

**M.Phil. Zoology  
Courses offered**

I Semester	Subject code	Title of the paper	Hours/week		Credit
			Contact	Library	
<b>C1</b>	MPZ181	Professional Skills for Teaching - Learning	<b>3 + 2</b>	<b>2</b>	<b>3 +1</b>
<b>C2</b>	MPZ182	Research Methodology	<b>5</b>	<b>3</b>	<b>4</b>
<b>C3</b>	MPZ183	Recent Trends in Zoology	<b>5</b>	<b>3</b>	<b>5</b>
<b>C4</b>	MPZ184	<b>Indepth paper</b> (a) Aquaculture	<b>3</b>	<b>4</b>	<b>5</b>
	MPZ185	(b) Applied Entomology			
	MPZ186	(c) Environmental Biology			
	MPZ187	(d) Applied Immunology and Microbiology			
<b>II</b>	MPZ18 D	<b>Project</b>	20		12
		<b>TOTAL</b>			<b>30</b>

**Semester I**  
**C1: Professional Skills for Teaching – Learning**  
**Sub Code: MPZ181**

No. of hours per week			Credit	Total no. of hours	Marks
<b>T</b>	<b>P</b>	<b>Library</b>	3 + 1	75	100
3	2	2			

**Objectives**

1. To empower scholars with soft skills.
2. To introduce the teaching and dynamics of teaching – learning
3. To facilitate e- learning/ e-teaching with the ICT tools
4. To acquire practical skills (in subject) aiming at gaining confidence to handle practical classes
5. To develop teaching skills and gain confidence in teaching.

**Unit I: Soft Skills**

Introduction to Soft Skills, Soft Skills Vs Hard Skills, types of Soft Skills.

**Communication Skills:** Basics in communication, structure of written and oral sentences, Verbal, non-verbal, body language, Intrapersonal and Interpersonal Communications, Activities in Effective Communication.

**Behavioral Skills:** Leadership skills, Time Management, Creativity and Lateral thinking.

**Interview Skills:** Resume Writing, Different types of interviews, Etiquettes in interviews, Mock interviews.

**Team Building and Group Discussion:** Progressive stages of Team Building, Parameters of GD (special reference to attending, listening, responding skills).

**Language skills (LSRW):** Strategies to acquire LSRW skills.

**Unit II: Techniques and Dynamics of Teaching- Learning**

**Emerging trends in Educational Psychology:** Meaning, Scope and Methods

**Learning:** Different Theories of learning, Approaches to learning (Classical Conditioning- Ivan Pavlov; Operant conditioning- B.F.Skinner; kinds of learning, factors affecting learning.

**Motivation:** Intrinsic and extrinsic motivation, Development of memory and intelligence.

**Unit III: Incorporating Teaching and Learning via Modern Gadgets:**

**An Overview of Microsoft Office-2007:** MS WORDS-2007- MS Excel-2007- MS Powerpoint-2007. Concepts in e-Resources: Making use of Web Resources .

**ICT for Research:** On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations.

**Unit IV: Instructional Technology:**

Definition, Objectives and Types – Difference between Teaching and Instruction –

**Lecture Technique:** Steps, Planning of a Lecture, Delivery of a Lecture – Narration in tune with the nature of different disciplines – Lecture with power point presentation –LCD Projector- AV aids – Smart class room.Teaching – learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion – Modes of teaching: CAI, CMI and WBI

## **Unit V: Learning, Teaching and Evaluation Practice**

Teacher assisted class room teaching- assignment – (5 classes) and Teacher evaluation and suggestions.-Teacher assisted laboratory practice –assignment – (5 lab sessions) and teacher evaluations and suggestions

### **Reference Books**

Don Skinner (2005), Teaching Training, Edinburgh University Press Ltd, Edinburgh  
Sharma, R.A. (2006) Fundamentals of Educational Technology, Surya Publications, Meerut  
Vanaja, M. and Rajasekar, S (2006), Computer Education, Neelkamal Publications, Hyderabad  
Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi

## Semester I

### C2: Research Methodology

Sub. Code: MPZ182

No. of hours per week		Credit	Total no. of hours	Marks
Contact	Library	4	75	100
5	3			

#### Objective

To enable the students to understand the basic concepts of research and its methodologies, identify appropriate research topics, select and define appropriate research problem and parameters, prepare a project proposal (to undertake a project), organize and conduct research (advanced project) in a more appropriate manner, write a research report and thesis and write a research proposal.

