayana U. 2006. Biotechnology, Books and Allied (P) Ltd. Kolkatta
6. Robert Preidt, LauraCostlow and Peter. 2007. Introductory Nanotecnology. Dominant Publishers and Distributors, Delhi
7. Suhas Bhattacharya, 2013. Introduction to Nanotechnology. Wisdom Press. Delhi

Practicals

Hrs/week : 2

1. Isolation of DNA from goat liver.
2. Isolation of RNA from yeast
3. PCR amplification.
4. Western blotting analysis.
5. Biogas production
6. Wine preparation
7. Mushroom culture
8. Charts and models pertaining to theory for spotters
9. Report of visit to biotechnology lab

SEMESTER IV			
Core XII: Applied Microbiology			
Code: 17PZOC43	**Hrs/ Week :6**	**Hrs/sem : 90**	**Credits : 5**

Objectives

- To know the basic principles of food, industrial and environmental Microbiology.
- To concentrate on the economic aspects and to make use of or combat the activities of microorganisms.
- To understand the interaction of microorganisms with their environments and the practical consequences of these interactions.

Unit I **Microbial Classification**

Definition – scope, history of Microbiology - Bergey's classification-recent status of classification- Five kingdom concept. Distinctive features of the major groups of microorganism- bacteria, fungi and virus

Unit II **Food Microbiology**

Microbiology of food -growth of microorganisms in food - food spoilage - food poisoning - food infections – food preservation – microbiology of fermented foods - detection of food - borne pathogens.

Unit III **Industrial Microbiology**

Choosing microorganism for industrial microbiology – bioreactors - types of bioreactors - major products of industrial microbiology – antibiotics – organic acids - biopolymers – biosurfactants - bioconversion process and biofuels. Beverages – wine, beer.

Unit IV **Medical Microbiology**

Microbial diseases - Protozoan diseases; Plasmodium, Entamoeba.Fungal diseases: mycotoxicosis, aspergillosis. Bacterial diseases: meningitis and streptococcal pneumonia .Food and waterborne diseases: cholera, typhoid. STD and contact diseases: gonorrhea and syphilis. Viral diseases: influenza, hepatitis B

Unit V **Environmental Microbiology**

Biodegradation using microbial communities -leaching of metals,hydrocarbon degradation in water, and soil. waste as a resource - microbes in composting, Sewage treatment, biofertilizers, symbiotic -asymbiotic nitrogen fixation.

Books for Reference

1. Dubey R. C.and D.K Maheswari, 2006 .A Text Book of Microbiology. S. Chand & Co, New Delhi.
2. Rogar&Stainer, John l.ingrahan, Mark l. Wheelis& Page R. Painter, 1992. General Microbiology. Mac Millan India Ltd.
3. Kannan,N. 1996. Laboratory Manual in General Microbiology..Palani Paramount Publications.
4. James cappuccino and Natalie Sherman,1999. Microbiology-a Laboratory Manual. Addison-Wesly - Hyman Inc. Tokyo.
5. Pelzer, Chan and Krieg, Microbiology 1998. 2nd edn. Tata MC Grow Hill Publishing Company.
6. Presscott, Harley and Klein. 2005 Microbiology, WCB MC Graw Hill Co. New York.
7. Purohit S. S.,1991. Microbiology – Fundamentals and Application. M/S SarawathiPurohit for Student edition, India

PRACTICALS

Hrs / Week : 2

1. Sterilization technique
2. Sample handling for microbial studies.
3. Preparation of culture media for microorganisms.
4. Counting of viable cells (CFU / ml) by serial dilution & spread plate or pour plate.
5. Dye reduction test in milk.
6. Gram staining
7. Capsular staining.
8. Test for antibiotic sensitivity.
9. Isolation of nitrogen fixing symbiotic bacteria from root nodule.
10. Observation of algae, fungi and blue green algae
11. Industrial visit/ Institutional visit and submission of report

SEMESTER –IV			
Elective III : Applied Entomology			
Code :17PZOE41	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 4**

Objectives

- To explore the rich diversity of insects.
- To impart knowledge about the beneficial services and harmful effects rendered by insects.
- To familiarize with effective control measures.

Unit I **Insect Taxonomy**

Introduction – principles of classification – Imm's classification down to orders with their diagnostic characters, familiar and important examples – methods of collection, killing and preservation of insects.

Unit II **Beneficial Insects**

Productive insects – economic value of products of honey bee, silk worm and lac insect-helpful insects – insect pollinators, scavengers - insects as protein sources of human and animal feeds, medicinal uses of insects ,Forensic entomology .

Unit III **Harmful Insects**

Insect pests of crops – general characters, bionomics and control measures of any four important pests of paddy, sugarcane and coconut – pests of stored products – internal and external feeders.

Unit IV **Medical Entomology**

Insects in relation to public health –Biology, mode of transmission of diseases and control: housefly, sand fly, human body louse and head louse and mosquito (special reference to dengue, chikungunya and filariasis)

Unit V **Pest Management**

Assessment of pest population and pest damage. Methods of pest control: natural, cultural, mechanical, legal, biological and chemical (organic and inorganic compounds – synthetic pyrethroids). Classification of insecticides: based on mode of entry, mode of action and chemical nature – Recent trends in pest control: chemosterlants, hormones, pheromones, anti-feedants, Integrated Pest Management

Books for Reference

1. Fenemore, P.G.andB.Prakash 1997. Applied Entomology, Wiley Eastern Ltd., New Delhi.
2. Tembhare. D.B. 1997. Modern Entomology, Himalaya Publishing House, New Delhi,
3. Nayar, K.K., Vasantharaj David, B, and T.N.Ananthakrishnan 2004. General and Applied Entomology Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. NalinaSundari, M.S.andR.Shanthi 2006. Entomology MJP Publishers, Chennai.
5. AbishekShukla 2008, Entomology Daya Publishing House, New Delhi.
6. SandhyaAgrawal 2009 Applied Entomology Oxford Book Company, Jaipur, India.
7. Ravindran K.R.2013. A Text Book of Economic Zoology, Wisdom Press , New Delhi
8. T.V.Sathe,A.TSatha, and Jagtap,2011. Mahendra.Mosquito Borne Diseases.Mangalam Publishers & Distributers.

SEMESTER II			
Elective II : Plant Cell and Tissue Culture			
Code: 17PBOE21	**Hrs/Week: 6**	**Hrs /Sem:90**	**Credits: 4**

Objective

- To acquire knowledge on basic plant tissue culture techniques

Unit I

Basic concept and scope of plant *in vitro* technology: History of *in vitro* plant biology, organization of a tissue culture laboratory, equipment, basic techniques, medium components, medium preparation- MS medium and White's medium.

Unit II

Differentiation/ regeneration- organogenesis-process, mechanism of action of plant hormones, multiple hormonal controls on organogenesis. Embryogenesis: Major processes in embryonic development, role of phyto-hormones in embryogenesis. Somatic embryogenesis- physiological, biochemical and molecular aspects of somatic embryogenesis. Synthetic seeds and its applications.

Unit III

Haploid and triploid culture: androgenesis, gynogenesis, endosperm culture. Techniques and applications in crop improvement. Protoplast culture -isolation, purification and culture of protoplasts, protoplast fusion and somatic hybridization. Selection of hybrids, regeneration, applications and limitations.

Unit IV

Micropropagation: methods and stages of clonal propagation.Strategiesfor virus-free plant production.Assessment of clonal fidelity using different types of markers.Field evaluation, packaging technology and transport methods.Soma clonal variation- genotypic and phenotypic variations in cell cultures and in regenerated plants.Chromosomal mutation in cultured plants.Applications in crop improvement.

Unit V

Production of secondary metabolites by cell and organ cultures. Germplasm preservation- *in-situ* and *ex-situ* conservations of germplasms. Cryopreservation: principle, techniques and applications

Books for Reference

1. HarinderChaddha 2011 Tissue culture and non-gene biotechnology, Dominant publishers and distributers Delhi.
2. Sharp, W.R., D.A.Evans, P.V.Ammirato and Yamada, 1984 hand book of plant cell culture volume II, Library of congress Macmillian publishing Co New York.
3. Narayanaswamy, S**.**1994 Plant cell and tissue culture. Tata McGraw- Hill publishing limited New Delhi
4. Green, C.E., D.A. Somers , W.P. Hackett and D.D. Biesboer 1987, Plant biology Volume 3 Plant and cell culture Alan R. Liss, Inc., New York.
5. Kumar, H.D. 1998 A text book of Biotechnology Affiliated east- west private limited, New Delhi.

SEMESTER II			
Core VI: Developmental Biology			
Code: 17PZOC23	**Hrs/Week: 6**	**Hrs /Sem:90**	**Credits: 5**

Objectives

- To understand the sequential changes in the organization of embryo
- To have a knowledge about post embryonic development
- To know the role of genes in development.

Unit I Gametogenesis and Fertilization

Basic concepts of development – gametogenesis – spermatogenesis – oogenesis. Structure of gametes - sperm and egg of sea urchin and mammal. Fertilization (biochemical, molecular aspects) - prevention of polyspermy .Parthenogenesis.

Unit II Cleavage and Blastulation

Planes of cleavage - Patterns of cleavage – role of yolk in cleavage.Mechanisms and regulation of cleavage cycles. Cleavage and blastulation in sea urchin, frog, bird and mammal. Fate map of sea urchin and frog.

Unit III Gastrulation and Organogenesis

Gastrulation – Morphogenetic movements - gastrulation in sea urchin and frog. Organogenesis in vertebrates - CNS, eye, skin and its derivatives, heart, kidney, digestive tube and its derivatives.

Unit IV Role of Genes in Development

Genomic equivalence – differential gene expression – amplified genes – selective gene transcription – control of gene expression.
Congenital abnormalities – teratogenic agents - programmed cell death in development. Stem cells.

Unit V Metamorphosis and Regeneration

Amphibian metamorphosis – morphological, physiological, biochemical change and causation of metamorphosis.
Regeneration – patterns – morphollaxis - epimorphosis and heteromorphosis – regeneration ability in different group of organisms - blatema formation-regeneration of amphibian limb – Wolffian regeneration - polarity and gradient in regeneration.

Books for Reference

1. Philip Grant. 1985. Biology of Developing Systems. Hall – Saunders International edition.
2. Scott F. Gilbert. 1994. Developmental Biology. Sinamer Associates Inc Publishers, Sunderland, Massachusetts.
3. N.J Berrill. 1982. Developmental Biology. Tata McGraw – Hill Publishing Co.Ltd, New Delhi.
4. Balinsky.B.I.1981. Introduction to Embryology. Saunders College Publishing Ltd.
5. Wendell Smith.C.P, Williams.P.L, Sylvia Tread Gold. 1996. Basic Human Embryology. ELBS Edition. Pitman Publishing Ltd.
6. Banerjee S. 2005. A Text Book of Developmental Biology. Dominant Publishers and Distributors, New Delhi.
7. Lewis Wolpert, Cheryll Tickle. 2010. Principles of Development. Fourth edition. Oxford University Press, New Delhi.
8. Verma P.S, V.K. Agarwal and B.S. Tyagi. 1980. Chordate Embryology. S. Chand & Company Ltd, New Delhi.

