Preamble

Master of Science in Zoology is a post graduation course of St. Mary's College. The students pursuing this course would have to develop in-depth understanding of various aspects. The working principles, design, guidelines and experimental skills associated with different fields of Zoology. In pace with the recent trends and developments in Zoology the course content is being modified. There is also scope for self- employment. The practicals will improve all skills of students in microscopy and different laboratory techniques. This curriculum of the zoologists, for the zoologists and by the zoologists developed with the united efforts will take our ever progressive subject to greater heights in the years to come

Vision: To prepare young women face the challenges of life through education, an ideal weapon for empowerment.

Mission: To impart knowledge and skills in zoology through specialization in recently emerging technologies and thereby to produce quality graduates capable of contributing to thedevelopment of knowledge based society

Programme Outcome:

PO.No.	**At the end of the M.Sc. Program, the students will be able to**
PO-1	obtain in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods in Science
PO-2	understand their subject areas more clearly and develop skills to critically reflect upon the theory they learn.
PO-3	adopt the scientific methods and hypothesis testing in designing and execution of experiments.
PO-4	think critically, work independently and focus in research oriented activities.
PO-5	inculcate an ability to engage in life-long learning to improve professional competency.
PO-6	extend and understand the impact of science on society.
PO-7	apply their professional ability for entrepreneurship and self-employment.
PO-8	understand and commit to professional ethics and social responsibility.

Programme Specific Outcome

PSO No.	Students of M.Sc., Zoology will be able to	PO Mapped
PSO-1	comprehend and synthesis advance knowledge in specific areas of Zoology	PO -1,5
PSO-2	demonstrate an in-depth understanding and the ability to apply information from different areas of biology.	PO -2,3
PSO-3	examine and evaluate knowledge across a broad range of courses, acquire a set of transferable skills for employment.	PO -3,7
PSO-4	appreciate and use science as a way of problem solving, formulate hypotheses, design experiments and draw logical conclusions.	PO -4,3
PSO-5	expound the relevance of the biological science to the real-world issues of bioethical, biological and social basis for human welfare and environment.	PO -5,6
PSO-6	achieve practical proficiency in experimental techniques and methods of analysis.	PO -4,5
PSO-7	design and develop projects with scientific report, oral / poster presentation and extend the findings to the society	PO -3,6
PSO-8	select and apply experimental procedures to the spectrum of fields in biology	PO -5,8

PG Zoology

Course Structure(w.e.f2021)

Semester – I

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core I	21PZOC11	Cell and Molecular Biology	6	4	40	60	100
Core II	21PZOC12	Genetics and Evolution	6	4	40	60	100
Core III	21PZOC13	Biochemistry	5	4	40	60	100
Core IV	21PZOC14	Applied Entomology	5	4	40	60	100
Core Practical I	21PZOCR1	21PZOC11, 21PZOC12	4	2	40	60	100
Core Practical II	21PZOCR2	21PZOC13, 21PZOC14	4	2	40	60	100
			30	**20**			

Semester – II

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core V	21PZOC21	Animal Physiology	5	4	40	60	100
Core VI	21PZOC22	Immunology	5	4	40	60	100
Core VII	21PZOC23	Applied Biotechnology	5	4	40	60	100
Core VIII	21PZOC24	Microbiology	4	4	40	60	100
Field Work	21PZFW21		3	3	40	60	100
Core Practical III	21PZOCR3	21PZOC21, 21PZOC22	4	2	40	60	100
Core Practical IV	21PZOCR4	21PZOC23, 21PZOC24	4	2			
			30	**23+2**			

It is mandatory for all I PG students to attend the course through Swayam Portal. Students who pass in MOOC through portals will get extra credit. Students who fail in MOOC can appear for supplementary exam and the institution will provide the certificate. No extra credits will be given.

