

15. B.Sc ZOOLOGY PROGRAMME- MODEL – III

**1. B.Sc. (BIOLOGICAL TECHNIQUES AND
SPECIMEN PREPARATION) (B.Sc. BT & SP)**

**2. INDUSTRIAL MICROBIOLOGY(DOUBLE
CORE)**

1. B.Sc. BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION (B.Sc. BT & SP)

Total Credits 120
Total Instructional Hours 150

a. SCHEME OF DISTRIBUTION OF HOURS & EXAMINATION

i. THEORY:

Theory Examinations will be conducted by the University at the end of the respective semester in which the course is conducted. Duration 3 Hrs (Internal External ratio =1:4)

SEMESTER 1

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English- (<i>From Board of studies - English</i>)	Common Course	5	4	1	4
2	ZB1CRT01	Introduction to Biological Sciences	Core Course 1 : Theory	2	2	1	4
3		Introduction to Biological Sciences	Core Course 1 : Practical	2	0	0	0
4	ZB1CRT02	Collection and Preservation of Biological Specimen 1 (Plants)	Core Course 2 : Theory	2	2	1	4
5		Collection and Preservation of Biological Specimen 1 (Plants)	Core Course 2 : Practical	2	0	0	0
6	ZB1CRT03	Collection and Preservation of Biological Specimen 2 (Animals)	Core Course 3 : Theory	2	2	1	4
7		Collection and Preservation of Biological Specimen 2 (Animals)	Core Course 3 : Practical	2	0	0	0
8		Biochemistry-1 (From Board of Studies“ Biochemistry)	Complementary I : Theory	2	2	1	4
9		Practical	Complementary I :	2	0	0	0

			Practical				
		Zoology -1 (From Board of Studies- Zoology)	Complementary II : Theory	2	2	1	4
		Practical	Complementary II : Practical	2	0	0	0
Total				25 hrs	14		

SEMESTER 2

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English (<i>From Board of studies – English</i>)	Common Course	5	4	1	4
3	ZB2CRT04	General Biological Techniques	Core Course 4 : Theory	2	2	1	4
4		General Biological Techniques	Core Course 4 : Practical	2	2	1	4
5	ZB2CRT05	Teaching Laboratory Techniques	Core Course 5 : Theory	2	2	1	4
6		Teaching Laboratory Techniques	Core Course 5 : Practical	2	2	1	4
7	ZB2CRT06	Food Microbiology & Biotechnology	Core Course 6 : Theory	2	2	1	4
8		Food Microbiology & Biotechnology	Core Course 6 : Practical	2	2	1	4
8		Biochemistry-2 (From Board of Studies - Biochemistry)	Complementary I : Theory	2	2	1	4
9		Practical	Complementary I : Practical	2	2	1	4
		Zoology -2 (From Board Of Studies- Zoology)	Complementary II : Theory	2	2	1	4
		Practical	Complementary II : Practical	2	2	1	4
Total				25 hrs	24		

SEMESTER 3

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZB3CRT07	Physiology With Clinical Correlation	Core Course 7 : Theory	3	3	1	4
2		Physiology With Clinical Correlation	Core Course 7 : Practical	2	0	0	0
3	ZB3CRT08	Clinical Chemistry an Clinical Microbiology	Core Course 8 : Theory	3	3	1	4
4		Clinical Chemistry and Clinical Microbiology	Core Course 8 : Practical	2	0	0	0
5	ZB3CRT09	Tissue Culture and Gene Manipulation	Core Course 9 : Theory	3	3	1	4
6		Tissue Culture and Gene Manipulation	Core Course 9 : Practical	2	0	0	0
7		Biochemistry-3(From Board Of Studies“ Biochemistry)	Complementary I : Theory	3	3	1	4
8		Practical	Complementary I : Practical	2	0	0	0
9		Zoology -3 (From Board Of Studies Zoology	Complementary II : Theory	3	3	1	4
10		Practical	Complementary II : Practical	2	0	0	0
Total				25 hrs	15		

SEMESTER 4

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZB4CRT10	Radiology and Advanced Instrumentation Techniques	Core Course 10 : Theory	3	3	1	4
2		Radiology and Advanced Instrumentation Techniques	Core Course 10 : Practical	2	2	1	4
3	ZB4CRT11	Entrepreneurship Development and Marketing	Core Course 11 : Theory	3	3	1	4
4		Entrepreneurship Development and Marketing	Core Course 11 : Practical	2	2	1	4
5	ZY4CRT04	Research methodology, Biophysics & Biostatistics (Core Course IV of Board of Studies - Zoology)	Core Course 12 : Theory	3	3	1	4
6		Research methodology, Biophysics & Biostatistics	Core Course 12 : Practical	2	2	1	4
7		Biochemistry - 4 (From Board of Studies - Biochemistry)	Complementary I : Theory	3	3	1	4
8		Practical	Complementary I : Practical	2	2	1	4
9		Zoology - 4 (From Board of Studies – Zoology)	Complementary II : Theory	3	3	1	4
10		Practical	Complementary II : Practical	2	2	1	4
Total				25 hrs	25		