PRACTICALS

Hrs / Week : 2

1. Spermatogenesis and oogenesis (vertebrate) - chart
2. Study of different types of eggs - frog, chick, man - slides/ model
3. Study of different types of sperms - frog, chick, man - slides
4. Frog developmental stages - cleavage, blastula, gastrula, external gill stage – slides
5. Observation of T. S. of testis and T.S. of ovary of frog and Mammal- slides.
6. Temporary mounting of chick blastoderm.
7. Observation of chick embryos – 24 hrs, 48 hrs, 72 hrs, 96 hrs.
8. Study of any two congenital abnormalities – Phocomelia, Cyclopic lamb.
9. Effect of thyroxine in amphibian metamorphosis
10. Regeneration in the tail of tadpoles

SEMESTER I			
Elective I : Environmental Biology and Resource Management			
Code: 17PZOE11	**Hrs / Week:6**	**Hrs/Sem :90**	**Credits : 5**

Objectives

- To create environmental awareness among students.
- To inculcate knowledge about the natural resources, their conservation and efforts towards their sustainability.
- To generate concepts of prediction, prospecting, promotion, preservation and vision about restoration and resuscitation of dwindling natural resources.

Unit I **Environment and Social Issues**

From unsustainable to sustainable development - environmental ethics, issues - possible solutions – urban problems related to energy - consumerism and waste products - climate change - global warming – ozone depletion - acid rain.

Unit II **Human Population & Environment**

Population growth – population explosion – family welfare programmes - environment and human health – human rights – value education – women and child welfare – Role of IT in environmental and human health.

Unit III **Natural Resources**

a. Forest resources: Use and over exploitation- deforestation- timber extraction- mining- dams and forests – tribes.

b. Water resources: Use and over exploitation of ground water – surface water – conflicts over water- dams - benefits and problems -Conservation of water.

c. Land resources: Land as a resource- land degradation- soil erosion and desertification -Conservation of soil

d. Energy resources: Growing energy needs – renewable and non-renewable energy sources – use of alternate energy source.

Unit IV **Biodiversity and Conservation**

Biodiversity – values of biodiversity - threats to biodiversity, *in-situ* conservation, *ex –situ* conservation- role of individual in conservation of natural resources - role of organizations - NB PGR, BSI, ZSI, WWF, IUCN and Convention on Biological diversity - Ramsar Convention, National Action Plan on Conservation of Biodiversity. Environmental Protection Act (1986) – Forest Conservation Act (1980).

Unit V **Disaster Management**

Flood warning system - earthquakes, droughts, famines and heat waves – cyclone - wild fires – land slide – Disaster Management Information System (DMIS) – A guideline for disaster management.

Books for Reference

1. DhulasiBrindha, V. 2004. Environmental Studies. Allied Publishers Pvt. Ltd., New Delhi.
2. Veer BalaRastogi and M.S. Jayaraj. 2009. Animal Ecology and Distribution of Animals KedarnathRamnath, Meerut – Delhi.
3. Agarwal, A.C. 1999. Environmental Biology, Agro Botanical, Bikaner.
4. Anjaneyalu, Y.B. 2004. Introduction to Environmental Science, SPBS. Publications. Hyderabad.
5. Kormondy Edward J. 1994. Concepts of Ecology - Prentice Hall of India, Pvt. Ltd.
6. Odum, E.P. 1983. Basic Ecology - CBS College Publishing, Saunder.
7. Anubhakaushik and C.P. Kaushik. 2007. Environmental Science & Engineering, Newage International (p) Publishers. New Delhi.
8. Ravikrishnan, A. 2010. Environmental Science & Engineering. Sri Krishna Publications, Chennai.
9. Saha, T.K. 2008. Ecology & Environmental Biology, Books and Allied (P) Ltd.

SEMESTER –I			
Core IV: Applied Entomology			
Code :19PZOC14	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Vision

To explore the richness and significance of insects

Mission

To impart knowledge on the beneficial services, harmful effects rendered by insects and to familiarize them with effective control measures

Course outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know about the diversity of insects, classify and state their major different orders	1	Un
CO-2	develop skills for collecting, mounting and preserving insects	1, 6	Cr
CO-3	acquire knowledge on beneficial insects, helpful insects and insects of medicinal and aesthetic value	1	Un
CO-4	analyse the main pest species of crops based on the symptoms of the attack and morphological traits	2	An
CO-5	explain the life cycle of main pest species on crops and insect vectors	2, 1	Un
CO-6	identify, collect and manage different insects of household, man and animals.	4, 6	Ap
CO-7	apply appropriate indirect and direct measures to prevent or reduce pest attack	5, 7	Ap
CO-8	plan and implement crop protection according to the IPM principles	4, 8	Ev, Cr

SEMESTER –I			
Core IV: Applied Entomology			
Code :19PZOC14	**Hrs/Week : 5**	**Hrs/Sem : 75**	**Credits : 4**

Unit I Insect Taxonomy

Introduction – principles of classification – Imm's classification down to orders with their diagnostic characters, familiar and important examples – methods of collection, killing and preservation of insects.

Unit II Beneficial Insects

Productive insects – economic value of products of honey bee, silk worm and lac insect-helpful insects – insect pollinators, scavengers - insects as protein sources of human and animal feeds, medicinal uses of insects , Forensic entomology .

Unit III Harmful Insects

Insect pests of crops – general characters, bionomics and control measures of any three important pests of paddy, sugarcane and coconut – pests of stored products – internal and external feeders.

Unit IV Medical Entomology

Insects in relation to public health –Biology, mode of transmission of diseases and control: housefly, human head louse and mosquito (special reference to dengue, chikungunya and filariasis).

Unit V Pest Management

Methods of pest control - natural, cultural, mechanical, legal, biological and chemical (organic and inorganic compounds – synthetic pyrethroids). Recent trends in pest control: chemosterlants, hormones, pheromones, anti-feedants, Integrated Pest Management (IPM).

Books for Reference

1. Fenemore, P.G. and B. Prakash. 1997. *Applied Entomology*. Wiley Eastern Ltd., New Delhi.
2. Tembhare. D.B. 1997. *Modern Entomology*, Himalaya Publishing House, New Delhi,
3. Nayar, K.K., Vasantharaj David, B. and T.N.Anantha Krishnan. 2004. *General and Applied Entomology.* Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
4. Nalina Sundari, M.S. and R. Shanthi. 2006. *Entomology.* MJP Publishers, Chennai.
5. Abishek Shukla. 2009. *Economic Entomology*. Daya Publishing House, New Delhi.
6. Sandhya Agrawal. 2009. *Applied Entomology.* Oxford Book Company, Jaipur, India.
7. Ravindran K.R. 2013. *A Text Book of Economic Zoology*. Wisdom Press, New Delhi.
8. Sathe, T.V., Satha, A.T. and Jagtap Mahendra. 2011. *Mosquito Borne Diseases*. Mangalam Publishers and Distributers, New Delhi.
9. Saxena, R. C. and R.C. Srivastava. 2007. *Entomology.* Agrotech Publishing Academy, Udaipur.

PRACTICALS

Hrs/Week: 2 **Credit: 1**

1. Identification and classification of common insects – Butterfly, Grasshopper, Stick insect, Leaf insect, Beetle.
2. Mounting of mouth parts of insects – Honey bee, Mosquito
3. Study of beneficial insect - Honey bee colony and their product(honey)
4. Study of beneficial insect - Silk moth – life stages, silk
5. Study of any three insect pests and their damages – one pest on each crop paddy, coconut, sugarcane.
6. Study of life history of the insect vector – House fly
7. Study of life history of the insect vector – Mosquito
8. Study of any two household insects – Bed bug, Silver fish
9. Study of any two ectoparasites – Human head louse, Flea
10. Submission of insect box with minimum 10 insects.

Books for Reference

1. Vasantharaj David, B. 2001. *Elements of Economic Entomology*. Popular Book Depot, Chennai.
2. Nayar, K.K., Vasantharaj David, B. and T.N.Anantha Krishnan. 2004. *General and Applied Entomology.* Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
3. Fenemore, P.G. and Alka.Prakash 2006. *Applied Entomology*. New Age International Publishers, New Delhi.

SEMESTER – II			
Core VII : Biotechnology			
Code : 19PZOC23	**Hrs / week : 5**	**Hrs / sem : 75**	**Credits : 4**

Unit I Cloning and Screening

Definition – scope – vectors - properties of good vector-cloning and expression vectors - E.coli vector- screening of recombinants - pBR 322 - bateriophage – Lambdaphage – plasmid and yeast. vector - integration of DNA insert with the vector - introduction of vector into suitable host.

Unit II Animal Cell and Organ Culture

Cell culture - culture media - initiation of cell culture - large scale culture of cell lines- stem cell culture – organ culture - hybridoma technology – Artificial insemination - transgenic animals- fish and mice.

Unit III Microbial Biotechnology and Human Welfare

Microbial biotechnology- Isolation and improvement of microbial strains –cloned genes and production of chemicals - human peptide hormones – insulin – vaccine for hepatitis B – foot and mouth disease viruses - disease prevention - gene therapy - DNA finger printing – Bioremediation.

Unit IV Enzyme and Industrial Biotechnology

Methods of enzyme production – immobilization of enzymes -application of enzymes. Single cell protein- mushroom culture – techniques-advantages and nutritive value. Bio gas production – mechanism of methane production

Unit V Nanotechnology

Nanomaterials, synthesis of nanoparticles: RF plasma, chemical methods, thermolysis, nanobiosensor, nanofluids, nanocrystals- synthesis of nanodrugs- nanomedicine.

Books for Reference

1. Dubey.R.C. 2006. *A Text Book of Biotechnology*. 4th edition. S.Chand & Company Ltd,New Delhi.
2. Singh.B.D. 2005. *Biotechnology.* Revised edition. KalyaniPublishers, New Delhi.
3. Kumaresan, V. 2009. *Biotechnology*. Saras Publication, Nagercoil.
4. Rema, L.P. 2007. *Applied Biotechnology*. MJP Publishers,Chennai.
5. Satyanarayana, U. 2006. *Biotechnology,* Books and Allied (P) Ltd. Kolkatta
6. Robert Preidt, Laura Costlow and Peter. 2007. *Introductory Nanotecnology*. Dominant Publishers and Distributors, Delhi
7. Suhas Bhattacharya. 2013. *Introduction to Nanotechnology*. Wisdom Press. Delhi

Practicals

Hrs/week : 2 **Credit: 1**

1. Isolation of plasmid DNA
2. Isolation of Genomic DNA
3. Immobilization of enzymes by sodium alginate method
4. PCR amplification.
5. Western blotting analysis.
6. Biogas production
7. Mushroom culture
8. Charts and models pertaining to theory for spotters
9. Report of visit to biotechnology lab

Books for Reference:

1. Harisha S. 2007. *Biotechnology Procedures and Experiments Hand Book*. Infenity Science Press, LIC, Hinghum, Massachusett, New Delhi, India.
2. Asish Verma, Surajit Das and Anchal Singh. 2008. *Laboratory Manual for Biotechnology*. S.Chand and Company, New Delhi.

SEMESTER II			
Core VIII		Microbiology	
19PZOC24	Hrs/ Week : 4	Hrs / Sem : 60	Credits : 4

Vision : To prepare graduate students with thorough knowledge and understanding of the core concepts in the field of Microbiology

Mission : To equip the students with knowledge about Taxonomy, organization, multiplication and infection of microbes and to develop expertise in microbiological techniques.