#### Unit I

Literature collection: Abstracts, reviews, journals, reference card. Literature citation - Name-year system of citation in the text and in references. Scope, identification and selection of research problems. Designing experiments. Data collection and analysis. Methods of edition and abstraction. Report writing – formatting and typing. Preparation of manuscript and proof reading for journals and conferences. Research funding agencies. Citation, Calculation of h - index, Scopus index and Impact factor.

#### Unit II

Principles of Microtechniques. Histology: Fixatives and Histological stains – Fixation - Tissue processing - Staining. Microtome and Freezing Microtome (Cryostat).

Histochemistry: Histochemical stains - Principles involved in identification of carbohydrates, Proteins, Lipids, Enzymes and Nucleic acids.

Principles and applications of Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), STEM. Preparations of tissues for SEM and TEM. Micrometer and its application. Photomicrography - principles and applications.

#### Unit III

Chromatography: Types, Principles and Applications of TLC, Column, Ion-exchange, HPLC, GLC and Affinity. Electrophoresis: Types, Principles and Applications of Agarose Gel (AGE), PAGE, SDS-PAGE. Blotting Techniques: Southern and Western.

Immunological Techniques: Antigen and Antibody preparation and purifications- Immunodiffusion - Immunoelectrophoresis, ELISA. Tracer techniques: Principles and applications of Autoradiography, Geiger Muller Counter, Scintillation Counter.

#### Unit IV

pH determination: pH indicators – pH meter. Principle and operation. Buffer solution - preparation – significance. Acid - base titration curve. Centrifugation: Principle, types of centrifugation, centrifuges and uses. Photometry: Principle, operation and applications of Colorimeter, Spectrophotometer, Atomic absorption spectrophotometer, Fourier Transform Infrared spectrometer (FTIR) and Flame photometer. NMR spectroscopy and gas chromatography-mass spectrometry (GCMS). Bioenergetics – principles – estimation of energetic components - Principles and applications of Bomb Calorimeter. Oxygen analyzer.

## Unit V

Statistical methods and applications: Experimental designs – Sampling – Probability - Normal curve - Test of significance: students “t” test - Chi Square test, F-test, Z-test - Analysis of variance (ANOVA) - one way and two way. Correlation coefficient- simple linear and multiple correlations. Simple linear regression. Bioinformatics: Biological databases, sequence comparisons, multiple sequence alignment, profiles, motifs and feature identification, phylogenetic analysis. Bioinformatics in genomes. Bioinformatics software.

### Reference Books

- Gurumani, N. (2006). *Research Methodology for Biological Sciences*. Chennai: MJP Publishers.
- Robert L. Dryer & Gene F. Lata (1989). *Experimental Biochemistry*. New York: Oxford University Press.
- Rana, S.V.S. (2002). *Biotechniques*. Meerut: Rastogi Publications.
- Keith Wilson & John Walker (2005). *Practical Biochemistry - Principles & Techniques* (5<sup>th</sup> ed.). London: Cambridge University Press Publications.
- Jayaraman, J. (2011). *Laboratory Manual in Biochemistry*. New Delhi: New Age International Pvt. Ltd Publishers.
- Palanichamy S. & Shanmugavelu, M. (1997). *Research methods in. Biological Sciences*. Palani: Palani Paramount Publications.
- Plummer, D.T. (2001). *An introduction to Practical Biochemistry*. Oxford University Press, London.
- Oser, B.L. (1976). *Hawk's Physiological Chemistry*, Tata McGraw-Hill Publishing Co., Ltd., New Delhi.
- Brewer, J., Pesce, A. & Ashworth, R. (1974). *Experimental Techniques in Biochemistry*. Englewood Cliffs, New Jersey: Prentice Hall Publication.
- Saravanavel P. (2006). *Research Methodology*. Sarojini Naidu Marg, Allahabad : Kitab Mahal Publishers.
- Zar, J.H. (1984). *Biostatistical Analysis* (2<sup>nd</sup> ed.). Prentice-Hall International, Inc., London.
- Gurumani, N. (2005). *An Introduction to Biostatistics*. Chennai: MJP Publishers.
- Day. R.A. (1994). *How to write and publish a scientific paper*. London: Cambridge University Press.