SEMESTER 5

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY5CRT05	Environmental Biology & Human rights	Core Course 13 : Theory	3	3	1	4
2	ZY5CRPO5	Environmental Biology & Human rights	Core Course 13 : Practical	2	0	0	0
3	ZY5CRT06	Cell Biology & Genetics	Core Course 14 : Theory	3	3	1	4
4	ZY5CRPO6	Cell Biology & Genetics	Core Course 14 : Practical	2	0	0	0
5	ZY5CRT07	Evolution, Ethology & Zoogeography	Core Course 15 : Theory	3	3	1	4
6	ZY5CRPO7	Evolution, Ethology & Zoogeography	Core Course 15 : Practical	2	0	0	0
7	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	Core Course 16 : Theory	3	3	1	4
8	ZY5CRPO8	Human Physiology, Biochemistry & Endocrinology	Core Course 16 : Practical	2	0	0	0
9	ZY5OPT01	1 – Vocational Zoology (Apiculture, Vermiculture, Ornamental fish culture)	Open Courses for other streams (<i>Select any one out of three</i>)	4	3	1	4
	ZY5OPT02	2 – Public health and Nutrition					
	ZY5OPT03	3 – Man, nature & Sustainable Development					
		Project work & Field Visit/Study Tour, Visit to research institutes , Group activity	Project work	1	0		
Total				25 hrs	15		

SEMESTER 6

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY6CRT09	Developmental Biology	Core Course 17 : Theory	3	3	1	4
2	ZY6CRP09	Developmental Biology	Core Course 17 : Practical	2	2	1	4
3	ZY6CRT10	Microbiology & Immunology	Core Course 18 : Theory	3	3	1	4
4	ZY6CRP10	Microbiology & Immunology	Core Course 18 : Practical	2	2	1	4
5	ZY6CRT11	Biotechnology, Bioinformatics and Molecular Biology	Core Course 19 : Theory	3	3	1	4
6	ZY6CRP11	Biotechnology, Bioinformatics and Molecular Biology	Core Course 19 : Practical	4	2	1	4
7	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course 20 : Theory	3	3	1	4
8	ZY6CRP12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course 20 : Practical	2	2	1	4
9	ZY6CBT01	Elective 1: Ecotourism & Sustainable Development	Choice Based Core Elective Courses (<i>Select any one out of four</i>)	3	2	1	4
	ZY6CBT02	Elective 2: Agricultural pest management					
	ZY6CBT03	Elective 3: Vector & Vector borne Diseases					
	ZY6CBT04	Elective 4: Nutrition, Health & life style management					
10	ZB6PRP01	Project work & Field Visit/Study Tour, Visit to research institutes , Group activity	Project		2		
11	ZB6OJP01	OJ (64 Hrs + 36 Hrs)	OJ		3		
Total				25 hrs	27		

**ii. SCHEME FOR PRACTICAL EXAMINATION
FOR BSc (Biological Techniques and Specimen Preparation)
BSc (BT&SP)**

University Practical Examinations will be conducted at the end of even semesters (Semester II, IV and VI).

Semester	Code	Course	Exam duration	Marks-ratio		Credits
				Internal (I)	External (E)	
2	ZB2CRP01	Practical 1 (Core 1 & 4)	3 hrs	1	4	2
	ZB2CRP02	Practical 2 (Core 2 & 5)	3 hrs	1	4	2
	ZB2CRP03	Practical 3 (Core 3 & 6)	3 hrs	1	4	2
		Complimentary 1 Biochemistry	3 hrs	1	4	2
		Complimentary 2 Zoology	3hrs	1	4	2
4	ZB4CRP04	Practical 4 (Core 7 & 10)	3 hrs	1	4	2
	ZB4CRP05	Practical 5 (Core 8 & 11)	3 hrs	1	4	2
	ZB4CRP06	Practical 6 (Core 9 & 12)	3 hrs	1	4	2
		Complimentary 1 Biochemistry	3 hrs	1	4	2
		Complimentary 2 Zoology	3hrs	1	4	2
6	ZY6CRP03	Practical 7 (Core 13 & 17)	3 hrs	1	4	2
	ZY6CRP04	Practical 8 (Core 14 & 18)	3 hrs	1	4	2
	ZY6CRP05	Practical 9 (Core 15 & 19)	3 hrs	1	4	2
	ZY6CRP06	Practical 10 (Core 16 & 20)	3 hrs	1	4	2

b. SYLLABUS THEORY & PRACTICALS

**(BIOLOGICAL TECHNIQUES AND SPECIMEN
PREPARATION) (B.Sc. BT & SP)**

SEMESTER I

ZB1CRT01 - CORE COURSE 1 INTRODUCTION TO BIOLOGICAL SCIENCES

36 hrs

Credits 2

OBJECTIVES

1. To develop proper scientific mind, culture and work habits
2. To emphasize the central role that biological sciences plays in the life of all organisms
3. To introduce the student to some of the present and future applications of bio-sciences

Module 1

6 Hrs

What is biology: Salient features of life; Importance of biology on the frontiers of science and technology, History of Biology, Biology in ancient times, Landmarks in the progress of Biology, Branches of Biology

Module 2

8 Hrs

Introduction to the world of living organisms: Outline classification of living organism, levels of biological organization, Broad overview of life on earth; history and evolution of life on earth, Theories of evolution, origin and progression of life on earth.

Module 3

10 Hrs

Chemicals of life: Elements found in living organisms, acids and bases, An overview of Carbohydrates, proteins, lipids, nucleic acids, vitamins and minerals including functions, physical, chemical properties, basic units, types, Physical chemistry and significance of water, interactions between molecules.

Module 4

6 Hrs

Homeostasis: Definition, Concept and importance in biological system. Control systems in biology, general idea of biological negative feedback mechanisms and temperature regulation.