Course Outcome :

CO.NO	Upon completion of this course, the students will be able to	PSO addressed	CL
CO- 1	classify micro organisms focusing on the modern trends of Taxonomy	1	Un
CO- 2	prepare media to be utilized in the cultivation of microorganisms	2	Ev
CO-3	understand the structural organization and life cycle of microorganisms	2	Un
CO-4	explain the role of microorganisms in fermentation, medicine and the production of microbial products	2	An
CO-5	gain familiarity with the unique role of pathogens in human infectious diseases	2	Ev
CO-6	identify the methodologies used in disease treatment and prevention	6	An
CO-7	demonstrate practical skills in the use of technologies and methods common to microbiology	8	Ev
CO-8	apply scientific methods in the design and execution of experiments	8	Ap

SEMESTER II			
Core	**VIII**	**Microbiology**	
19PZOC24	**Hrs/ Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Vision : To prepare graduate students with thorough knowledge and understanding of the core concepts in the field of Microbiology

Mission : To equip the students with knowledge about Taxonomy, organization, multiplication and infection of microbes and to develop expertise in microbiological techniques.

Course Outcome :

CO.NO	Upon completion of this course, the students will be able to	PSO addressed	CL
CO- 1	classify micro organisms focusing on the modern trends of Taxonomy	1	Un
CO- 2	prepare media to be utilized in the cultivation of microorganisms	2	Ev
CO-3	understand the structural organization and life cycle of microorganisms	2	Un
CO-4	explain the role of microorganisms in fermentation, medicine and the production of microbial products	2	An
CO-5	gain familiarity with the unique role of pathogens in human infectious diseases	2	Ev
CO-6	identify the methodologies used in disease treatment and prevention	6	An
CO-7	demonstrate practical skills in the use of technologies and methods common to microbiology	8	Ev
CO-8	apply scientific methods in the design and execution of experiments	8	Ap

SEMESTER II			
Core VIII		Microbiology	
19PZOC24	Hrs/ Week : 4	Hrs / Sem : 60	Credits : 4

Unit I Classification

Classification of microorganism – Five Kingdom concept . Modern trends of bacterial Taxonomy- Ribosomal RNA and sequencing - Construction of phylogenetic tree. General characters of main groups of microorganisms.

Unit II Cultivation of microorganisms

Preparation of culture media – Isolation and maintenance of pure culture- Cultural and morphological characteristics of bacteria – Microscopic examination of microorganisms- gram staining- acid fast staining – spore staining - capsular staining – flagellar staining.

Unit III Microbes – Structural organization

Structural organization of bacteria, virus and fungi – Life cycle of Actinomycetes, yeast and mycoplasma.

Unit IV Production of microbial products

Yeast fermentation and its products – Production of alcohol, beer and wine. Mixed fermentation product- Production of vinegar. Production of antibiotics - penicillin and tetracycline.

Unit V Microbial diseases

Protozoan diseases- ameobiais and sleeping sickness. Bacterial diseases- diphtheria, tetanus and gonorrhea. Viral diseases- chikungunya, dengue fever, rabies and ebola. Fungal diseases- actinomycosis and aspergillosis.

Books for Reference

1. Arti Kapil. 2016. *Text Book of Microbiology*. 9th Edition. University Press. Hyderabad.
2. Dubey, R .C and D.K. Maheswari. 2006. *A Text Book of Microbiology.* S chand & Co New Delhi.
3. Roger Stainer, John Lingraham, Mark I Wheelis and Page R. Painter. 1992. *General Microbiology* Mac Millan, Hampshire, London.
4. Pelzer Chan and Krieg. 1998. *Microbiology.* 2nd Edition. Tata MC Grow Hill Publishing Company, New Delhi.
5. Presscott Harley and Klein. 2005. *Microbiology.* WCB MC Graw Hill Co New York.
6. Purohit, S.S. 1991. *Microbiology – Fundamentals and Application*. M/ S Saraswathi Publication, India

7. Power, C.B, and K.F. Daginawala. 1988. *General Microbiology* . Vol I & II. Himalaya Publishing House, Mumbai.
8. Vijaya Ramesh. 2007. *Food Microbiology.* MJP Publishers, Chennai.

PRACTICALS

Hrs / Week : 2 **Credit: 1**

1. Sterilization Techniques

2. Sample handling for microbial studies

3. Preparation of culture media:

Nutrient broth, Nutrient agar, Potato dextrose agar, Mullen- Hinters agar

4. Counting of viable cells (CFU/ ml) by serial dilution & spread plate or pour plate methods

5. Gram staining

6. Spore staining

7. Simple biochemical tests of bacteria

a Acid and gas production in glucose broth

b Starch hydrolysis

c Catalase

d Nitrate reduction

8. Dye reduction test in milk

9. Test for antibiotic sensitivity

10. Isolation of symbiotic nitrogen fixing bacteria from root nodules

11. Observation of algae, fungi and blue green algae

Books for Reference:

1. Kannan N. 1996. *Laboratory Manual in General Microbiology.* Palani Paramount Publications, Palani.
2. James Cappuccino and Natalie Sherman. 1990. *Microbiology A Laboratory Manual*. Addison - Wesly- Hyman Inc,Tokyo.
3. Dubey R.C. and D.K. Maheswari. 2008. *Practical Microbiology*. S Chand & Company Ltd., New Delhi.

SEMESTER - III			
Core IX Computational Biology			
Code : 19PZOC31	**Hrs/Week : 6**	**Hrs/Sem : 90**	**Credits : 4**

Vision

To understand the central concepts of biostatistics and bioinformatics

Mission

To impart interdisciplinary expertise from the biological science, computer science and mathematics

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	analyse and interpret results of descriptive statistical methods effectively	1, 3	An, Ev
CO-2	apply the methods of hypothesis testing, statistical inference and design	4	Ap
CO-3	appreciate biological data in statistical perspective correctly and contextually	4	Un
CO-4	infuse critical appraisal skills to assess the research data and produce original research	7	Cr
CO- 5	carry out correlation and regression analysis and recognise theoretical distributions	6	Un, An
CO -6	formulate and test using appropriate statistical software	4	Cr
CO-7	implement statistical methods and statistical software programmes to a variety of practical problems	5	Ap
CO- 8	demonstrate the mastery of concepts of bioinformatics	1, 2	Un,

SEMESTER - III			
Core IX Computational Biology			
Code : 19PZOC31	Hrs/Week : 6	Hrs/Sem : 90	Credits : 4

Unit I Biostatistics –Descriptive Statistics

Introduction – measures of central tendency - arithmetic mean, geometric mean, harmonic mean, median and mode – measures of dispersion – range, quartiles, mean deviation, standard deviation, standard error and coefficient of variation – measures of skewness and kurtosis – stem and leaf diagram - box plot.

Unit II Inferential Statistics

Theoretical probability distributions - binomial - Poisson – normal distribution – steps in hypothesis testing procedure – student's t- test – chi – square test – goodness of fit and contingency tables – ANOVA – assumptions - types - one way and two way.

Unit III Correlation and Regression

Computation and interpretation of correlation coefficient – Karl Pearson's correlation coefficient – coefficient of determination - Spearman's rank correlation coefficient – regression – types – regression lines and their properties – fitting linear regression equations and forecasting – relationship between correlation and regression coefficients.

Unit IV Computer Applications

MS Excel – spread sheet – statistical functions calculation of arithmetic mean – t test – ANOVA one way classification– statistical packages –SIGMAPLOT – statistical calculation –SPSS package – Principal Component Analysis(PCA).

Unit V Bioinformatics

Basic concepts and scope - nucleic acid database - GENBANK and EMBL – protein sequence database - NBRF – PIR and SWISSPROT - database similarity searches – BLAST and PSI – BLAST algorithms – Smith – Waterman algorithm – Needleman – Wunsch algorithm – scoring matrices - PAM and BLOSUM – multiple sequence alignment – sum of pairs method and progressive method.

Books for Reference.

1. Jerrold H. Zar. 1984. *Biostatistical Analysis*. 2nd edition, Prentice -Hall International Edition. USA.
2. Snedecor, G.W. and W.G. Cochran. 1991. *Statistical Methods.* (8th edition). Affiliated East West Press, New Delhi,.
3. Gurumani, N. 2005. *An Introduction to Biostatistics*. MJP Publishers, 2nd edition, Triplicane, Chennai-5
4. Agarwal, S.K. 2008. *Bioinformatics.* APH Publishing Corporation. New Delhi.
5. Gautham, N. 2009. *Bioinformatics - Databases and Algorithms*. Narosa Publishing House Pvt Ltd. New Delhi.

6. Thiagarajan, B. and Pa.Rajalakshmi 2009. *Computational Biology,* MJP publishers, Chennai .
7. Rajathi, A and Chandran, P. 2010. *SPSS for you*. MJP Publishers, Chennai.

PRACTICALS

Hrs/ Week : 2 **Credit:1**

1. Computation of mean, median, mode, variance, standard deviation, standard error and coefficient of variation for biological variables.
2. Display of data through stem and leaf diagram.
3. Test of significance using student's t – test.
4. Test of goodness of fit of data with the aid of chi- square test.
5. Analysis of variance of molluscan shells
6. Correlation coefficient between height and weight of students and length and width of leaves.
7. Fitting regression equations for two variables and prediction of values.
8. Seqence alignment and similarity searching - BLAST
9. Statistical calculation using SPSS software package.
10. Retrieving data from EMBL database - Print out.

Books for Reference

1. Gurumani, N. 2005. *An Introduction to Biostatistics*. MJP Publishers, 2nd edition, Triplicane, Chennai-5.
2. Rajadurai, M. 2010. *Bioinformatics – A Practical Manual*, PSB Book Enterprises, Chennai.

SEMESTER - IV			
Core XV - Commercial Zoology			
Code :19PZOC43	**Hrs /Week: 5**	**Hrs/ Sem : 75**	**Credits : 4**

Vision :

To facilitate self- employment and entrepreneurship in Apiculture and Sericulture.

Mission :

To motivate the students to take up carriers related to agro- based, rural oriented cottage industry through imparting knowledge in apiary management, mulberry cultivation and silkworm rearing.

Course Outcome:

CO. No	upon completion of this course, students will be able to	PSO addressed	CL
CO-1	identify, choose suitable bees and maintain bee hive successfully	2	Ev
CO-2	understand the behavior of bees, prevent swarming and manage bee colonies	3	Un
CO-3	inspect bee colony, identify diseases of bees, recognize their enemies and take necessary control measures	4	An, Ap
CO-4	apply their knowledge to implement the procedure to extract honey and other bee products and to preserve honey	5	Ap
CO-5	demonstrate an understanding of mulberry cultivation, silkworm rearing and silk reeling	1	Un
CO-6	identify diseases, pests of mulberry and silkworm and adapt control measures	4	Ap, Cr
CO-7	utilize their knowledge in harvesting, marketing cocoons and reeling operations	5	Ap
CO-8	develop practical proficiency in apiculture and sericulture from the lab work and visit to the apiary and the department of sericulture	6	Ap

SEMESTER - IV			
Core XV - Commercial Zoology			
Code :19PZOC43	Hrs /Week: 5	Hrs/ Sem : 75	Credits : 4

Unit I Bee keeping technology

Apiculture as a cottage industry - choice of species in apiculture- Indian bee, European bee. Bee keeping equipments - Langstroth hive and Newton's hive- Appliances used in apiaries. Swarming – prevention and control. Queen rearing and introduction. Artificial feeding.