**Semester I**  
**C3: Paper II- Recent Trends in Zoology**  
**Sub. Code: MPZ183**

No. of hours per week		Credit	Total no. of hours	Marks
Contact	Library			
5	3	4	75	100

**Objective**

To provide the students, an understanding on the latest developments and technologies introduced in the field of Biology and to update their knowledge and information especially in Zoology. The student would be able to keep herself abreast with the recent developments.

**Unit I**

Cell and tissue engineering: Biomaterials for tissue engineering – approaches in tissue engineering - Artificial skin, bone grafts, artificial nerve grafts. Transgenic biology: Gene transfer methods, Transgenic plants and animals. Immunotechnology: Hybridoma – production and applications of monoclonal antibodies - Flow cytometry - Blotting techniques: Southern, Northern and Western - Polymerase chain reaction.

**Unit II**

Molecular markers and their applications. Gene therapy – types, approaches and antisense gene therapy. Human genome project, mapping and sequencing. Genomic research - methods of genome sequencing. Proteomic research - Methods of proteome analysis.

**Unit III**

Nanotechnology basics- Introduction to nano world- classification of nano materials - application of nano crystals, nano factories, nano biosensors, optical biosensors - DNA sensors, quantum dots. Biomedical applications: drugs- drug delivery - photodynamic therapy. Application of nano particles in pollution control, waste water treatment, nano particles as biosensors, risk and threats of nano particles to environment and mankind.

**Unit IV**

Environmental education, planning and management. Bioremediation. Renewable and non-renewable sources of energy, conventional and non conventional – solar energy - Biogas production - Nuclear energy - Indian nuclear power plant. Biodiversity - Types, Measures of diversity - Biodiversity conservation laws. Remote sensing and radiotelemetry in ecological research.

**Unit V**

Stem cell Biology- embryonic and adult stem cells- reprogramming in stem cell biology- molecular mechanisms of self-renewal - pluripotency, multipotency and lineage differentiation. Skin stem cells - neural stem cells- cancer stem cells - stem cell gene therapy . Stem cells and diabetes - repair of damaged heart using stem cells. Bioethics: need for ethical review - biosafety - ethical implications on transgenic animals- monitoring the welfare of transgenic animals - laboratory animal ethics - ethical guidelines for use of animals in scientific research. Intellectual Property Rights (IPR) and patenting of biological materials.

## Reference Books

- Mark Ratner & Daniel Ratner (2007). *A general introduction to the next big idea*. New Delhi, India: Dorling Kindersley (India) Pvt. Ltd.
- Emmanuel, C. Rev.Fr. Ignacimuthu. S.J. & Vincent, S. (2006). *Applied Genetics: Recent trends and techniques*. Chennai, India: MJP Publishers.
- Parthasarathy, B.K. (2007). *Nanotechnology in Life Science*. New Delhi, India: ISHA Books.
- Gupta, P.K. (2009). *Elements of Biotechnology*. Meerut: Rastogi Publications.
- Singh, B.D. (2006). *Biotechnology Expanding Horizons*. Chennai: Kalyani Publishers.
- Satyanarayana, V. (2004). *Biotechnology*. Kolkota: Books and Allied (P) Ltd.
- Dubey, R.C. (2006). *A Text Book of Biotechnology* (4<sup>th</sup> ed.). New Delhi: S. Chand and Co. Ltd.
- Robert Lanza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pederson, Donnall Thomas, James Thomson and Ian Sir Wilmot (2009). *Essentials of Stem Cell Biology* (2<sup>nd</sup> ed.). San Diego, USA: Academic Press.