Module 5

6 Hrs

Nature and Scope of biology: Branches of biology- Botany, Zoology, Cell biology, Molecular biology, Developmental biology, Marine biology, Ecology, Physiology, Anatomy, Morphology, Genetics, Biochemistry, Microbiology, Biotechnology

References

1. Debbies Holmes, Peter Moody and Diana Dine (2006) Research methods for the Biosciences. International student Edition: Oxford University Press. P. 288-299.
2. Bowler Peter J. And Iwan Rhys Morus (2005) Making Modern Science: A Historical Survey. University of Chicago Press, Chicago, IL:
3. N. Campbell and J. Reece (2005) Principles of Biology: Interactive textbook from Nature Education Biology: 7th edition, Pearson, Benjamin, Cummings
4. Chakrabarti B K, Ghosh H N & Sahana S N (1984): Human Physiology, The New Book Stall, Calcutta, India
5. Ernst Mayr (1982) The Growth of Biological Thought: Diversity, Evolution and Inheritance. Published by Harvard University Press.
6. Ernst Myer. (1997). This is Biology: The Science of the living World. University Press, Hyderabad, India
7. Kuhn, Thomas. (1996) The Structure of Scientific Revolutions 3rd ed.: University of Chicago Press, Chicago, IL
8. Knudsen, J.W (1966) *Biological Techniques* Harper International Edition by Harper & Row
9. Marie, M (2005) Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers
10. D.E. Metzler (2003) Biochemistry: The chemical reactions of living cells: Volumes I & II, 2nd edition, Academic Press
11. Roger Eckert; D Randall; George Augustine (1988) *Animal Physiology, Mechanism and Adaptations*, W.H Freeman, New York
12. Taylor et al., (2008) Biological Science Cambridge University Press,
13. Thomas, A.P (2009) Biology – Perspectives and Methods. Green Leaf Publishers, Kottayam.
14. K. Vijayakumaran Nair & Biju Dharmapalan (2010) Methodology and Perspectives of Science; Publisher: Trivandrum: Academica.

SEMESTER I

CORE COURSE 1 INTRODUCTION TO BIOLOGICAL SCIENCES (PRACTICAL)

36 Hrs

0 Credit

1. Simple identification of any 5 vertebrates and 5 invertebrates upto species and differences in classification of vertebrates and invertebrates **6 Hrs**
2. Identification of a) plant c
3. ell (onion cell) b) animal cell (cheek cell) (5 hrs)
4. Study on food chain and food web **5 Hrs**
5. Physiological Measurements: Blood Pressure (normal & under stress) and Temperature **8 Hrs**
6. pH measurements **6 Hrs**
 - a) Measurement of pH of different solutions, like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter
 - b) Determination of pH of water
7. Titration experiments: estimation of acids and bases **6 Hrs**

SEMESTER I

ZB1CRT02 - CORE COURSE 2 COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 1 (PLANTS)

36 Hrs

2 Credits

Objectives

1. To introduce the student to some of the collection and preservation of plant specimens
2. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science

Module 1

12 Hrs

Broad classification of plants: where and how to collect plants, Overview of economically important plants, preparation and storage of herbarium sheets; preparation of dry specimens for

display boxes; preparation of museum specimens. Modelling materials: characteristics of teaching models, proportions, durability, attractiveness, innovativeness.

Module 2

9 Hrs

Anatomy of Plants: Special features of anatomical sections of monocot and dicot stems and roots; Double staining methods; Special staining methods; Preparation and storage of permanent slides.

Module 3

9 Hrs

Cell division stages: Stages of Mitosis and Meiosis in Plants; Sources of materials; Preparation of permanent slides showing stages of division; Use of chemicals to arrest division; Special stains and their preparation.

Module 4

6 Hrs

Distribution of plants: methods of survey, different approaches of sampling, determination of frequency dominance

References

1. Aggarwal S.K (2009) Foundation Course in Biology Ane's Students Edition
2. Cappuccino J.G., and Sherman, N. Microbiology – A Laboratory Manual 3rd Ed. The Benjamin/Cummings Publishing Co.
3. Dubey, R.C. and Maheshwari, D.K. (2002) Practical Microbiology S.Chand & Company Ltd.
4. Eldon D. Enger, Frederick C. Ross and David Bailey (2008) (Eleventh Edition) Concepts in Biology. Tata – McGraw Hill, New Delhi
5. Talaro, K.P., and Talaro, A. 2002. Foundations in Microbiology 4th Ed. McGraw Hill.
6. Taylor, Green, Stout (2008) Biological Science, Cambridge University press.

SEMESTER 1

CORE COURSE 2

COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 1 (PLANTS) (PRACTICALS)

36 Hrs

0 Credit

1. Preparation of herbarium sheets **(5 Hrs)**
2. Identification of mitotic stages: onion root tip **(5 Hrs)**

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| 3. Preparation of museum specimens | (5 Hrs) |
| 4. Preparation of display boxes of dry plant and plant product mounts | (5 Hrs) |
| 5. Preparation of whole mounts | (4 Hrs) |
| 6. Collection and preservation of materials for anatomical and cytological studies | (2 Hrs) |
| 7. Preparation of teaching models [Plaster of Paris, Epoxy Resin, Clay] | (10 Hrs) |

SEMESTER 1

ZB1CRT03 - CORE COURSE 3 COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 2 (ANIMALS)

**36 Hrs
2 Credits**

Objectives

1. To introduce the student to some of the collection and preservation of animal specimens
2. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science

Module 1 **10 Hrs**

Collection and preservation of invertebrates: (Protista, porifera, coelenterata, ctenophora, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, hemichordata)

Module 2 **6 Hrs**

Collection and preservation of vertebrates: Pisces, aves, amphibians, reptiles and mammals

Module 3 **8 Hrs**

Life cycles: study on life cycle of a selected animal from each phylum (Protista, porifera, coelenterata, ctenophora, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, hemichordate, Pisces, aves, amphibians, reptiles and mammals)

Module 4 **6 Hrs**

Preparation of specimens: Preparation of museum specimens, articulated skeletons, Dermestid technique, Alizarin preparation and resin-embedded specimens, Preparation of sections involving microtome and cryostat, Taxidermy.