Unit II Management of bees & Honey bee products

Diseases of bees- brood diseases, diseases of adult bees - nosema and septicemia, enemies - greater wax moth, lesser wax moth, ants, wasps - control measures. Extraction and uses of honey- bee wax- bee venom and pollen. Preservation and storage of honey.

Unit III Moriculture

Mulberry cultivation – cultivation practices – biofertilizers – foliar spray – triacontanol and seriboost. Diseases of mulberry – white root rot, stem canker, leaf spot, powdery mildew, leaf blight and leaf mosaic - deficiency diseases — symptoms and control measures.

Unit IV Silk worm rearing

Mulberry silk worm development – silk worm rearing – rearing house – rearing appliances rearing operations – chawki rearing – application of sampoorna. Silk worm diseases - flacherie, muscardine, grasserie, and pest- Indian uzifly- symptoms and control measures.

Unit V Cocoon Mounting and Reeling

Mountages- mounting methods - cocoons – harvesting, transport and marketing. Silk reeling – reeling operations, reeling appliances – cottage basin – filature units. By-products of sericulture.

Books for Reference

1. Mishra. R.C. 1997-98. *Perspectives in Indian Apiculture.* Agro Botanica, 4E 176 J.N.Vyas Nagar, Bikaner, H.S.Offset Printers,Daryagunj, New Delhi.
2. Pierre Jean – Prost. 1994. *Apiculture*. Oxford & IBH Publishing Co.Pvt. LTD. New Delhi.
3. Root, R.I. 1985. *Encyclopedia of Bee Culture*. International Books & Periodicals Supply Service. 24 – B/5, Desh Bandhu Gupta Road, New Delhi

4. Raja Instus, E. 1994. *Economics of Bee Keeping Industry*. Rawat Publications, Jaipur and New Delhi.
5. Everett Franklin Phillips. 2010. *Bee Keeping*. Agrobios (India), Agro House, Chopasani Road, Jodhpur – 342 002.
6. Ganga, G. and J. Sulochana Chetty. 1997. *An Introduction to Sericulture*. Oxford & IBH Publishing Co Pvt. Ltd. New Delhi.
7. Krishnaswami, S. 1990. *Improved Method of Rearing Young Age Silkworms*. Central Silk Board – Bangalore.
8. Acharya, J. 1993. *Sericulture and Development*. Indian Publishers Distributers Kamak Nagar – New Delhi
9. Hisao Aruga. 1990. *Principles of Sericulture*. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

PRACTICALS

Hrs / Week : 2 **Credit: 1**

1. Identification of bee species and casts.
2. Mounting of mouth parts and legs of worker bee.
3. Bee keeping equipments - Newton's hive, hive tool, smoker, uncapping knife, pollen box, honey extractor.
4. Identification of diseases and enemies of honey bees.
5. Mulberry diseases and pests
6. Development of silkworm.
7. Silk gland.
8. Rearing house and appliances.
9. Silkworm diseases and pests.
10. Visit to an apiary and sericulture department.

Books for Reference

1. Alka Prakash. 2001. *Laboratory Manual of Entomology*. New Age International (P) Ltd, 4835/ 24, Ansari Road, Daryaganj, New Delhi – 110002.
2. Tammanna N.Sonwalker.1993. *Hand Book of Silk Technology*. Wiley Eastern Ltd. Chennai.

SEMESTER – I			
Core I : Cell and Molecular Biology			
Course Code: 21PZOC11	**Hrs/Week : 6**	**Hrs/Sem: 90**	**Credits: 4**

Objectives

- To develop basic knowledge and skills in cell and molecular biology and become aware of the complexity and harmony of the cell
- To gain the comprehensive knowledge on the molecular structure of cells, organelles including membrane structure and its dynamics

Course outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	acquire knowledge on the structure and function of biological membrane including the roles of gradients in energy transduction	1	Un
CO-2	compare the different types of transporters and its functions	2	An
CO-3	relate the mechanisms of cell to cell signaling, including intercellular signaling and second messenger	1	An
CO-4	understand the structure and function of proteins including the roles of amino acids in protein folding and protein-protein interactions.	1	Un
CO-5	identify the regulation of gene at the transcriptional and post transcriptional level	3	Ap
CO-6	illustrate the structural organization of gene and the control of gene expression	5	Un
CO-7	explain the cell cycle and its regulation, including the mechanism of mitosis and meiosis	6, 7	Ev
CO-8	demonstrate the characteristics, causes and onset of cancer, metastasis, proto oncogenes, tumor suppressor genes and apoptosis	6, 8	Un

Unit I **Cell and Transport Across Cell Membranes**

Molecular organization of cell membrane – molecular models (Unit membrane, Trilaminar and Fluid mosaic) – intercellular junctions - types of transport - diffusion –membrane transport proteins – uniportercatalysed transport – membrane electrical potential. Active transport by ATP powered pumps. Co - transport by symporters and antiporters.

Unit II **Cell Receptors and Cell Signaling**

Cell signaling –principle of cell signaling- signaling mechanisms-signal receptors - intercellular signaling - cell surface receptors –types- G protein coupled receptors- second messengers (cAMP, IP_3,DAG, cGMP, & Ca^{2+}) - signaling from plasma membrane to nucleus.

Unit III **Chromosome and Genes**

Chromosome structure, Organization of genes in chromosomes – introns and exons – simple, complex and split genes – forms of DNA-A,B,Z - molecular basis of mutation – transition- transversion – frame shift – induction of mutation – repair systems to counteract DNA damage and mutation –post-transcriptional modification.

Unit IV **Cell Organelles, Protein Synthesis and Processing**

Ultrastructure of ribosome – endoplasmic reticulum – Golgi complex, mitochondria. Protein synthesis- translational proof reading. Post translational modification - disulfide bond formation, correct folding, assembly into multimeric proteins and protein glycosylation - O-linked and N-linked glycolysation in endoplasmic reticulum.

Unit V **Cell Division**

Cell division and cell cycle: Mitosis and meiosis, their regulation, cell cycle - control -apoptosis and its regulations - characteristics of cancer cells – causes and onset of cancer – metastasis – proto oncogenes - tumour suppressor genes.

Books for Reference

1. De Robertis, E.D.P. and Robertis E.M.F. Cell *and Molecular Biology 9th International Edition,* Mumbai: K.M. Varghese Company, 1988.
2. David M. Prescott Cells – *Principles of Molecular Structure and Function*. USA: Jones and Bartlett Publishers. 1988.
3. Lodish, H., Baltimore D. and Darnell J. *Molecular Cell Biology*. USA : Scientific American Book, Inc.
4. Ajoy Paul.. *Text Book of Cell and Molecular Biology*. Kolkata: Books and Allied (P)

Ltd. Third Edition. 2011.

5. Bhamrah, H.S. *Molecular Cell biology*. New Delhi: Publications Pvt Ltd. 1995
6. David Freifelder. *Essentials of Molecular Biology*. New Delhi: Narosa Publishing House. 1995.
7. Sivarama Sastry, K., Padmanaban G. and Subramanyam. C. *Text Book of Molecular Biology*. New Delhi : MacMillan India Limited. 1994
8. Gerald Karp. *Cell Biology*. McGraw Hill. Second Edition. 1984.
9. Prakash S. Lohar. *Cell and Molecular Biology*. Chennai: MJP Publishers. 2007
10. Gupta M.L and Jangir, M.L. *Cell Biology Fundamentals and Application*. Jodhpur: Saraswati Purchit for Student Edition. 2001
11. Rastogi S.C. *Molecular Biology*. New Delhi : CBS Publishers and Distributors Pvt.Ltd., 2006.

PRACTICALS

Course Code: 21PZOCR1

Hrs / Week : 2 **Credit : 1**

1. Preparation and observation of squamous epithelial cells.
2. Preparation and observation of human blood smear.
3. Preparation and observation of cockroach haemolymph smear.
4. Meiotic cell division in grasshopper testis.
5. Giant chromosome in chironomous larva.
6. Observation of blood smear of frog.
7. Genomic DNA isolation
8. Observation of sarcomere, columnar epithelial cells and ciliated epithelial cells.
9. Observation of different types of tissues : bone, hyaline cartilage, liver, kidney and nervous tissue.

Books for Reference

1. Nagesh Rao K.M.S. *Histology.* New Delhi: CBS Publishers and Distributors. 2007.
2. Shah and Chinoy, N.J. *Essential Techniques in Cell Biology*. Ahmedabad: Anada Book Depot. Educational Publishers. 2007
3. Goswaml, H.K. *Practical Cytology*, *Applied Genetics and Biostatistics*. Bombay: Himalaya Publishing House.1986.

SEMESTER I			
Core II : Genetics and Evolution			
Course Code: 21PZOC12	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Objectives:

- To highlight the importance of genetics and evolutionary significance to the society
- To learn about the genetic recombination of chromosomes, microbial genetics, evolutionary concepts and future evolution of man.

Course outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	examine the chromosomes and genetic recombination and interpret linkage and mapping data	1	Un
CO-2	discuss the theories of crossing over and construction of chromosome map	1	Un
CO-3	infer genetic recombination mechanisms in bacteria and assess the genetic and clinical significance of transposons	2	Un,Ev
CO-4	analyse changes in gene and genotypic changes and evaluate its consequences in populations	6	An, Ev
CO-5	discriminate various human genetic disorders and genetic variations in drug metabolism	4	An
CO-6	provide detailed explanations of neo – Lamarkism, neo – Darwinism, stabilizing and experimental evolution	1 , 6	Un,Cr
CO-7	examine, summarize and integrate central ideas underpinning evolutionary patterns and processes from the molecular to the macro scale	2	Un,Ap,Cr
CO-8	Critically analyse, issues such as speciation mechanisms relating to the formation of species.	2	Un, An

Unit I Chromosomes and Genetic Recombination

Introduction – human karyotype analysis– linkage – comparison of complete and incomplete linkage – Morgan's experiments - theories and molecular mechanism of crossing over – construction of chromosome map – three point test cross (Drosophila), tetrad analysis (Neurospora) - chromosome banding and chromosome paintingtechniques.

Unit II Microbial Genetics

Recombination in bacteria – conjugation – transformation – transduction – sexduction – transposons – families of transposable elements in bacteria. Yeast Ty elements – Drosophila transposons – modes of transposition – genetic, medical and evolutionary significance.

Unit III Population Genetics and Human Genetics

Gene pool concept – gene and genotype frequencies – Hardy – Weinberg equilibrium – algebraic proof- estimation of equilibrium gene frequencies for complete dominance, co-dominance and multiple alleles. Neurodegenerative diseases – Alzheimer's – Huntington's disease – genes in pedigree - dermatoglyphics – diagnostic features – pharmacogenetics – drug metabolism – genetic variation in the effect of drugs – genetic counselling.

Unit IV Evolutionary Concepts

Neo – Lamarkism, Neo- Darwinism - stabilizing, directional and diversifying selection, experimental evidences - modern concepts of recapitulation theory; genetic and non-genetic variations - origin and evolutionary significance.