**Semester I**  
**C4: Optional: In-depth Study Paper (a) Aquaculture**  
**Sub. Code: MPZ184**

No. of hours per week		Credit	Total no. of hours	Marks
Contact	Library	5	45	100
3	4			

**Objectives**

1. To provide knowledge on the rearing of aquatic organisms in controlled or selected aquatic environments for commercial or recreational, or public purpose.
2. To promote the development of environmentally sound aquaculture: reducing the impact of waste and preventing pollution

**Unit I**

**Scope and status of aquaculture:** Scope of Aquaculture. Present state of Aquaculture (Aquaculture in the world and Aquaculture in India). Basic principles of Aquaculture - desirable characteristics of cultivable organisms. Kinds of aquaculture- extensive culture, semi-intensive culture and intensive culture; race way culture; monoculture; monosex culture; poly culture; Integrated fish culture; waste water fish culture; pen culture; cage culture.

**Unit II**

**Fish nutrition and Feed technology:** Principles of fish nutrition: Nutritional requirements of cultivable finfish and shellfish. Feed ingredients and their composition, feed formulation, preparation and evaluation; digestibility of feeds, feed additives (attractants, growth stimulants, colour enhancers and probiotics) and binders. Live feed organism: Diatom, Rotifer, Cladoceran, Artemia and Tubifex. Nutritional pathology: Antinutritional factors and antimetabolites, microbial toxins, methods of elimination, nutrient deficiency and symptoms. Feeding management: methods of feeding, ration size and frequency, feed performance and economics.

**Unit III**

**Fin fish culture, Shell fish culture and Seaweed culture:** Culture of carps: indigenous and exotic carps, mullet, milk fish, trout and air breathing fishes. Induced breeding: seed procurement - hypophysation - Management of nursery, rearing and stocking ponds - Fish seed transportation. Ornamental fish culture. Fresh water prawns: breeding, larval rearing and culture. Culture of penaeid prawns: species selection-seed production-eyestalk ablation-larval rearing-culture- Harvesting and marketing. Oyster culture (pearl oyster and edible oyster) and mussel culture. Seaweed culture.

**Unit IV**

**Fish Biotechnology and Genetics:** Chromosomal manipulation - cytogenetics - hybridization - transgenic species - cryopreservation of gametes - bioencapsulation. Heritability - growth rate-stocks and strains-spawning time-food conversion efficiency; sex determination - sex ratio-sex linkage-sex reversal and sex determination - Androgenesis, Gynogenesis and sex determination - H-Y antigen.

**Unit V**

**Aquaculture management and Review of Research papers:** Water quality management- dissolved gases- environment and biological factors. Fish diseases and their management - parasitic, viral, bacterial, fungal, protozoan, Pollution hazards. Aquatic weeds and their control.

Review of relevant research articles in the field of Aquaculture.



## Reference Books

- Bardach, J. (1972). *Aquaculture*. New York.: Wiley-Interscience Publication.
- Jhingran, V.G. (1991). *Fish and Fisheries of India*. New Delhi: Hindustan Publishing Co.
- Jeyaram, V.C. (1981). *The Fresh water Fishes in India Hand book*. Kolkatta: ZSI.
- Pillay, T.V.R. (1990). *Aquaculture: Principles and Practices*. England: Fishing News Books Ltd.
- Purdon E.Colin (1993). *Genetics and Fish Breeding*. London: Chapman and Hall Publication.
- Chris Andrews, Adrien Exell & Neville Carrington (1988). *Manual of Fish Health*. London: Salamander books Ltd.
- Jaques Arrignon (1999). *Management of Fresh water Fisheries*. Delhi: Oxford and IBH Publishers.
- Christopher Meseke (1985). *Fish Aquaculture*, United Kingdom, UK: Pergamon Press.
- Zdenek Lucky (1977). Amerind Publishing Co. Pvt. Ltd., New Delhi: *Methods for the diagnosis of fish diseases*.