Module 5

6 Hrs

Demographic Techniques and Population Patterns of animals: Techniques Used to Quantify Population Density, Patterns of Spacing, Fragmented Habitats, Spatial Arrangement of Habitats and Organisms.

References

1. Blamire, J. (1994) Exploring Life- The Principles of Biology, Wm. C. Brown Publishers
2. Campbell, N.A., and Reece, J.B (2005) Biology. 7th (International) Ed. Pearson-Benjamin-Cummings
3. Green, N.P.O., Stout, G. W. & Taylor, D.J (1990) Biological Science 2nd Ed. Cambridge Low Price Edition, Cambridge University Press.
4. Knudsen, J.W (1966) Biological Techniques Harper International Edition by Harper & Row
5. Hickman, C.P., Roberts, L.S. and Larson, A (2003) Animal Diversity 3rd Ed. Mc Graw Hill
6. Miller, S.A., and Harley J.P. (2005) Zoology. 6th Ed. Mc Graw Hill

SEMESTER I

CORE COURSE 3

COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 2 (ANIMALS) (PRACTICALS)

36 Hrs

0 Credit

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| 1. Whole mount preparation of small animals and parts of animals | (9 Hrs) |
| 2. Alizarin preparation of small invertebrates | (4 Hrs) |
| 3. Preparation of articulated skeletons | (6 Hrs) |
| 4. Preparation of resin embedded specimens | (4 Hrs) |
| 5. Demonstration of Taxidermy | (5 Hrs) |
| 6. Preparation of specimens by each student from a given phylum | (4 Hrs) |
| 7. Frequency distribution of animals in a specific area of campus | (4 Hrs) |

SEMESTER 2

ZB2CRT04 - CORE COURSE 4 GENERAL BIOLOGICAL TECHNIQUES

36 Hrs
2 Credits

Objectives

1. To impart a knowledge and understanding of biological experimental techniques, including practical laboratory skills
2. To familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences

Module 1

12 Hrs

Microscopy: Magnification and Resolution, bright field, dark field, phase contrast, stereoscopic, fluorescence, polarization microscopy, electron microscopy-SEM, TEM.

Ocular and stage micrometers; Hemocytometer; Camera lucida

Module 2

6 Hrs

Separation techniques: Centrifuge, chromatography, electrophoresis

Module 3

6 Hrs

Analytical techniques: Colorimeter, pH meter, Spectrophotometer, x-ray crystallography.

Module 4

12 Hrs

Microbiological Techniques: Identification of common microorganisms, culture techniques; Types of solid and liquid culture media for bacteria, fungi, algae and protozoa (at least 2 for each); Sterilization methods, Cell counting and methods for measuring microbial growth; Storage and maintenance of Stock cultures.

References

1. Bhaskaran, K.K (1986) Microtechnique and Histochemistry. Evershine Press, Vellangalloor
2. Cappuccino, J.G., and Sherman N. *Microbiology – A Laboratory Manual* 3rd Ed. The Benjamin/Cummings Publishing Co
3. Dubey, R.C. and Maheshwari, D.K (2002) Practical Microbiology S.Chand & Company Ltd.
4. Junqueira, L.C., and Carneiro, J (2005) Basic Histology 11th Ed. Mc Graw Hill
5. Talaro, K.P., and Talaro, A (2002) Foundations in Microbiology 4th Ed. McGraw Hill.

SEMESTER 2

ZB2CRP01 - CORE COURSE 4 GENERAL BIOLOGICAL TECHNIQUES (PRACTICALS)

**36 Hrs
Credit 2**

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| 1. Light microscope: its parts and their description | (3 Hrs) |
| 2. Use of ocular and stage micrometers for measurement of width of hair etc. | (5 Hrs) |
| 3. Camera lucida | (4 Hrs) |
| 4. Chromatography | (10 Hrs) |
| 5. Instrumentation-pH meter, Colorimeter, centrifuge, electrophoresis | (8 Hrs) |
| 6. Counting cells in hemocytometer; Growth Curve | (6 Hrs) |

SEMESTER 2

ZB2CRT05 - CORE COURSE 5 TEACHING LABORATORY TECHNIQUES

**36 Hrs
Credits 2**

Objectives

1. To impart a knowledge and understanding of biological experimental techniques, including practical laboratory skills.
2. To learn about laboratory techniques, water, soil and air analyses.

Module 1

10 Hrs

Organization of a teaching laboratory: equipment, reagents, glass wares, specimens, purchase and maintenance of stock register

Module 2

8 Hrs

Distillation of water: Types of distillation stills [metal, solar, glass still], Cleaning agents for glassware, Methods of sterilization and storage of glassware.

Module 3

6 Hrs

Water pollution: Abiotic and biotic pollutants of water and their indicators; Assay techniques (any 5).

Module 4

6 Hrs

Air pollution: Introduction to air pollution, various factors contributing to air pollution, common air pollutants and sources of air pollutants, technology for air pollution control, Assay techniques (any 5).

Module 5

6 Hrs

Soil pollution: Introduction to soil pollution, types and sources, main causes and effects, control measures of soil pollution. Assay techniques (any 5).