Unit V Speciation

Species - modes of speciation – sexual selection and co - evolution- Genetic drift-evolutionary significance - isolating mechanisms and their significance – Simpson's adaptive grid concept – micro, macro, and mega evolution – evolution of man – cultural evolution – future evolution.

Books for Reference

1. Strickberger M.W. *Genetics*. 3rd edition, New York: Maxwell Macmillan International Edition 1985.
2. Gardner, Simmons and Snustad. *Principles of Genetics*, 6th edition NewYork: Prentice Hall. Inc. 1991.
3. Klug W.S. and M.R. Cummings. *Concepts of Genetics*. 6th edition New York: Prentice Hall. Inc. 2000.
4. Emmanuel C, IgnacimuthuS. and S. Vincent. *Applied Genetics – Recent Trends and Techniques.* Chennai: JP Publishers 2009.
5. Amita Sarkar. *A Text Book of Human Genetics.* New Delhi: Wisdom Press 2011.
6. Kreb J.E. Goldstein. S. and T. Kilpatrick. *Genes*10th edition. USA: Jones Bartlett Publishers 2011.
7. Ujjwala Deshmukh. *Cytogenetics and Evolution*. New Delhi: Dominant Publishers and Distributors 2005.
8. Gurbacham S. and Miglani. *Essentials of Molecular Genetics*. New Delhi: Narosa Publishing House 2015.
9. Ledyard Stebbins. *Processes of Organic Evolution*. New Delhi: Prentice Hall of India 1970.
10. Ernst Mayr. *Populations, Species and Evolution. An Abridgment of Animal Species and Evolution*. Cambridge: Harvard University press 1970.
11. Dobzshansky, Francis J. Ayala, G. and W. Ledyard Stebbins James. *Valentine Evolution*. Delhi: Surjeet Publications 1973.

PRACTICALS

Hours/Week: 2 **Course Code: 21PZOCR1** **Credit: 1**

1. Construction of genetic map for a given three point test cross.
2. Preparation of culture medium of Drosophila
3. Tracing the stages in the life cycle of Drosophila.
4. Observation of common mutants of Drosophila
5. Survey of simple Mendelian traits and ABO blood group in the class population and estimation of gene and genotype frequencies based on Hardy – Weinberg law.
6. Demonstration of role of random genetic drift in small populations using simulation (beads)
7. Analysis of dermatoglyphicdata (finger print) of the class population.
8. Construction of pedigree
9. Bacterial conjugation (chart).
10. Industrial melanism- Peppered moth

Books for Reference

1. Michael Breitenback. *Experimental Genetics I– biophysics*. *shg. ac /at/ home.htm*1997.

2. William. D. Stansfield. Schaum's Outline Series. *Theory and Problems of Genetics. Second Edition.* USA: McGraw Hill Book Company 1977.

SEMESTER –I			
Core III – Biochemistry			
Course Code: 21PZOC13	**Hrs/ Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Unit I **Atoms and Molecules**

Structure of an atom, chemical bonds (ionic, covalent and hydrogen). Structure and properties of water. Vanderwaals interaction, role of water in life. pH and buffers - Weak acids and alkalies, Henderson and Hasselbalch's equation - Biological buffer system.

Unit II **Carbohydrates**

Classification – structure – properties and functions of carbohydrates. Metabolism: glycolysis – TCA cycle – energy budget of glucose oxidation – glycogenolysis – glycogenesis – gluconeogenesis – HMP shunt pathway.

Unit III **Protein**

Classification – structure – properties and functions of amino acids – classification – properties and functions of proteins – metabolism of proteins – metabolism of tryptophan – phenylalanine – tyrosine - Inborn errors of metabolism (Phenylketonuria and Hartnup's disease).

Unit IV **Lipid**

Classification – Biological importance of simple lipids (Triglycerides and Wax), compound lipids (phospholipids and glycolipids) and derived lipids (saturated, unsaturated and cholesterol) – β oxidation, ketogenesis – biosynthesis of fatty acids – disorders of fat metabolism (hypercholestrolemia, hyperlipoproteinemia and atherosclerosis). Role of liver in fat metabolism.

Unit V **Enzymes and Nucleic acids**

Nomenclature – classification – properties – functions and mechanism of enzyme action and its regulation – coenzyme, isoenzyme. Nucleic acids, chemistry of nucleic acids, structure, biosynthesis and degradation, purine and pyrimidine nucleotides and disorders of their metabolism (Gout, Severe combined immunodeficiency, Orotaciduria and Thymidine phosphorylase deficiency).

Text Book:

1. Ambika Shanmugam, *Fundamentals of Biochemistry for Medical Student*s, Madras: Navabharat Printers and Traders, 2012.
2. Pankaj Naik, *Biochemistry for Medical Students* NewDelhi: 4th edition, Health Science Publishers, 2016.
3. Jain J.L, Sunjay Jain, Nitin Jain, *Fundamentals of Biochemistry*, New Delhi: S. Chand& Company, 2007.
4. Styer L.W.H, *Biochemistry*, San Francisco: Freeman & Company, 1995.
5. Murray R.K., Gaaner D.K, Mayer P.A and V.W. Rodwell. *Harper's Biochemistry*, Tokyo: 24th edition. Prentice Hall of Japan, Inc, 1996.
6. Rastogi S.C, *Biochemistry*, New Delhi: Second Edition. Tata Mc Graw Hill Publishing Company Ltd., 2003.
7. Satyanarayana U and U. Chakrapani. *Biochemistry*, Haryana and Kolkata : Fourth Edition. Elsevier & Allied. 2014.
8. Edward Staunton West, Wilbert R. Todd, Howard S. Mason, John T. Van. Bruggen, *Biochemistry*, New Delhi: Fourth edition. Oxford and IBH Publishing Co. 1966.
9. Bernard L. Oser, *Hawk's Physiological Chemistry*, New Delhi: 14th edition. Tata Mc Graw Hill Publishing Company Ltd.1965.
10. Chatterjee M.N, *A Textbook of Biochemistry*. New Delhi: Jaypee Brothers, Medical Publishers Pvt Ltd. 2010.
11. Lehninger, A. *Principles of Biochemistry*, New Delhi: CBS Publishers & Distributers, 1993.

SEMESTER I			
Core IV	**Applied Entomology**		
Course Code: 21PZOC14	**Hrs/ Week : 5**	**Hrs/ Sem: 75**	**Credits: 4**

Objective:

- To explore the richness and significance of insects.
- To impart knowledge on the beneficial and harmful effects of insects and to familiarize them with effective control measures

Course outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know about the diversity of insects, classify and state their major different orders	1	Un
CO-2	develop skills for collecting, mounting and preserving insects	1, 6	Cr
CO-3	acquire knowledge on beneficial insects, helpful insects and insects of medicinal and aesthetic value	1	Un
CO-4	analyze the main pest species of crops based on the symptoms of the attack and morphological traits	2	An
CO-5	explain the life cycle of main pest species on crops and insect vectors	2, 1	Un
CO-6	identify, collect and manage different insects of importance to household, man and animals.	4, 6	Ap
CO-7	apply appropriate indirect and direct measures to prevent or reduce pest attack	5, 7	Ap
CO-8	plan and implement crop protection according to the IPM principles	4, 8	Ev, Cr

Unit I Insect Taxonomy

Introduction – principles of classification – Imm's classification down to orders with their diagnostic characters of any ten significant orders – methods of collection, killing and preservation of insects.

Unit II Beneficial Insects

Productive insects – economic value of products of honey bee, silk worm and lac insect - helpful insects – insect pollinators, scavengers - insects as protein sources of human and animal feeds, medicinal uses of insects, weed killers, Forensic Entomology.

Unit III Harmful Insects

Insect pests - general characters, damage, symptoms, bionomics and control measures of any three important pests of paddy (paddy stem borer, rice gall midge, rice swarming caterpillar), sugarcane (sugarcane stemborer, sugarcane leaf hopper, cane white fly) and coconut (leaf caterpillar, red palm weevil, rhinoceros beetle) – pests of stored products – Internal feeders (rice weevil, cigarette beetle) – External Feeder (Red Flour beetle, Indian meal moth).

Unit IV Medical Entomology

Insects in relation to public health –Direct effect: annoyance, dermatosis, myiasis, envenomization, allergic reaction and entomophobia. Indirect effects: host pathogen interactions: common insects of medical importance - life cycle and control measures – mosquitoes (Anopheles and Aedes), housefly, human louse - vector borne disease: dengue, malaria, chikungunya, filariasis and sleeping sickness.

Unit V Pest Management

Methods of pest control - natural, cultural, mechanical, legal, biological and chemical (organic and inorganic compounds – synthetic pyrethroids). Recent trends in pest control: Biointensive integrated pest management, hormones, pheromones, anti-feedants, sterile

insect technique - insect viruses - modern trends in pest control - integrated pest management (IPM).

Books for Reference

1. Fenemore, P.G. and B. Prakash. *Applied Entomology.* New Delhi: Wiley Eastern Ltd.1997.
2. Tembhare. D.B. *Modern Entomology.* New Delhi: Himalaya Publishing House. 2017.
3. Nalina Sundari, M.S. and R. Shanthi. *Entomology.* Chennai: MJP Publishers. 2006.
4. Abishek Shukla. *Economic Entomology*. New Delhi: Daya Publishing House. 2009.
5. Sandhya Agrawal. *Applied Entomology*. Jaipur, India: Oxford Book Company. 2009.
6. Ravindran K.R. *A Text Book of Economic Zoology*. New Delhi: Wisdom Press. 2013.
7. Sathe, T.V., Satha, A.T. and Jagtap. *Mahendra. Mosquito Borne Diseases*. New Delhi: Mangalam Publishers & Distributers. 2011.
8. Saxena, R. C. and R.C. Srivastava. *Entomology.* Udaipur: Agrotech Publishing Academy, 2007.
9. David, B.V and T.N. Ananthakrishnan. *General and Applied Entomology.* Bangalore: Mc Graw Hill Education, 2004.
10. Vasanthraj David B. and V.V. Ramamurthy. New Delhi: Elements of Economic Entomology. Brillion Publication. 2016.

PRACTICALS

Course Code: 21PZOCR2

Hrs/ Week: 2 **Credit: 1**

1. Identification and classification of common insects – butterfly, grasshopper, stick insect, leaf insect, beetle.
2. Mounting– Honey bee (mouthparts, sting and pollen basket), Mosquito (mouthparts)
3. Submission of insect box with minimum 10 insects.

   Spotters (Museum specimen/ Slide) :
4. Beneficial insect - Honey bee colony and their product (honey)
5. Beneficial insect - Silk moth – life stages, silk
6. Any three insect pests and their damages – one pest on each crop paddy, coconut, sugarcane.
7. Life history of the insect vector – House fly
8. Life history of the insect vector – Mosquito

9. Any two household insects – bed bug, silverfish
10. Any two ectoparasites – human head louse, flea

Books for Reference

1. Vasantharaj David B. *Elements of Economic Entomology*. Chennai: Popular Book Depot. 2001.
2. Nayar, K.K., Vasantharaj David, B, and T.N. Ananthakrishnan. *General and Applied Entomology.* New Delhi: Tata Mc Graw Hill Publishing Company Ltd. 2004.
3. Fenemore, P.G. and Alka Prakash. *Applied Entomology*. New Delhi: New Age International Publishers. 2006.