Semester – III

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core IX	21PZOC31	Computational Biology	6	4	40	60	100
Core X	21PZOC32	Aquaculture Practices and Farm Management	6	4	40	60	100
Core XI	21PZOC33	Developmental Zoology	5	4	40	60	100
Core XII	21PZOC34	Research Methodology and Biotechniques	5	4	40	60	100
Core Practical V	21PZOCR5	21PZOC31, 21PZOC32	4	2	40	60	100
Core Practical VI	21PZOCR6	21PZOC33, 21PZOC34	4	2	40	60	100
Self Study Course / MOOC	21PZOSS1/ 21PZOM31	Zoology for Competitive Examination		+2		100	100
			30	**20+2**			

Semester – IV

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core XIII	21PZOC41	Marine Biotechnology	4	4	40	60	100
Core XIV	21PZOC42	Conservation Biology	5	4	40	60	100
Core XV	21PZOC43	Commercial Zoology	5	4	40	60	100
Core Practical VII	21PZOCR7	21PZOC41	2	2	40	60	100
Core Practical VIII	21PZOCR8	21PZOC42, 21PZOC43	4	3	40	60	100
Core Elective	21PZOE41	A. Ornamental Fish Culture B.Vermitechnology C. Parasitology	4	4	40	60	100
Project	21PZOP41		6	6		100	100
			30	**27**			

Semester	Hours / Week	Credits	Extra Credits	Total Marks
I	30	20	-	500
II	30	23	2	600
III	30	20	2	600
V	30	27	-	500
Total	**120**	**90**	**4**	**2200**

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

Vision: To develop basic knowledge and skills in cell and molecular biology and become aware of the complexity and harmony of the cell

Mission : Students will 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

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

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 E.M.F. Robertis, 1988. Cell and Molecular Biology 9th International Edition, K.M. Varghese Company, Mumbai.
2. David M. Prescott. 1988. Cells – Principles of Molecular Structure and Function. Jones and Bartlett Publishers, USA.
3. Lodish, H., Baltimore D. and J. Darnell. 1999. Molecular Cell Biology. Scientific American Book, Inc, USA.
4. Ajoy Paul. 2011 (Third Edition). Text Book of Cell and Molecular Biology. Books and Allied (P) Ltd. Kolkata.
5. Bhamrah, H.S. 1995. Molecular Cell biology. Anmoi Publications Pvt Ltd, New Delhi.
6. David Freifelder.1995. Essentials of Molecular Biology. Narosa Publishing House, New Delhi.

7. SivaramaSastry, K., Padmanaban G. and C. Subramanyam. 1994. Text Book of Molecular Biology. MacMillan India Limited, New Delhi.
8. Gerald Karp. 1984. Cell Biology. Second Edition McGraw Hill.
9. Prakash S. Lohar. 2007. Cell and Molecular Biology. MJP Publishers, Chennai.
10. Gupta M.L and M.L. Jangir. 2001. Cell Biology Fundamentals and Application. SaraswatiPurchit for Student Edition,Jodhpur.
11. Rastogi S.C. Molecular Biology, 2006. CBS Publishers and Distributors Pvt.Ltd., New Delhi.

PRACTICALS

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., 2007. Histology, CBS Publishers and Distributors, New Delhi.
2. Shah and N.J. Chinoy. 1988. Essential Techniques in Cell Biology. Anada Book Depot. Educational Publishers, Ahmedabad.
3. Goswaml, H.K., 1986. Practical Cytology, Applied Genetics and Biostatistics. Himalaya Publishing House, Bombay.

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

Vision: To highlight the importance of genetics and evolutionary significance to the society

Mission: Students will 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	criticallyanalyse, issues such as speciation mechanisms relating to the formation of species.	2	Un, An

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

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

PRACTICALS

Hours/Week: 2 **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.1997. *Experimental Genetics I– biophysics*. *shg. ac /at/ home.htm*

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

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

Vision

To develop and enhance an optimum academic environment to prepare professional graduates in the field of biochemistry**.**

Mission

To give a broad based knowledge on how biological molecules give rise to the processes that occur within living cell which in turn relates greatly to the study and understanding of the whole organism.