References

1. Arms, K. (1990) Environmental Science, Saunders College Publishing
2. Christopher.F Forster, D.A. John Wase, (1987) Environmental Biotechnology, Ellis Harwood.
3. Joseph C. Daniel (1999), Environmental aspects of Microbiology, Bright Sun publication
4. Khopkar, S.M (1993) Environmental Pollution Analysis, New Age International (P) Limited Publishers
5. Robert Jennings Heinsohn, Robert Lynn Kabe (1999) Sources and Control of Air Pollution, Prentice Hall
6. Sharma, P.D (1994) Ecology and Environment 6th ed. Rastogi Publications
7. R. P. Singh (2012) Microbiology, Kalyani Publishers

SEMESTER 2

**ZB2CRP02 - CORE COURSE 5
GENERAL LABORATORY TECHNIQUES
(PRACTICALS)**

36 Hrs

2 Credits

1. Components of distillation stills and ion exchanger **(2 Hrs)**
2. Cleaning of dirty glass wares using various cleaning agents. **(4 Hrs)**
3. Sterilization of glass wares [using hot air oven and autoclave] **(4 Hrs)**
4. Analysis of water pollutants:
 - Determination of hardness of water **(3 Hrs)**
 - Determination of residual chlorine of water **(3 Hrs)**

Estimation of COD	(3 Hrs)
Estimation of BOD	(3 Hrs)
Bacteriological examination of water by MPN method	(6 Hrs)
5. Analysis of soil pollutants: Determination of total bacterial populations from soil	(4 Hrs)
6. Analysis of air pollutants: Enumeration of microorganisms from air	(4 Hrs)

SEMESTER 2

ZB2CRT06 - CORE COURSE 6 FOOD MICROBIOLOGY & BIOTECHNOLOGY

36 Hrs
2 Credits

OBJECTIVES

1. To make aware of different useful microorganisms, their role in food processing and preservation.
2. To understand the factors and predict microorganisms, which can cause foodspoilage.
3. To understand the causes of foodborne diseases.
4. To give a brief outline of food production through biotechnology

Module 1 8 Hrs

Roles of microbes in food production: Bread, wine, curd, yoghurt, cheese, , food and fodder yeast. Mushroom production.

Module 2 8 Hrs

Preservation and spoilage of food: Principles underlying spoilage of food, causes of spoilage, classification of food by ease of spoilage.

Control of microbes in food; Sterilization- Preservation by the use of high temperature, low temperature, drying. Aseptic packaging , Canning

Module 3 8 Hrs

Food borne diseases: Important groups of bacteria associated with various foods. Food poisoning , food borne infections and intoxication. Brief description on *Clostridium botulinum*, *Vibrio*, *Salmonella*, *Hepatitis A*, *E. coli* 0157:H7, *Listeria*.

Module 4 6 Hrs

Food additives and adulteration: Uses of food additives: Non preservative, preservative.

Food adulterants & Prevention of Food Adulteration: common adulterants for foods like milk and milk products, atta, edible oils, cereals, condiments and curry powder.

Module 5

6 Hrs

Biotechnology in food production: Transgenic plants-Flavr- savr tomatoes; Nutritionally enriched foods: Golden rice, “heart healthy” canola oil. GM foods- advantages and disadvantages. Single cell protein, algae as food. Biotechnological potential of microalgae, food, feed and fuel production of pharmaceutically valuable microalgae.

References

1. M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers .
2. Bala Subramanian D., C.F & Bryle & K. Dharmarajan J. Green Kunthala Jayaraman (2007) Concept in Biotechnology. University Press
3. Colin Ratledge & Bijorn Kristiansen (2008) Basic Biotechnology 3 rd ed. Cambridge University
4. W.C. Frazier and Westhoff, . Food Microbiology.
5. Lindsay, (1988) Willis Biotechnology, Challenges for the flavour and food industries", Elsevier Applied Science.
6. George J.B., (1987) Basic Food Microbiology, CBS Publishers & Distributors,
7. Gavin Brooks (1998) Biotechnology in Healthcare: An Introduction to Biopharmaceuticals Pharmaceutical Press.
8. Janarthanan S & Vincent S (2007) Practical Biotechnology, Method of Protocols. University Pres .
9. John E. Smith (2005) Biotechnology Cambridge Low priced ed. (Third Ed)
10. Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.
11. Roger A., Gorden B., and John T., (1989). Food Biotechnology Cambridge University Press
12. Ronald H. Schmidt and Gary E. Rodrick. (2002). Food Safety Handbook. Wiley; 1st edition. Part 1: Definition of food safety and characterization of food hazards.
13. Ronald H. Schmidt and Gary E. Rodrick (2002) Food Safety Handbook. Wiley; 1st edition. Part 2: Prevalence of foodborne pathogens
14. Singh B.D. (2002) Biotechnology Kalyan Publishers Nw Delhi.
15. N Shakuntala Manay, M. Shadakshara Swamy Food-Facts and Principles II Ed. New Age International Pub.