SEMESTER II			
Core VI : Immunology			
Course Code: 21PZOC22	**Hrs /Week : 5**	**Hrs / Sem: 75**	**Credits : 4**

Objectives:

- To understand the fundamentals of immunology and key principles of immune System.
- To impart knowledge on the structure and functioning of immune system and how it relates to health and disease.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	C L
CO-1	analyse the genetic basis of antibody diversity, organization and arrangement of immunoglobulin genes	1	An
CO-2	understand the principle of the routine serologic procedures performed in the clinical laboratory.	1, 2	Un
CO-3	describe the structure and function of MHC molecules and the immunologic responses involved in preventing and combating infections	1	Un
CO-4	describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity	1, 4	Un
CO- 5	describe immunological response and how it is triggered and regulated	1	Un
CO -6	transfer knowledge of Immunology into clinical decision – making	5	Ev
CO-7	elaborate the role and advances being made in transplantation with artificial organs and the aberrations of the immune system such as infections and autoimmunity	1, 6	Cr
CO- 8	discuss the modern laboratory techniques applicable in the diagnosis and monitoring of diseases involving the immune system.	6	Cr

Unit I Immunoglobulin Genes- Organisation and Expression

Scope- structure of Immunoglobulin (IgG) - Genetic model for Immunoglobulin structure - germ line and somatic variation – Dryer and Bennett two gene model organization of Immunoglobulin (Ig) genes. Gene rearrangements in variable region - mechanism of variable region DNA rearrangements - generation of diversity – class switching.

Unit II Antigen- Antibody Responses

Antigen - Antibody reactions: Salient features of antigen antibody reaction. Detection of antigenantibody reaction - precipitation - single radial immunodiffusion – doubleimmunodiffusion –immunoelectrophoresis – rocket immune electrophoresis - immunofluorescence. Agglutination: haemagglutination- bacterial agglutination- passive agglutination- agglutination inhibition test - ELISA.

Unit III Immunobiology

Hypersensitivity: Types – Type I Anaphylaxis – Type II Antibody dependent cytotoxicity – Type III Immune complex mediated disease – Type IV Delayed type hypersensitivity and Type V Stimulatory hypersensitivity- factors causing hypersensitivity- Major Histocompatibility Complex - MHC products – structure, distribution and functions - clinical importance of HLA - HLA typing - HLA paternity testing - HLA and diseases.

Unit IV Infection and Immunity & Defects in immunity

Immune response to pandemic virus infections - role of innate immunity in controlling viral infection – adaptive immune responses to viral infection- examples of pandemic virus infections (Influenza virus and corona virus). Autoimmunity – causes of autoimmune diseases - organ specific and systemic autoimmune diseases – diagnosis and treatment.

Unit V Clinical Immunology

Tumour immunology– tumour antigens - natural immunity to tumours – T cell mediated immunity to tumours - therapeutic approaches to cancer - immune surveillance.Transplantation immunology - types of grafts - mechanism of graft rejection - graft versus host reaction –immune suppression - prevention of graft rejection. Vaccine – types – live attenuated vaccine and inactivated killed vaccines – Vaccination schedule.

Books for Reference

1. Catherine Sheehan. *Clinical Immunology*. *Principles and Laboratory Diagnosis*. Philadelphia: Wolterskluwer Company 1997.
2. David Male, Brian Champian and Annie Cooke. *Advanced Immunology*. Philadelphia: J.B. Lippincott Company, Gower Medical Publishing 1987
3. Emil R. Unanue and Baruj Benacerraf. *Text Book of Immunology*. *II Edition.* London: Williams and Wilkins 1984.
4. Ivan M. Roitt. *Essential Immunology*. Oxford: Blackwell Scientific Publications 1994.
5. Joshi K.R and Osamo N.O. *Immunology*. India: Agro Botanical Publishers1994.
6. Mary S. Leftfel, Albert D. Donnenberg and Noel R. Rose. *Hand Book of Human Immunology.* New York: CPC Press 1997.
7. Vamen Rao C. *Immunology*. New Delhi: Narosa Publishing House 2011.
8. Rastogi, S.C. *Essentials of Immunology*. New Delhi: CBS Publishers and Distributors 2002.
9. Talwar G.P. and Gupta S.K. *A Hand Book of Practical and Clinical Immunology.* Delhi: CBS Publishers and Distributors 1993.
10. Yadav P.R. *Immunology.* New Delhi: Discovery Publishing House 2004.
11. SurendraNaha. *Fundamentals of Immunology*. New Delhi: Dominant Publishers Pvt. Ltd 2012.
12. Sudha Gangal and Shubhangi Sontakke. *Textbook of Basic and Clinical Immunology*. Hyderabad: Universities Press (India) Pvt. Ltd 2016.

PRACTICALS

Hrs/Week - 2 **Course Code: 21PZOCR3** **Credit - 1**

1. Radial Immunodiffusion.
2. Double Immunodiffusion.
3. Haemagglutination.
4. Direct Agglutination - ABO blood grouping.
5. Rh - Typing.
6. Immunoelectrophoresis.
7. ELISA - Demonstration.
8. Isolation of lymphocytes and enumeration.
9. HLA typing.
10. Lymphoid organs in rat (spotter)

Books for Reference

1. Rabindra Narain, *Practical Immunology*. New Delhi: Wisdom Press, 2012.

2. Talwar G and S. K. Gupta. *A Handbook of Practical and Clinical Immunology.* Vol. 1 Second Edition. Delhi: CBS Publishers & Distributers 1992.

SEMESTER III			
Core IX	**Computational Biology**		
Course Code: 21PZOC31	**Hrs/ Week: 6**	**Hrs/ Sem: 90**	**Credits: 4**

Objectives

- To understand the central principles and concepts of computational methods, tools and algorithms for biological data analysis and interpretation
- To impart interdisciplinary expertise in biological science, computer science and mathematics

Course Outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand descriptive and inferential statistical methods effectively	1,3	Un
CO-2	apply the methods of hypothesis testing, statistical inference and designing experiments	4	Ap
CO-3	analyse and interpret the biological data in a statistical perspective correctly and contextually	4	An
CO-4	infuse critical appraisal skills to assess the research data and produce original research	7	Cr
CO-5	carryout correlation and regression analysis and recognize theoretical distributions	6	An
CO-6	Formulate and test using appropriate statistical tools and softwares	4	Cr
CO-7	convert biological data into computational problem and execute quantitative analysis	5	Ap
CO-8	Demonstrate the mastery of concepts of skills for biological data management, analysis and graphical presentation	1,2	Ap

Unit I Biostatistics – Descriptive Statistics

Introduction – measures of central tendency - arithmetic mean, geometric mean, harmonic mean, median and mode – measures of dispersion – range, quartiles, mean deviation, variance, standard deviation, standard error and coefficient of variation – measures of skewness and kurtosis – stem and leaf diagram – boxplot.

Unit II Inferential Statistics

Theoretical probability distributions – binomial – Poisson – normal distribution – steps in hypothesis testing procedure – student's t – test and its applications in experimental biology – chi – square test – goodness of fit and contingency tables – ANOVA – assumptions – types – one-way and two-way – factorial design and randomized block design.

Unit III Correlation and Regression

Correlation – types – methods of determining correlation - graphical methods – mathematical methods – Computation and interpretation of Karl Pearson's correlation coefficient – coefficient of determination - Spearman's rank correlation coefficient – regression – types – regression lines and their properties – algebraic method of fitting linear regression equations and forecasting – relationship between correlation and regression coefficients.

Unit IV Computer Applications

MS Excel – spread sheet – statistical analysis of data - calculation of arithmetic mean – t test – ANOVA one-way classification – statistical packages – GenStat – statistical calculation – SPSS package – Principal Component Analysis (PCA).

Unit V Bioinformatics

Nucleic acid databases - DDBJ – protein sequence databases - NBRF – PIR and PSD - database similarity searches – Smith – Waterman algorithm – Needleman – Wunsch algorithm – scoring matrices-PAM and BLOSUM – multiple sequence alignment – sum of pair-wise method and progressive method – Phylogenetic trees – structure, construction and interpretation.

Books for Reference

1. Gurumani N. *An Introduction to Biostatistics*. Chennai: MJP Publishers, 2nd Edition, Triplicane, 2005.
2. Agarwal S.K. *Bioinformatics.* New Delhi: APH Publishing Corporation, 2008.
3. Gautham N. *Bioinformatics - Databases and Algorithms*. New Delhi: Narosa Publishing House Pvt Ltd., 2009.
4. Thiagarajan B. and Rajalakshmi Pa. *Computational Biology.* Chennai: MJP Publishers, 2009.
5. Rajathi A and Chandran P. *SPSS for you*. Chennai: MJP Publishers, 2010.
6. Claverie J M. and Notredame C. *Bioinformatics for Dummies.* 2nd edition, Hoboken: Wiley Publishing Inc, NJ07030-5774, 2007.
7. Pezzullo J.C. *Biostatistics for Dummies.* Hoboken: John Wiley & Sons Inc., NJ07030-5774, 2013.
8. Khan I and Khanum A. *Introductory Bioinformatics*. Hyderabad: Ukaaz Publications, 1st edition, 2004.

PRACTICALS

Course Code: 21PZOCR5

Hrs/ Week: 2 **Credit: 1**

1. Computation of mean, median, mode, variance, standard deviation, standard error and coefficient of variation for biological variables.
2. Display of data through stem and leaf diagram.
3. Test of significance using student's t – test.
4. Test of goodness of fit of data with the aid of chi – square test.
5. Analysis of variance of molluscan shells
6. Correlation coefficient between height and weight of students and length and width of leaves.
7. Fitting regression equations for two variables and prediction of values.
8. Statistical calculation (ANNOVA) using SPSS software package (version: 1.0.0.1406).
9. Multiple sequence alignment using Smith – Waterman algorithm
10. Construction of phylogenetic tree.

Books for Reference

1. Gurumani N. *An Introduction to Biostatistics*. Triplicane, Chennai: MJP Publishers, 2nd edition, 2005.
2. Rajadurai M. *Bioinformatics – A Practical Manual*. Chennai: PSB Book Enterprises, 2010.

SEMESTER II			
Core VIII	**Microbiology**		
Course Code: 21PZOC24	**Hrs/ Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objective

- To prepare graduate students with thorough knowledge and understanding of the core concepts in the field of Microbiology.
- To equip the students with knowledge about taxonomy, organization, multiplication and infection of microbes and to develop expertise in microbiological techniques.

Course Outcome :

CO. NO	**Upon completion of this course, the students will be able to**	**PSO addressed**	**CL**
CO- 1	classify microorganisms focusing on the modern trends of Taxonomy	1	Un
CO- 2	prepare media to be utilized in the cultivation of microorganisms	2	Ev
CO-3	understand the structural organization and life cycle of microorganisms	2	Un
CO-4	explain the role of microorganisms in fermentation, medicine and the production of microbial products	2	Ev
CO-5	gain familiarity with the unique role of pathogens in human infectious diseases	2	Un
CO-6	identify the methodologies used in disease treatment and prevention	6	An
CO-7	demonstrate practical skills in the use of technologies and methods common to microbiology	8	Ev
CO-8	apply scientific methods in the design and execution of experiments	8	Ap

Unit I Classification

Classification of microorganism – Five Kingdom concept. Modern trends of bacterial taxonomy - ribosomal RNA and sequencing - construction of phylogenetic tree. General characters of main groups of microorganisms – analysis based on Bergey's Manual of Determinative Bacteriology (biochemical tests).