Course Outcome:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	classify and explain structure and functions of biomolecules	1	Un
CO-2	relate between biology and chemistry	2, 4	Un
CO-3	compare the specificity of enzymes (biochemical catalysts) and the chemistry involved in enzyme action.	3	An
CO-4	recognise the metabolic pathways of protein, amino acids,carbohydrates, fats and nucleic acids	1	Ev
CO-5	relate to real life situations and applications in research and industry	4	Un
CO-6	have firm foundations in fundamental applications of biomolecules	7	Un
CO-7	solve the problems in biochemistry	5, 8	Ap
CO-8	design,carryout, record and analyse the results of chemical experiments	6	Cr

SEMESTER I			
Core III : Biochemistry			
Code: 21PZOC13	**Hrs/Week: 5**	**Hrs/Sem: 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 andHartnup'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).

Books for Reference

1. AmbikaShanmugam, 2012. *Fundamentals of Biochemistry for Medical Student*s, Navabharat Printers and Traders, Madras.
2. PankajNaik, 2016. *Biochemistry for Medical Students* 4thedition, Health Science Publishers, NewDelhi.
3. Jain J.L, Sunjay Jain, Nitin Jain, 2007. *Fundamentals of Biochemistry*, S.Chand & Company, New Delhi.
4. Styer L.W.H, 1995. *Biochemistry*, Freeman & Company, San Francisco.
5. Murray R.K., GaanerD.K, MayerP.A and V.W.Rodwell, 1996. *Harper's Biochemistry*, 24th edition. Prentice Hall of Japan, Inc, Tokyo.
6. Rastogi S.C, 2003. *Biochemistry*, Second edition. Tata McGraw Hill Publishing Company Ltd., New Delhi.
7. SatyanarayanaU and U.Chakrapani, 2014. *Biochemistry,* Fourth edition. Elsevier & Allied. Haryana and Kolkata.
8. Edward Staunton West, Wilbert R. Todd, Howard S.Mason, John T.Van. Bruggen, 1966. *Biochemistry*, Fourth edition. Oxford and IBH Publishing Co. New Delhi.
9. Bernard L. Oser, 1965. *Hawk's Physiological Chemistry*, 14th edition.Tata McGraw Hill Publishing Company Ltd. New Delhi.
10. Chatterjee M.N, 2010. *A Textbook of Biochemistry*. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi.
11. Lehninger, A1993. *Principles of Biochemistry*, CBS Publishers & Distributers, New Delhi.

PRACTICALS

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

1. Effect of pH on salivary amylase activity.
2. Effect of substrate concentration on salivary amylase activity.
3. Salivary amylase activity in relation to enzyme concentration.
4. Preparation of standard graph for carbohydrate
5. Preparation of standard graph for protein
6. Quantitative estimation of muscle protein
7. Determination of iodine number of an edible oil
8. Separation of lipids by TLC -Demonstration only
9. Separation of amino acids by paper chromatography / Ninhydrin method
10. Preparation of buffers : acetic acid and acetate buffers
11. Phenylketonuria (chart)

Books for Reference

1. Jayaraman J, 2000. *Laboratory Manual in Biochemistry*- New Age International (P) Ltd. Publishers, New Delhi.
2. Kanai L. Mukherjee &Swarajit Ghosh, 2012.*Medical Laboratory Technology* – 2nd Edition, Tata McGraw Hill Education (P) Ltd- New Delhi
3. DeeptiSaini and Deepak K. Sain, 2008.*Hand Book of Practical Biochemistry* – PEE PEE Publishers & Distributers (P) Ltd., New Delhi.

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

Vision

To explore the richness and significance of insects.