16. Som Nath Mahindru (2009). Food additives: characteristics, detection and estimation New Delhi APH Publ. Corp.

SEMESTER 2

ZB2CRP03 - CORE COURSE 6 FOOD MICROBIOLOGY & BIOTECHNOLOGY (PRACTICALS)

36 Hrs

2 Credits

1. Preparation of fermented foods: curd, yogurt. **(6 Hrs)**
2. Isolation and Enumeration of bacteria from spoiled food (vegetables, meat and fish) .
(8 Hrs)
3. Identification of bacteria from spoiled food samples. **(6 Hrs)**
4. Qualitative analysis of milk by standard plate count method. **(6 Hrs)**
5. Methylene blue reduction test for microbial contamination of milk. **(5 Hrs)**
6. Food adulteration detection by physical and chemical tests. **(5 Hrs)**
Physical tests; Tea leaves, Black pepper, Cumin seeds, Cloves, Arhar dal (Toor dal)
Chemical tests; Coffee powder, Turmeric powder, Coconut oil, Ghee, Jaggery, Sugar

SEMESTER 3

ZB3CRT07 - CORE COURSE 7 PHYSIOLOGY WITH CLINICAL CORRELATION

54 Hrs

3 Credits

Objectives

1. To inspire the students in learning the frontier areas of biological sciences
2. To appreciate the correlation between structure and function of organisms
3. To make them aware of the different body systems and the need for maintaining good health through appropriate life style.

Module 1 **2 Hrs**

Basics of human physiology: levels of structural organisation- chemical level, cellular level (in brief), tissue level- epithelial tissue, connective tissue, membranes.

Module 2 **6 Hrs**

Muscular system: types of muscular tissue, ultra structure of myofibril, sliding filament mechanism, neuromuscular junction, muscle metabolism, common clinical abnormalities (any 8).

Respiratory system: functional organization, common clinical abnormalities

Module 3 **10 Hrs**

Nervous system: structure of neuron, electrical signals in neuron, signal transmission, anatomy of brain and anatomy of spinal cord, spinal cord physiology, common clinical abnormalities (any 8).

Module 4 **8 Hrs**

Endocrine system: anatomy of endocrine glands, hormone activity, mechanism of hormone action, functions and common clinical abnormalities (any 8).

Module 5 **10 Hrs**

Cardiovascular system: anatomy of Heart and circulation of blood, cardiac conducting system, ECG, cardiac cycle, cardiac output, composition of blood, blood clotting and blood groups, blood pressure and Common clinical abnormalities (any 8)

References

1. Fox, S.I.(2006) Human Physiology 9th ed. McGraw Hill International Edition
2. Guyton and Hall (2006) Text book of Medical Physiology
3. Seeley, R.R., Stephens, T.D., and Tate, P(2006) Anatomy and Physiology 7th ed. McGraw Hill International Edition
4. Thibodeau, G.A., and Patton, K.T(2007) Anthon's Textbook of Anatomy and Physiology. 18th ed. Mosby
5. Tortora, G.J., and Derrickson, B (2006) Principles of Anatomy and Physiology 11th ed. John Wiley & Sons, Inc.

SEMESTER 3

CORE COURSE7 PHYSIOLOGY WITH CLINICAL CORRELATION (PRACTICALS)

**36 Hrs
0 Credit**

- | | |
|--|----------------|
| 1. Determination of O ₂ uptake by cockroach [Respirometer] | (3 Hrs) |
| 2. Effect of adrenalin and noradrenalin on the heart beat of frog (demo) | (2 Hrs) |
| 3. Preparation of human blood smear and identification of leucocytes | (6 Hrs) |
| 4. Determination of differential WBC count | (6 Hrs) |
| 5. Estimation of haemoglobin | (4 Hrs) |
| 6. Demonstration of hemin crystals | (3 Hr) |
| 7. ESR | (4 Hrs) |
| 8. Blood grouping (ABO, Rh). | (2 Hrs) |
| 9. Bleeding time and Clotting time | (6 Hrs) |

SEMESTER 3

ZB3CRT08 - CORE COURSE 8 CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY

**54 Hrs
3 Credits**

Objectives

1. To inspire the students in learning the frontier areas of biological sciences
2. To expose the students to fundamentals in clinical chemistry and to make them appreciate the relevance of the subject in biological studies.
3. To make them aware of the pathogens, health related problems, their origin and treatment.

Module 1

12 Hrs

Lifestyle diseases: AIDS, Diabetes Mellitus, Obesity, Cancer, Cardiovascular diseases, kidney disorders, liver disorders.

Module 2

12 Hrs

Functions of various organs and their clinical assessment (Brief treatment only but emphasizing the biochemical aspect): e.g., liver, kidney, heart, pancreas, endocrine glands, lung, brain. Biochemical changes in the organs under pathological conditions.

Module 3 **4 Hrs**

Routine biochemical tests of blood sugar, cholesterol and NPN.

Module 4 **14 Hrs**

Microorganisms of medical importance- Symptoms, causative agents, clinical features, laboratory diagnosis and treatment of important

Bacterial diseases- Diphtheria, Pneumonia, Cholera, Tuberculosis, Salmonellosis, Typhoid

Viral diseases - Common cold, Respiratory Syncytial virus infections, Corona virus (SARS), AIDS

Fungal diseases - Oral thrush, Aspergillosis

Module 5 **12 Hrs**

Parasitic diseases- Symptoms, causative agents, clinical features, laboratory diagnosis and treatment of Malaria, Filariasis, Giardiasis, Amoebiasis,