Unit II Cultivation of Microorganisms

Preparation of culture media – isolation and maintenance of pure culture - cultural and morphological characteristics of bacteria, fungi – microscopic examination of microorganisms - Gram staining - acid fast staining – spore staining - capsular staining – flagellar staining.

Unit III Microbes – Structural Organization

Structural organization of bacteria – structure of *E. coli*, virus – plant virus – Tobacco Mosaic Virus, animal virus – adenovirus - bacteriophage and fungi – yeast, penicillium - life cycle of Actinomycetes and yeast.

Unit IV Production of Microbial Products

Yeast fermentation and its products – production of alcohol, beer and wine. Mixed fermentation product - production of vinegar. Production of antibiotics - penicillin and tetracycline.

Unit V Microbial Diseases

Protozoan diseases - ameobiais and leishmaniasis. Bacterial diseases- diphtheria, tetanus and gonorrhea. Viral diseases - corona virus, dengue fever, rabies and ebola. Fungal diseases - actinomycosis, aspergillosis, ringworm and candidiasis.

Books for Reference

1. Arti Kapil. *Text Book of Microbiology*. Hyderabad: University press 9th Edition. 2016
2. Dubey R .C and D.K. Maheswari. *A Text Book of Microbiology.* New Delhi: S. Chand & Co. 2006
3. Roger Stainer, John Lingraham, Mark I Wheelis and Page R. Painter. *General Microbiology.* London: Mac Millan, Hampshire 1992.

4. Pelzer Chan and Krieg. *Microbiology.* New Delhi: Tata Mc Grow Hill Publishing Company, 2nd Edition 1998.
5. Wulf Crueger and Annellese Crueger. Biotechnology: *A Textbook of Industrial Microbiology*. New Delhi: CBS Publishers and Distributors, 3rd Edition. 2016.
6. Presscott Harley and Klein. *Microbiology.* New York: WCB Mc Graw Hill Co. 2005
7. Purohit S.S. *Microbiology – Fundamentals and Application*. India: M/S Saraswathi Publication, 1991
8. Power C.B and K.F. Daginawala. *General Microbiology*. Vol I & II. Himalaya Publishing House, 1988.
9. Ramesh. *Food Microbiology.* Chennai: MJP Publishers. 2007
10. Casida, J.R. Industrial Microbiology. New Delhi: New Age International Pvt. Ltd., 2nd Edition 2015
11. Ananthanaryanan, R and J. Panikar. *Text Book of Microbiology*, Chennai Anna Salai : Orient Longman Private Ltd., 160, 7th Edition. 2006.

PRACTICALS

Course Code 21PZOCR4

Hrs / Week : 2 **Credit: 1**

1. Sterilization Techniques
2. Sample handling for microbial studies
3. Preparation of culture media:

   Nutrient broth, Nutrient agar, Potato dextrose agar, Mullen- Hinters agar
4. Counting of viable cells (CFU/ ml) by serial dilution & spread plate or pour plate methods
5. Pure culture techniques - Streaking and spread plate methods.
6. Spore staining
7. Simple biochemical tests of bacteria
   a. Acid and gas production in glucose broth
   b. Starch hydrolysis
   c. Catalase
   d. Nitrate reduction
8. Dye reduction test in milk

9. Test for antibiotic sensitivity - Kirby Bauyer disc diffusion test

10. Isolation of symbiotic nitrogen fixing bacteria from root nodules

11. Observation of algae and fungi

Books for Reference:

1. Kannan N. *Laboratory Manual in General Microbiology* Palani: Palani Paramount Publications, 1996.
2. James Cappuccino and Natalie Sherman. *Microbiology: A Laboratory Manual*. Addison –Wesly - Hyman Inc,1990.
3. Dubey R.C. and D.K. Maheswari. *Practical Microbiology*. New Delhi: S Chand & Company Ltd. 2008.

SEMESTER III			
Core XI - Developmental Zoology			
Course Code: 21PZOC33	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Objectives :

- To understand the sequential changes in the development and organization of an embryo
- To acquire knowledge about the metamorphosis, regeneration and role of genes in development

Course Outcomes

CO. No	**upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	define the process of gametogenesis and describe the structure of gametes	**1**	**Kn,**
CO-2	outline the events that lead up to and comprise the process of fertilization	**1, 2**	**Un**
CO-3	compare and contrast the patterns of cleavage in the various model organisms	**2**	**An**
CO-4	discuss the morphogenetic movements, cellular mechanisms and the functions of gastrulation	**2**	**Cr**
CO-5	explain tissue interactions and the development of organ systems in vertebrates	**3**	**Cr**
CO-6	analyse the role of genes in development, aging and senescence	**5**	**An**
CO-7	experiment with the role of hormones in amphibian and insect metamorphosis	**4, 6**	**Ap**
CO-8	determine the ability of regeneration in different groups of organisms	**4, 6**	**Ev**

Unit I **Gametogenesis and Fertilization**

Gametogenesis – spermatogenesis – oogenesis. Structure of gametes - sperm and egg of sea urchin and mammal – types of egg- Fertilization (biochemical, molecular aspects) in sea urchin and mammal- prevention of polyspermy. Parthenogenesis.

Unit II **Cleavage and Gastrulation**

Planes and patterns of cleavage – cleavage in sea urchin, drosophila, frog, bird and mammal. Mechanism of cleavage. Fate map of sea urchin and frog. Gastrulation – morphogenetic movements - gastrulation in sea urchin and frog.

Unit III **Organogenesis**

Derivatives of ectoderm, mesoderm and endoderm. Organogenesis in vertebrates - CNS, eye, heart, kidney, digestive tube and its derivatives-Development of extraembryonic membranes in chick. Placentation in mammals - types and physiology.

Unit IV **Role of Genes in Development**

Genomic equivalence – differential gene expression – amplified genes – selective gene transcription – control of gene expression. Programmed cell death in development – Aging and senescence.

Unit V **Metamorphosis and Regeneration**

Metamorphosis – definition - insect metamorphosis - moulting and metamorphic changes - hormonal control of insect metamorphosis. Amphibian metamorphosis – morphological, physiological, biochemical change and causation of metamorphosis. Regeneration – patterns – morphollaxis - epimorphosis and heteromorphosis – regeneration ability in different group of organisms - mechanism of limb regeneration in amphibian.

Books for Reference

1. Michael J.F. Barresi, Scott F. Gilbert. *Developmental Biology*. USA: OUP USA, 9th Edition. 2010
2. Wendell Smith, C.P., Williams,P.L. and Sylvia Tread Gold. *Basic Human Embryology*. Great Britain: ELBS Edition. Pitman Publishing Ltd., 1996.
3. Banerjee, S. *A Text Book of Developmental Biology*. New Delhi: Dominant Publishers and Distributors, 2015

4. Lewis Wolpert and Cheryll Tickle. *Principles of Development*. New Delhi: Oxford University Press, Fourth Edition . 2018
5. Verma, P.S, Agarwal, V.K. and B.S. Tyagi. *Chordate Embryology*. New Delhi: S.Chand & Company Ltd, 14th Edition. 2010.
6. Sanjib Chattopadhyay. *An Introduction to Developmental Biology*. Kolkata: Books and Allied (P) Ltd., First Edition. 2017.

PRACTICALS

Hrs / Week : 2 **Credit: 1**

Course Code: 21PZOCR6

1. Mounting of chick blastoderm.
2. Study of effect of thyroxin in amphibian metamorphosis
3. Study of regeneration in the tail of tadpoles
4. Culture of Drosophila
5. Observation of sperm, egg, T. S. of testis and T.S. of ovary of frog.
6. Observation of sperm, egg, T.S. of testis and T.S. of ovary of mammal.
7. Observation of developmental stages of frog - cleavage, blastula, gastrula external gill stage and tadpole stages
8. Observation of chick embryos – 24 hrs, 48 hrs, 72 hrs, 96 hrs.
9. Types of placenta in mammals (one eg. in each type).

Books for Reference.

1. Verma, P.S, Agarwal, V.K. and B.S. Tyagi. *Chordate Embryology*. New Delhi: S.Chand & Company Ltd, 14th Edition, 2010.
2. Verma P. S.*A Manual of Practical Zoology Chordates.* New Delhi : S. Chand and Company Ltd, First Edition, 2007.
3. Balinsky B.I. 1976. *An Introduction To Embryology*. Japan: B.W. Saunders Company, U.S.A and Toppan Company Ltd., Fifth Edition, 2012.

SEMESTER IV			
Core XIII	**Marine Biotechnology**		
Course Code: 21PZOC41	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives

- To impart knowledge of biotechnological applications of marine organisms among the students.
- To provide an excellent education emphasizing the important processes and impacts on the marine ecosystems and ways to control them.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	recall different zones of the sea	2	Un
CO-2	understand the physical and chemical properties of seawater and its impact on ocean life	5	Un
CO-3	identify and classify marine planktons based on their characteristics	3	An
CO-4	classify the flora and fauna of estuaries, mangroves and salt marshes and their adaptations	1	An
CO-5	analyse the role of microbes in recycling of nutrients	3	An
CO-6	explain the aspects of marine pollution and its impact on marine life	5	Un
CO-7	appraise the complexity and diversity of resources in the marine environment	4	Ev
CO-8	develop skills in a range of theoretical and practical applications on bioactive substances	6	Cr

Unit I Marine Habitat

Classification of marine habitat, plankton – classification and adaptations. Intertidal rocky, sandy and muddy shores – the features of fauna and adaptations. Marine microbes (bacteria, viruses and fungi).

Unit II Marine Ecosystems

Estuaries, mangroves, coral reef – ecology and types, species interaction and adaptations. Conservation of Gulf of Mannar Biosphere Reserve. Role of microbes in the sea: recycling of nutrients – nitrate, phosphate and sulphate.

Unit III Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil and thermal pollutions. Biotechnology in marine pollution control.

Marine bioremediation - microplastics.

Unit IV Microbial Action in the Marine Environment

Biofouling – biofoulers – micro and macro foulers – impact of biofouling in maine environment and prevention. Biodeterioration: agents and protective methods.

Corrosion – mechanism and prevention.

Unit V Wealth of the Sea

Mineral wealth – petroleum, manganese nodules, beach placers, glauconite and garnet. Bioprospecting of marine resources - bioactive compounds from marine organisms (bacteria, fungi micro, macro algae and sponges). Sea-ranching of economically important marine organisms – crustaceans and molluscs.

Books for Reference

1. Bimla Singh. *Marine Biotechnology and Aquaculture Development*. Delhi: Vista International Publishing House. 2006.
2. Girish Chopra. *Coastal and Marine Geography*. Delhi: Common Wealth Publisher. 2012.
3. Gross G. *Oceanography: A view of the Earth*. New Jersey: Sixth edition. Prentice Hall Inc. 2008.
4. Mc Cormick J.M. and J.V. Thiruvathaakal. *Elements of Oceanography*. Philadelphia: W.B. Saunders Company. 1981.
5. Nybakken J.W. *Marine Biology – An Ecological Approach*. California: Addison Weslay Longman, Inc. 1997.
6. Olivia J. Fernando. *Sea water-Properties and Dynamics*. Thanjavur: Dhanesh Publications. 1999.
7. Frank E. Firth. *The encyclopedia of marine resources*. New York: Van Nostrand Reinhold Company.1969.
8. Veena. *Understanding Marine Biology*. New Delhi: Discovery Publishing House Pvt. Ltd. 2012.
9. Atlas R.M. and Bartha. M. *Microbial ecology- Fundamentals and Applications*. California: Benjamin- Cummings. 2003.
10. Vijaya Ramesh K. *Environmental Microbiology*. Chennai: MJP Publishers. 2004.
11. Moshrafuddin Ahamed and Basumatary S.K. *Applied Microbiology*. Chennai : MJP Publishers. 2006.
12. Tait R.V. and F.A. Dipper. *Elements of Marine Ecology*. Great Britain: British Library Cataloguing in Publication Data. 4th edition 1998.