Mission

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

SEMESTER – I			
Core IV: Applied Entomology			
Code: 21PZOC14	**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 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, filariasisand sleeping sickness

Unit VPest 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. 1997. *Applied Entomology*, Wiley Eastern Ltd., New Delhi.
2. Tembhare. D.B. 2017. *Modern Entomology*, Himalaya Publishing House, New Delhi,
3. NalinaSundari, M.S. and R. Shanthi. 2006. *Entomology* MJP Publishers, Chennai.
4. Abishek Shukla. 2009, *Economic Entomology*, Daya Publishing House, New Delhi.
5. Sandhya Agrawal. 2009, *Applied Entomology* Oxford Book Company, Jaipur, India.

6. Ravindran K.R. 2013. *A Text Book of Economic Zoology*, Wisdom Press, New Delhi
7. Sathe,T.V., Satha,A.T. andJagtap. 2011. *Mahendra. Mosquito Borne Diseases*. Mangalam Publishers & Distributers, New Delhi.
8. Saxena, R. C. and R.C. Srivastava. 2007. *Entomology,* Agrotech Publishing Academy, Udaipur.
9. David, B.V and TN. Ananthakrishnan. 2004 General and Applied Entomology, McGraw Hill Education, Bangalore.
10. Vasanthraj David B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology. Brillion Publication, New Delhi.

PRACTICALS

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, 2001. *Elements of Economic Entomology*, Popular Book Depot, Chennai.
2. Nayar, K.K., Vasantharaj David, B, and T.N. Ananthakrishnan, 2004. *General and Applied Entomology.* Tata McGraw 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 V : Animal Physiology			
Code : 21PZOC21	**Hrs/ Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Vision

To provide students with an outstanding educational experience that prepares them for different careers, innovative and cutting edge research, and academia.

Mission

To equip the students in the discipline of Physiology, by imparting knowledge and understanding of structure and function of human biological systems.

To foster the development of professional skills through well designed curriculum; based on experiments, training and research.

Course outcomes

CO. No	Upon completion of this course, students will be able to	PSOs addressed	CL
CO- 1	compare digestive and circulatory system and infer regulation of blood pressure and heart beat	1, 2	Un,An
CO-2	understanding mechanisms of respiration and point out physiological adaptations to special conditions	1, 2	Un,An
CO-3	indicate the relationship between different environments and excretory organs and osmo ionic regulation	5	Ap, An
CO-4	appraise neuromuscular mechanisms and relate the physical and chemical phenomena	2 , 6	Un, Ev
CO-5	associate the endocrine glands with physiological actions and develop healthy life style	2, 4	Un,Cr
CO-6	perceive the steps involved in transmission of nerve impulses	5	Ev
CO-7	relate the structure and physiology of muscular system	7	Un
CO-8	elaborate the integration and interactions of hormones	8	Cr

Unit I **Digestive and Circulatory Systems**

Digestive system - gastrointestinal secretary functions and the glands - role of GI hormones. Structure of mammalian heart-cardiac cycle - cardiac output- control of heart beat - blood pressure and its regulation – related diseases (hypertension, hypotension, stroke)

Unit II **Respiratory System**

Human respiration**:** Anatomy and Physiology of the respiratory tract- transport of oxygen and carbondioxide-regulation of respiration-artificial respiration-physiological response to oxygen deficient stress (diving, high altitude) and exercise.

Unit III **Neuromuscular System**

Nervous system: neurons –structure and types- nerve impulse propagation – concept of synapse- transmission of electrical and chemical synapse- reflex arc-– reflex action.

Muscular system:Structural basis of contraction - sliding filament theory – mechanism and energetics of muscle contraction.

Unit IV **Excretory System**

Human kidney: nephron – mechanism of urine formation – regulation of ionic and osmoregulation in invertebrates – Protozoa, crustaceans and insects, Chordates – fishes, birds and mammals.