References

1. Ananthanaryanan R. and C.K.J. Paniker (2009) Text book of Microbiology, 9th edition, University Press (India) Pvt. Ltd. Publisher
2. Elmer W. Koneman (2006) Color Atlas & Textbook of Diagnostic Microbiology 5th edition, Lippincott Publication
3. Cheesbrough, M. (1998) District Laboratory Practice in Tropical Countries Part 1. Cambridge Low Price Edition. Cambridge University Press
4. Cheesbrough, M. (1998) District Laboratory Practice in Tropical Countries Part 2. Cambridge Low Price Edition. Cambridge University Press
5. Mukherjee, K.L. (ed,) (1988) Medical Laboratory Technology Vol. 1. TataMcGraw Hill
6. Mukherjee, K.L. (ed,)(1988) Medical Laboratory Technology Vol. 2. TataMcGraw Hill
7. Mukherjee, K.L. (ed,)(1988) Medical Laboratory Technology Vol. 3. TataMcGraw Hill
8. Philip A. Thomas (2007) Clinical Microbiology, Orient Longman Pvt. Ltd.
9. Talaro, K.P., and Talaro, A. (2002). Foundations in Microbiology 4th ed. McGraw Hill

SEMESTER III

CORE COURSE 8 CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY (PRACTICALS)

36 Hrs
0 Credit

1. Estimation of: blood glucose, total protein in serum, serum albumin, blood urea, creatinine in blood, serum bilirubin, serum cholesterol, serum alkaline phosphatase, serum acid phosphatase. (14 Hrs)
2. Media preparation, Inoculation, and maintenance of bacteria. (7 Hrs)
3. Gram staining (2 Hrs)
4. Acid fast staining (2 Hrs)
5. Widal Test (2 Hrs)
6. Identification of microorganisms (bacteria, fungi) of clinical significance (9 Hrs)

SEMESTER 3

ZB3CRT09 - CORE COURSE 9 TISSUE CULTURE & GENE MANIPULATION

54 Hrs
3 Credits

OBJECTIVES

1. To emphasize the central role that genetics plays in the life of all organisms
2. To learn about the tissue culture techniques
3. To introduce the student to some of the present and future applications of bio-sciences
4. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.

Module 1

12 Hrs

Manipulating DNA: in microbes, plants and animals – overviews

Restriction endonucleases, ligases, cloning vectors [plasmids & phage DNA]

Isolation of genomic DNA, Mechanism of gene transfer and methods, Identification and selection of recombinants.

Recombinant DNA technology and its applications.

Module 2

12 Hrs

Gene Cloning: Introduction and overview of Gene cloning; Techniques, principles and applications

Module 3

8 Hrs

Plant tissue culture: media and composition. Characteristic of plant cells in culture, callus, meristem, anther, embryo, ovule, ovary and endosperm culture

Module 4

12 Hrs

Germ plasm: Storage, somatic hybridization

Module 5

10 Hrs

Animal cell culture: growth media and maintenance of culture. Characteristics of animal cells in culture, hybridoma technology.

References

1. Brown, T.A (2007) Genomes 3. GS Garland Science
2. Glick B.R., Pasternak, J.J. and Patten, C.L (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th ed., ASM Press (Washington DC).
3. James D. Watson (1993) Recombinant DNA: 2nd Edition
4. Prakash, M., and Arora, C.K. (1998) Cell and Tissue Culture Anmol Publications Pvt. Ltd.
5. Rema, L.P (2006). Applied Biotechnology MJP Publishers
6. Surzycki, S. (2003) Human Molecular Biology Laboratory Manual, Blackwell Publishing
7. Watson, J.D., Caudy, A.A., Myers, R.M. and Witkowski, J.A., (2007) Recombinant DNA: Genes and Genomes- A Short Course, Cold Spring Harbor Laboratory Press

SEMESTER 3

CORE COURSE 9 TISSUE CULTURE AND GENE MANIPULATION (PRACTICALS)

36 Hrs

0 Credit

- | | |
|---|-----------------|
| 1. Media formulation for plant tissue culture | (4 Hrs) |
| 2. Surface sterilization. | (2 Hrs) |
| 3. Callus induction. | (2 Hrs) |
| 4. Auxillary bud culture. | (2 Hrs) |
| 5. Isolation of protoplast. | (4 Hrs) |
| 6. Isolation of genomic DNA and its quantification. | (10 Hrs) |
| 7. Isolation of plasmid DNA. | (6 Hrs) |
| 8. Restriction digestion, ligation, bacterial transformation. | (6 Hrs) |

SEMESTER 4

ZB4CRT10 - CORE COURSE10 RADIOLOGY AND ADVANCED INSTRUMENTATION TECHNIQUES

54 Hrs

3 Credits

Objectives

1. To introduce the student to some of the radiological techniques and its applications
2. To develop an awareness about the harmful effects of radiation

Module 1

7 Hrs

Radioactive materials: Types and sources of radiation. Effect of various types of radiation on biological systems. Radioactive emissions.

Module 2

10 Hrs

Isotopes: Definition, isotopes of common biological use, techniques for detection of isotopes and applications - [Autoradiography, Geiger counting technique, liquid scintillation, Gamma counter]

Use of radio isotopes in biological research, auto-radiography- pulse chase experiment.

Isotope dilution technique

Module 3

10 Hrs

Management of radioactive wastes: waste disposal and cleaning of contaminated glassware.

Precautions for handling, safety in use of radiation sources and radio isotopes.

Module 4

12 Hrs

Newer techniques in microscopy: Confocal, Scanning probe microscopy, Flowcytometry & cell sorting.

Module 5

15 Hrs

Chromatographic techniques: Theory, methods and application of paper, gas, affinity, ion exchange chromatography, TLC, HPLC, Gel filtration.

Electrophoresis: Theory, methods and applications of gelelectrophoresis: AGE, PAGE,

Polymerase chain reaction, DNA sequencing, DNA fingerprinting.