PRACTICALS

Course Code: 21PZOCR7

Hours/ Week : 2 **Credits : 2**

1. Determination of acidity

2. Estimation of salinity

3. Determination of alkalinity

4. Estimation of total dissolved solids

5. Determination of nitrite

6. Estimation of phosphate

7. Collection and identification of marine plankton (any three phyto and zooplankton)

8. Identification and comments on the following

   i. Plankton net

   ii. Inter-tidal organisms

   a. Rocky shore: Sea anemone, Chiton
   b. Muddy shore: Uca, Cerithidia
   c. Sandy shore: Arenicola, Murex

   iii. Biofouling

   iv. Corrosion

9. Analysis of buckle canal sample (TDS/ Microbial load)

10. Visit to mangroves / estuaries / marine environment

Books for Reference

1. Strickland and Parsons. J.D.H. *A Practical Handbook of Seawater Analysis*, Canada: Bulletin 167, Fisheries Research Board of Canada. Second Edition 1972.

2. Kiewood Maff, D. *ICES* T*echniques in Marine Environmental Sciences*. Denmark: International Council for the Exploration of the Sea, 1987.

SEMESTER IV			
Core XIV	**Conservation Biology**		
Course Code: 21PZOC42	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Objectives

- To create environmental awareness among students.
- To inculcate knowledge about the natural resources, biodiversity their conservation and efforts towards their sustainability.
- To generate concepts of prediction, prospecting, preservation and restoration of dwindling natural resources.

Course Outcome

CO. No.	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	infer the problems of unsustainable development	1	Un
CO-2	justify that human survival depends on developing practices that will achieve sustainable systems	3	Ev
CO-3	explore the biological, sociological and legislative perspectives for the management of flora and fauna to conserve wildlife.	5	An
CO-4	evaluate the importance of natural resources on conservation of biodiversity	3	Ev
CO-5	analyse the conservation management of various resources	3	An
CO-6	gain knowledge on values and threats of biodiversity	2	Ap
CO-7	learn the role of various organization in conservation of biodiversity	6	Un
CO-8	apply scientific principles and modern technologies to resolve problems in disaster management	8	Ap

Unit I Environment–Sustainable Development

Environmental ethics, issues - possible solutions - from unsustainable to sustainable development; Environmental Protection Act (1986) - Forest Conservation Act (1980), Wildlife (Protection) Act of Government of India (1972).

Unit II Conservation of Forest and Water Resources

Forest resources: Use and overexploitation – deforestation - timber extraction – mining - dams and forests – tribes. Conservation of forest.

Water resources: Use and over exploitation of ground water – surface water – conflicts over water – dams – benefits and problems - conservation of water.

Unit III Conservation of Land and Energy Resources

Land resources: Land as a resource – land degradation – soil erosion and desertification – conservation of soil.

Energy resources: Growing energy needs – renewable and non-renewable energy sources – use of alternate energy source.

Role of individual in conservation of natural resources.

Unit IV Biodiversity and Conservation

Biodiversity - values of biodiversity - threats to biodiversity – hot spots – biosphere reserve. *In-situ* conservation - *ex-situ* conservation - role of organizations in conservation **-** NBPGR, BSI, ZSI, WWF, IUCN - Ramsar Convention.

Unit V Disaster Management

Climate change – global warming

Causes, impact and management of earthquakes – cyclone – wildfires – landslide – flood – drought - disaster management system (DMIS).

Books for Reference

1. Dhulasi Brindha, V. *Environmental Studies*. New Delhi : Allied Publishers Pvt. Ltd. 2004.
2. Veer Bala Rastogi and M.S. Jayaraj. *Animal Ecology and Distribution of Animals*. Delhi: Kedarnath Ramnath, Meeruti.2009.
3. Agarwal, A.C. *Environmental Biology*, Bikaner : Agro Botanical. 1999.

4. Anjaneyalu, Y.B. *Introduction to Environmental Science*, Hyderabad: SPBS. Publications. 2004.
5. Kormondy Edward J. *Concepts of Ecology.* India: Prentice Hall Pvt. Ltd. 1994.
6. Odum, E.P. *Basic Ecology.* Saunder: CBS College Publishing. 1983.
7. Anubha Kaushik and C.P. Kaushik. *Environmental Science and Engineering*. NewDelhi: New Age International (P) Publishers. 2007.
8. Ravi Krishnan, A. *Environmental Science and Engineering*. Chennai: Sri Krishna Publications. 2010.
9. Saha, T.K. *Ecology and Environmental Biology*. Kolkatta: Books and Allied (P) Ltd. 2008.

PRACTICALS

Course Code: 21PZOCR8

Hrs/ Week: 2 **Credit: 1**

1. Estimation of population density using Quadrat method
2. Population density study – Mark and Recapture method
3. Chart – Rare, Threatened, Endangered and Extinct species
4. Mapping of National Parks in India with a note on important fauna
5. Mapping of Wild Life Sanctuaries in India with a note on important fauna
6. Renewable Energy Resources – Wind Energy
7. Case Study on Man Animal Conflict
8. Red Data Book
9. Shannon Wiener Index
10. Visit to an ecologically important place – National parks, Sanctuaries.

Books for Reference

1. Gareth Williams. *Techniques and Field work in Ecology*. Bell & Hyman Ltd. London. 1987.

2. Jaya Surya, Arumugam. N, Dulsy Fatima, Meyyan, R.P., Prasannakumar, S., Mani, A., Mariakuttikan, A., Narayanan, L.M., Nallasingam, K., Kumaresan, V. and A.M. Selvaraj. *Practical Zoology Vol-3*. Saras Publication, Nagercoil. 2013.

SEMESTER III	
Self Study Course **Zoology for Competitive Examination**	
Course Code: 21PZOSS1	**Credit: +2**

Objectives

- To motivate the students appear for high level competitive exams
- To make students competent to face the examinations effectively.
- To provide in-depth knowledge on different fields of Zoology which are vital for any competitive examination.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	gain knowledge about the systematic position of the organisms.	1	Un
CO-2	able to identify the different species based on their salient features	6	An
CO-3	acquire in depth knowledge on biomolecules and relate the various physiological mechanisms prevailing in the organism	3	An
CO-4	analyse the genetic concepts and laws	4	An
CO-5	understand different theories and patterns of evolution	1	Un
CO-6	acquire in-depth knowledge about cellular components and cell cycle regulation and discuss the consequences of uncontrolled cell division	2, 7	Kn, Cr
CO-7	evaluate the techniques help in bioremediation and demonstrate gene therapy technique	7, 8	Ev
CO-8	understand the various types of pathogens, analyse their transmission and prevention of infectious diseases	5	An, Un

Unit I **Diversity of Life Forms**

Concepts of species and hierarchial taxa, biological nomenclature, classical and quantitative methods of taxonomy of animals. Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Classification of invertebrates up to classes and chordates up to order – diagnostic features and examples. Organisms of conservation concern – principles of conservation - rare, endangered species - conservation strategies.

Unit II **Biochemistry and Physiology**

Composition, structure and function of biomolecules - carbohydrates, lipids, proteins, nucleic acids and vitamins. Conformation of proteins - Ramachandran plot. Physiology of digestion and absorption, respiration, transport of oxygen, carbon-di-oxide; structure of kidney and nephron, urine formation in man; structure of heart, cardiac cycle; structure, composition and functions of blood of man; types of muscle, structure of neuron, nerve impulse conduction, physiology of vision and hearing in man. Structure and functions of pituitary, Islets of Langerhans and thyroid gland. Human reproductive systems – menstrual cycle.

Unit III **Genetics and Evolution**

Mendelian principles, modern concept of gene, split gene, genetic regulation, genetic code. Sex chromosomes and their evolution, sex determination in Drosophila and man. Recombination, linkage, multiple alleles, genetics of blood groups, pedigree analysis, hereditary diseases in man – Inborn errors of metabolism- mutations and mutagenesis, structural and numerical alterations of chromosomes. Theories of evolution- natural selection, role of mutation in evolution, evolutionary patterns, molecular drive, mimicry, variation, isolation and speciation, biological and cultural evolution of man.

Unit IV **Cell and Molecular Biology**

Structure of model membrane, Structure and function of cell and its organelles (nucleus, plasma membrane, mitochondria, Golgi bodies, endoplasmic reticulum, ribosomes and lysosomes), cell division and cell cycle (mitosis and meiosis), steps, control and

regulation of cell cycle, chromosome movement, chromosome type – polytene and lamp brush, organization of chromatin, heterochromatin. Protein synthesis, structure of DNA, RNA, replication of DNA. Nucleic acid topology, DNA motif, transcription, RNA processing, translation, protein folding and transport.

Unit V **Biotechnology and Microbiology**

DNA sequencing methods, RFLP, RAPD and AFLP techniques, transgenic animals. Bioremediation and phytoremediation. Biosensors, tissue culture, Genomics and its applications to health – gene therapy – recombinant vaccines. Major infectious and communicable diseases (malaria, filariasis, tuberculosis, cholera, AIDS and Covid-19) their vectors, pathogens and prevention.

Books for Reference

1. Jordan. K.C. & Verma. P.S. *Invertebrate Zoology*. New Delhi: S. Chand& Company Ltd. 2009.
2. Jordan E.L. and Verma. P.S. *Chordate Zoology*. New Delhi: S. Chand & Company Ltd, Ram Nagar. 1965.
3. Sinha, Adhikari, Ganguly, Bharati Gowswani. Biology of Animals – Volume I. Kolkatta: New Central Book Agency; 7th edition. 2012.
4. Sinha, Adhikari, Ganguly, Bharati Gowswani. Biology of Animals – Volume II. Kolkatta: New Central Book Agency; 7th edition. 2012.
5. Ambika Shanmugam. *Fundamentals of Biochemistry for Medical Students*. Madras: Navabharat Printers and Traders. 2012.
6. Satyanarayana. U and U. Chakrapani. *Biochemistry*. Haryana and Kolkatta: Elsevier and Allied. Fourth Edition 2014.
7. Shembulingam. K. and Prema Shembulingam. *Essentials of Medical Physiology*. New Delhi : Jaypee Brothers, Medical Publishers Ltd. 2005.
8. Verma. P.S and Agarwal. V.K. *Cell Biology, Genetics, Molecular Biology, Evolution & Ecology*. New Delhi: S. Chand & Company Ltd, Ram Nagar. 2013.
9. Kumaresan. V. *Biotechnology*. Nagercoil: Saras Publication. 2009.
10. Presscott Harley and Klein. *Microbiology*. New York: WCB Mc Graw Hill Co. 2005.