**Semester I**  
**C4: Optional - In-depth Study Paper (b) Applied Entomology**  
**Sub. Code: MPZ185**

No. of hours per week		Credit	Total no. of hours	Marks
Contact	Library	5	45	100
3	4			

### Objectives

1. To know about the insect diversity and biology.
2. To identify the economically important insects and explore the ways of exploiting the beneficial ones
3. To understand and adopt practices for integrated pest management so as to minimize the environmental damage, human health risks, and cost associated with pest suppression

### Unit I

**Introduction to the study of Entomology:** Outline classification of insects up to super families - key to the identification of various orders (Thysanura, Orthoptera, Dycotera, Odonata, Thysanoptera, Isoptera, Anapleura, Coleoptera, Lepidoptera, Hemiptera, Diptera and Hymenoptera) with common South Indian examples.

### Unit II

**Insect structure and function:** Insect body plan and the following systems: integumentary, digestive, excretory, circulatory, respiratory, muscular, locomotory, nervous, sensory, exocrine and endocrine, reproduction and development.

### Unit III

**Beneficial and Productive insects:** Beneficial insects: Insects in biological research, insects as entomophagous, pollinators, food consumers, soil builders, weed killers, scavengers, predators and parasites effecting biological control and bio-indicators. Productive insects: Insects that produce honey and bee wax, silk, lac, dyes, and medicines. Forensic Entomology.

### Unit IV

**Harmful insects:** Insect pests and pest control: pests of major crops (cotton, sugarcane, paddy) - pests of vegetables, stored grains, and pulses- pests of house hold goods and structural materials. Principles and Application of pesticides – dusting and spraying. Insect vectors and diseases: Bioecology, medical importance and management – Mosquitoes (malaria and filariasis), Common and Greater Housefly (dysentery and other gastro intestinal disorders), Fleas and Lice (plague, typhus fever and Trench fever), Bed bugs (Q-fever) and Tsetse flies (sleeping sickness).

### Unit V

**Pest management and Review of research papers:** Integrated Pest Management (IPM). Food preference and bioenergetics – feeding stimulants- feeding deterrents. Review of relevant research articles in the field of Pest management.

### Reference Books

- Tembhare, D.B. (1997). *Modern Entomology*. India: Himalaya Publishing House.  
Vasantharaj David, B. (2003). *General and Applied Entomology* (2<sup>nd</sup> ed.). New York: McGraw-Hill Publishers.

Ramakrishnan Iyer, T. V. (1940). *Handbook of Economic Entomology for South India*. South India: Superintendent, Government Press.

Dennis S. Hill (1975). *Agricultural insect pests of the tropics and their control*. United Kingdom, UK: Cambridge University Press.

Clell Lee Metcalf and Wesley Pillsbury Flint (1962). *Destructive and Useful insects* (4<sup>th</sup> ed.). New York: Mc Graw-Hill Publication.

Pradhan, S. (2002). *Agricultural Entomology and Pest control*. New Delhi: ICAR.

Little, V.A. (1967). *General and Applied Entomology*. New Delhi: Oxford and IBH Co.

Ralph H. Davidson, William F. Lyon (1987). *Insect pests of farm, garden and orchard* (8<sup>th</sup> ed.). New York: John Wiley & Sons.

Ross, H.H., Ross, C.A. and Ross, J.R.P. (1982). *A text book of Entomology*. New York: John Wiley & Sons Publication.

Moni, M.S. (1982). *Text book of Entomology*. New Delhi: Oxford and IBH Co.

Dunston P. Ambrose (2007). *The insects: Beneficial and Harmful aspects*. New Delhi, India: Kalyani Publishers.

Dorothy Gennard (2007). *Forensic Entomology*. New York: John Wiley Sons Publication.

Jason H. Byrd, James L. Carstener (2009). *Book of Forensic Entomology*. United Kingdom, UK: CRC Press.

Nayar, K.K., Ananthakrishnan, T.N. and Vasantharaj David B. (1976). *General and Applied Entomology*. New York: Tata McGraw- Hill Publishers.