Unit V **Endocrinology**

Basic mechanisms of hormone action -endocrine glands in mammal –pituitary, thyroid, adrenal and islets of Langerhans - hormones and functions-hormonal disorders- role of hormones inmenstrual and estrous cycle-pregnancy – parturition – lactation - hormones and neoplastic growth.

Books for Reference

1. Hoar1975. *General and Comparative Physiology*. Prentice. Hall of India Pvt Ltd, New Delhi.
2. Sembulingmam K, and PremaSembulingam. 2006. *Essentials of Medical Physiology* Jay Pee Brothers, New Delhi.
3. KuntSchmidt-Nielsen K.1985. *Animal Physiology, AdaptationandEnvironment* CambridgeUniversity Press, Cambridge.
4. Ladd Prosser C. 1984.*Comparative Animal Physiology*, Third edition. Satish Book Enterprise Book Sellers and Publishers, Agra.
5. Malcolm S. Gordon. 1984. *Animal Physiology Principles and Adaptations*. Third edition. Collier MacMillan International edition. Collier MacMillan Publishers, London.
6. Nagabhushanam, R and M.S. Kodarkar.1978.*Textbook of Animal Physiology,* Oxford and IBH Publishing Co., New Delhi.

7. Bentley P.J.1980. *Comparative Vertebrate Endocrinology*, First edition Chand& Company Ltd, Delhi.

8. Constance R.Martin. 1985. *Endocrine Physiology*, First edition. Oxford University Press, New York

9. Prakash S. Lohar. 2005. *Endocrinology – Hormones and Human Health*, MJP Publishers, Chennai.

10. SawantS.C.2015. *A Textbook of Human Physiology* Wisdom Press, New Delhi.

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

1. Estimation of haemoglobin
2. Determination of erythrocyte sedimentation rate (ESR)
3. Detection of haemin crystals of blood
4. Salt loss/ salt gain in a fish
5. Effect of temperature on oxygen consumption of fish
6. Urine analysis for sugar,albumin, urea and creatinine
7. Urine analysis for sediments
8. Assay of acid/alkaline phosphatase enzyme
9. Chart/slide/photograph
   a. Endocrine glands in man - Transverse section of pituitary,thyroid,pancreas and adrenal
   b.Conditional reflex
   c. Pregnancy test – demonstration

Books for Reference

1. Rastogi S.C. 1982. *Experimental Physiology*, Wiley Eastern Limited, New Delhi
2. Nigam S.C. and Omkar. 2006.*Experimental Animal Physiology and Biochemistry,*New Age International (P) Limited, New Delhi.

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

Vision: To understand the fundamentals of immunology and key principles of immune system

Mission: 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

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

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 IIIImmunobiology

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

PRACTICALS

Hrs/Week - 2 **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. RabindraNarain, 2012. *Practical Immunology*. Wisdom Press, New Delhi

2. Talwar, G. and S. K. Gupta, 1992. *A Handbook of Practical and Clinical Immunology.*

Vol. 1 Second Edition. CBS Publishers & Distributers, Delhi.

SEMESTER – II			
Core VII : Biotechnology			
Code : 21PZOC23	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Vision: To impart the knowledge and skills in various aspects of biotechnology and to train the students to be competent to appreciate and take up research in biotechnology.

Mission : Tomotivate the students to develop scientific attitudes towards emerging technologies

To discover the potential sources of biotechnology and their applications in various fields

To serve as a platform for students to explore their professional skills

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	perform biotechnological manipulation of microbes for production of industrially important products	1	Un
CO-2	get more insight on the application of biotechnology in treatment of diseases	3	Un
CO-3	apply biotechnology for production of pharmaceutical products .	7	Ap
CO-1	use biotechnology to monitor environmental pollution	3	Ap
CO-5	apply their knowledge to alleviate the effects of various environmental pollutants using biotechnology.	8	Ap
CO-6	create transgenic animals	3	Ap
CO-7	evaluate the ethical issues related with genetically modified organism	2	Ev
CO-8	imbibe the practical and theoretical knowledge of nanomaterials essential for pursuing higher studies.	6	Un

SEMESTER – II			
Core VII : Biotechnology			
Code : 21PZOC23	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Unit I Microbial Biotechnology:

Isolation and improvement of microbial strains –microbial production of food –beverages-single cell proteins-methods of enzyme production - production of penicillin-bioethanol – biogas.