Vasantha Raj David and Ananthakrishnan (2003). *General and Applied Entomology*. New York: Tata McGraw- Hill Publishers.

## Semester I

### C4: Optional: In-depth study paper (c) Environmental Biology

Sub. Code: MPZ186

No. of hours per week		Credit	Total no. of hours	Marks
Contact	Library	5	45	100
3	4			

#### Objective

To provide a comprehensive coverage on components of environment, biodiversity and impact of toxicants on organisms.

#### Unit I

**Biodiversity:** Measures of biodiversity - Diversity indices: Dominance index- Shannon Weiner index-Similarity index- Dissimilarity index- Association index. **Ecosystem:** Types – Abiotic and Biotic components - Primary productivity and measurements - Energy flow- Nutrient cycling, Homeostasis. Field sampling techniques - Animal trapping techniques - Basic methods in behavioral and food habit studies. Specimen collection and preservation.

#### Unit II

**Population Ecology and Ethology:** Population: Population growth - growth patterns, growth models- (time lag models). Life history strategies: r and k selection, Life tables and Survivorship curves. Demography. Behaviour in insects and birds – Social life in ants and termites - Foraging and defensive behavior - Nesting behavior - Clutch size and Sex ratio.

#### Unit III

**Environmental degradation:** Environmental pollution - Air, Water, Soil, Radioactive and Noise Pollution and their impact -. Degradation of environment due to Mining, Industries, Agriculture and Urbanization– Global warming. Xenobiotics. Bioremediation: Microbial and phytoremediation.

#### Unit IV

**Toxicology:** Toxicity of pollutants – safety evaluation – acute and chronic toxicity – Bioassays (LC<sub>50</sub>/LD<sub>50</sub> determination) – selection of test animals – probit analysis – Dose response – behavioural aspects. Impact of toxicants on organisms: Feeding energetics - hematology – respiration – Excretion - Histological, Biochemical and Molecular changes.

#### Unit V

**Environmental management and Review of research papers:** Concept of Bioconservation- Sustainable ecodevelopment – Environmental Impact Assessment (EPA) - Remote sensing and its applications in Ecology. Nonconventional sources of energy. Status and management of endangered animals of India.

Review of relevant research articles in the field of Environmental studies.

#### Reference books

- Bhatia, A.L. (2010). *Text book of Environmental Biology*. New Delhi: I.K. International Publishing House Pvt. Ltd.
- Benny Joseph (2005). *Environmental studies*. New Delhi: The McGraw-Hill Companies.
- Kato, M. (Ed.) (2000). *The biology of biodiversity*. Tokyo: Springer – Verlag Publication.
- Kapoor, V.C. (2001). *Practice of Animal taxonomy* (5<sup>th</sup> ed.). New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
- Simpson, G.G. (1969). *Principles of animal taxonomy*. New Delhi: Oxford and IBH Publishing Co. Ltd.
- Supriyo Chakraborty (2004). *Biodiversity*. Jaipur: Pointer Publishers.
- Pande, K., Shukla, J.P. and Trivedi, S.P. (2006). *Fundamentals of Toxicology*. Kolkata, India: New Central Book Agency (P) Ltd.

- Trivedi, P.C. and Sharma, K.C. (2003). *Biodiversity Conservation*. Jaipur: . Avishekar Publishers.
- Trivedi, R.N. (1993). *Text Book of Environmental Sciences*. New Delhi: Anmol Publications Pvt. Ltd.
- Shukla, S.K. and Srivastava, P.R. (1992). *Water Pollution and Toxicology*. New Delhi: Common-Wealth Publishers.
- Subramanian, M.A. (2004). *Toxicology. Principles and Methods*. Chennai: MJP Publishers.
- Sharma, P.D. (1999). *Ecology and Environment*. Meerut: Rastogi Publications.
- Dash, M.L. (1996). *Fundamentals of Ecology*. New Delhi: Tata McGraw-Hill Publishing Company Ltd.
- Odum, E. P. (1983). *Basic Ecology*. USA: W.B. Saunders Company.

## Semester I

### Optional: In-depth study paper (4) Applied Immunology and Microbiology

Sub. Code: MPZ187

No. of hours per week		Credit	Total no. of hours	Marks
Contact	Library	5	45	100
3	4			

#### Objective

To provide knowledge on recent research in immunology and microbiology and its applications.

#### Unit I

**Basic concepts and functions of Immune system:** Immunity: innate and acquired immunity. Lymphoid organs and cells of the immune system. Antigens - preparation of antigens, types of antigens - haptens, super antigens and clusters of differentiation molecules (CDs). Immunoglobulins - structure and types, genetic diversity of immunoglobulin, Abzymes (catalytic antibodies). Immune response: humoral and cell mediated immune response. Immunohematology. Hypersensitivity (Immediate and delayed type). Vaccines and Immunization schedule. Hybridoma technology and monoclonal antibodies.

#### Unit II

**Techniques in immunology:** Antigen-Antibody reactions: agglutination reactions (Widal, Hemagglutination) - tube agglutination reaction, slide agglutination reaction, indirect agglutination inhibition reaction (Human Chorionic Gonadotropin (HCG) detection in urine). Precipitation reactions: Immuno-diffusion, Immuno-electrophoresis, Immuno-blotting, ELISA, RIA, fluorescence immunosorbent assay, immuno-electronmicroscopy. Purification techniques: Centrifugation, Electrophoresis, Chromatography.

#### Unit III

**Biodiversity of microbes and application:** Microbial diversity: bacteria, viruses, micro algae, micro fungi & protozoans. Genetically modified organisms. Microbes in Nanotechnology, applications of microbes in tissue engineering and therapeutics. Microbial products, biopolymers, biosurfactants, biofertilizers, biopesticides, bioluminescence, carbon sequestration.

#### Unit IV

**Techniques in Microbiology:** Sterilization – Physical and chemical control of microorganisms. Identification of microorganisms: morphological and biochemical methods. Molecular biological techniques: DNA microarrays/chips. DNA finger printing – RFLP, plasmid profiles, 16S rRNA in taxonomy and phylogeny. Microscopy and its applications - Light Microscopy – bright field, dark field, phase contrast, fluorescent and polarization microscopes, confocal microscope. Susceptibility test for antimicrobial activity - Disc diffusion - well diffusion. Etest.

#### Unit V

Tumour Immunology – Diagnosis and therapy. Transplantation immunology. Microbial food spoilage and its control. Antimicrobial agents (anti-bacterial, anti- fungal, anti- viral and anti-protozoan) and their mode of action.

Review of relevant research articles in the field of applied immunology and microbiology.

## Reference Books

- Kuby, J. (1997). *Immunology*. New York: W.H. Freeman and Company.
- Ivan Roitt, Peter Delves (2001). *Roitt's Essential Immunology* (10<sup>th</sup> ed.). New York: John Wiley and Sons Pvt. Ltd.
- Ashim, K. Chakravarty (2007). *Immunology and Immunotechnology* (2<sup>nd</sup> ed.). Delhi: Saurabh Printers Pvt. Ltd.
- Barbara, B. M. and Stanley, M.S. (1980). *Selected methods in Cellular Immunity*. New York: W.H. Freeman and Company.
- Glynni, L.E. and Steward, M.W. (1977). *Immunochemistry*. New York: John Wiley and Sons Pvt. Ltd.
- Dubey R.C. and D.K. Maheswari (2005). *A text book of Microbiology*. New Delhi: S. Chand and Co.
- Prescott, Harley and Klein (2005). *Microbiology*. New York: WCB McGraw-Hill Co. Ltd.
- John L. Ingraham and Catherine A. Ingraham (2004). *Introduction to Microbiology*. California: Thomson Books/ Cole.
- Purohit, S.S. (2003). *Pharmaceutical Microbiology*. India: M/S Saraswati Purohit.
- Vijaya Ramesh K. (2004). *Environmental Microbiology*. Chennai: MJP Publishers.