Unit II Biotechnology and Health Care

Gene therapy: Ex vivo- gene therapy for adenosine deaminase deficiency, in vivo gene therapy - cancer and AIDS. Pharmaceutical products: Insulin, human growth hormone. Recombinant vaccines: Hepatitis B -influenza virus. Monoclonal antibodies-production and applications.

Unit III Environmental Biotechnology

Biotechnological methods for management of pollution-Atmospheric CO_2, metal pollution-biotechnological methods for measurement of pollution-Bioassays –animal test systems-molecular biology – biosensors for environmental monitoring – bioremediation.

Unit IV Genetic Engineering

Construction of animal viral vectors for animal transformations-methods of developing transgenic animals: mice - fish –genetically engineered microbes (GEMOs)- applications of genetic engineering-ethics of genetic modification of animals.

Unit V Nanotechnology

Nanomaterials, synthesis of nanoparticles: RF plasma, chemical methods, thermolysis,biological methods-biofabrication,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. Kalyani Publishers, New Delhi.
3. Kumaresan V. 2009 *Biotechnology*. Saras Publication, Nagerkoil.
4. RemaL.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 Nanotechnology*. 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. Restriction digestion
3. Immobilization of enzymes by sodium alginate method
4. Bioadsorption or phytoremediation of an organic substrate.
5. PCR amplification.
6. SDS-PAGE
7. Mushroom culture
8. Charts and models pertaining to theory for spotters

   pBR322, monoclonal antibodies, transgenesis, organ culture, somatic cell fusion, Southern blotting, *Agaricusbisporus,* ultra sonication, laminar flow chamber.
9. Report of visit to biotechnology lab

Books for Reference:

1. AsishVerma, Surajit Das, Anchal Singh. 2008. *Laboratory Manual for Biotechnology*, S. Chand and Company, New Delhi.
2. Harisha S. 2007. *Biotechnology Procedures and Experiments Hand Book*, Infenity Science Press, LIC, Hinghum, Massachusett, New Delhi, India
3. Joseph Sambrook and David S. Russel, 2001. Molecular cloning- A laboratory manual, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

SEMESTER II			
Core VIII : Microbiology			
21PZOC24	**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 infectionof 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

SEMESTER II			
Core VIII : Microbiology			
21PZOC24	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 –Analysis based on Bergey'sManual of DeterminativeBacteriology (biochemical tests).

Unit IICultivation 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. ArtiKapil. 2016. *Text Book of Microbiology*. 9th Edition. University Press. Hyderabad.
2. DubeyR .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. WulfCrueger and AnnelleseCrueger. 2016. Biotechnology: A Textbook of Industrial Microbiology 3rd Edition. CBS Publishers and Distributors, New Delhi
6. Presscott Harley and Klein. 2005. *Microbiology.* WCB McGraw Hill Co New York.

7. Purohit S.S. 1991. *Microbiology – Fundamentals and Application*. M/SSaraswathi Publication, India
8. Power C.B and K.F. Daginawala. 1988. *General Microbiology*.Vol I & II. Himalaya Publishing House, Mumbai.
9. Vijaya Ramesh. 2007. *Food Microbiology.* MJP Publishers, Chennai.
10. Casida, J.R.2015. Industrial microbiology 2nd Edition , New Age International Pvt. Ltd., New Delhi
11. Ananthanaryanan, R and J. Panikar.2006. Text Book of Microbiology, 7th Edition. Orient Longman Private Ltd., 160, Anna Salai, 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. 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. 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.