References

1. Jones, M., Jones, Geoff, G. and Marchington, P (1999) Physics 2nd ed. Cambridge University Press
2. Jones, M., Jones, Geoff, G, and Acaster D. (1999) Chemistry 2nd ed. Cambridge University Press
3. Blei, I and Odian, G (2006) General, Organic and Biochemistry- Connecting Chemistry to your Life 2nd Ed. W.H. Freeman and Company
4. Kotz, J.C., and Treichel, P(1999) Chemistry and Chemical Reactivity 4th ed. Saunders College Publishing
5. Wilson, K., and Walker, J (2000) Practical Biochemistry- Principles and Techniques 5th ed. Cambridge Low Price Editions, Cambridge University Press

SEMESTER 4

ZB4CRP04 - CORE COURSE10 RADIOLOGY AND ADVANCED INSTRUMENTATIONTECHNIQUES (PRACTICALS)

**36 Hrs
2 Credits**

1. Types and effects of various radiations. Isotope dilution techniques. (Visit to a radioisotope lab.) **(14 Hrs)**
2. Problems in radiology [on half cycle, quantity, disposal] **(14 Hrs)**
3. Agarose gelelectrophoresis: AGE **(8 Hrs)**

SEMESTER 4

ZB4CRT11 - CORE COURSE 11 ENTREPRENEURSHIP DEVELOPMENT AND MARKETING

**54 Hrs
3 Credits**

Objectives

1. To understand the importance of marketing strategies and effects on entrepreneurial development.

Module 1 **8 Hrs**

Institutions, financing procedure and financial incentives.

Module 2 **10 Hrs**

Resource management: man, machine and materials, quality control/ quality assurance and testing of products

Module 3 **12 Hrs**

Elements of marketing & sales management [Nature of product and marketstrategy, packaging and advertising, after sales service]

Module 4 **12 Hrs**

Income tax, sales tax and excise rules

Module 5 **12 Hrs**

Need, scope and approaches for project formulation, structure of project reports. Project implementation, project report and appraisal. Network analysis –PERT, CPM
Entrepreneur traits of entrepreneur

References

1. Khanna, O.P. and Sarup A. (1999) Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd.
2. Khanna, O.P (1999). Work Study, Dhanpat Rai Publications (P) Ltd.
3. Khanna, O.P (1999) Textbook of Mechanical Estimating and Costing, Dhanpat Rai Publications (P) Ltd.

SEMESTER 4

CORE COURSE 11 ENTREPRENEURSHIP DEVELOPMENT AND MARKETING (PRACTICALS)

**36 Hrs
2 Credits**

1. Preparation and analysis of a project **(14 Hrs)**
2. Entrepreneurial motivation training through games, role playing, discussions and exercises **(8 Hrs)**
3. Preparation of report on an industry/firm **(14 Hrs)**

SEMESTER IV

CORE COURSE 12

RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

54 Hrs

3 Credits

Objectives

1. To familiarise the learner the basic concept of scientific method in research process.
2. To have a knowledge on various research designs.
3. To develop skill in research communication and scientific documentation.
4. To create awareness about the laws and ethical values in biology.
5. To equip the students with the basic techniques of animal rearing collection and preservation
6. To help the student to apply statistical methods in biological studies.

RESEARCH METHODOLOGY

Module I

13 Hrs

Basic concepts of research: Meaning, Objectives, Approaches, Types of research.

Research Process: Scientific method in research (eight steps).

Importance of literature reviewing in defining a problem,

Identifying gap areas from literature review.

Research Communication and scientific documentation: Project proposal writing,

Research report writing, (Structure of a scientific paper), Thesis, dissertation, research article.

Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop, Colloquium, Conference

Sources of Information: Primary and secondary sources. Library- Books, Journals, Periodicals, Reviews, Internet.

Search engines Online libraries, e-Books, e-Encyclopedia, Institutional Websites.

Plagiarism

Module II

12 Hrs

Animal Collection – Tools & techniques

Sampling techniques

 Quadrat

 Line transect

Measurements

 Density

 Abundance

 Frequency

Biodiversity indices – concepts

 Simpson index

Collection methods, techniques and equipments

 Plankton

 Insects

 Fish

 Bird

 Preservation techniques – Taxidermy

 Rearing techniques

 Laboratory and field.

Units of measurements- units, SI system, Equivalent weight, normality, molarity

Biophysics

Module III

14 Hrs

Basic understanding on principle and uses of the following:

Microscopy

(a) Light microscopy, Bright field (Compound Microscope), Phase contrast, Dark field microscopy, Fluorescence, Polarization microscopy, Video microscopy.

(b) Electron - Scanning (SEM), Transmission (TEM) and STEM

 Micrometry – Stage and Eyepiece micrometers

Camera Lucida

Instrumentation

pH Meter

Separation Techniques: Centrifuge, Chromatography, Electrophoresis

Analytical techniques: Colorimeter, Spectrophotometer, X-ray crystallography

BIOETHICS

Module IV

5 Hrs

Bioethics : Introduction, Animal rights and animal laws in India, Prevention of cruelty to animals Act 1960, Biodiversity Act 2003.

Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means), Animal use in research and education.

Laboratory animal use, care and welfare, Animal protection initiatives- Animal Welfare Board of India, CPCSEA, ethical commitment. Working with human: Consent, harm, risk and benefits.

BIOSTATISTICS

10 Hrs

Module V

Sample & Sampling techniques: Collection of data, classification of data, frequency distribution tables, graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves - Ogives.

Measures of Central Tendency: Mean, Median, Mode (Problem - Direct method only)

Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits and problems on SD).

Correlation: Definition, Types of correlation.(mention in brief)

Test of Hypothesis and Test of Significance: Basic concept, Levels of significance, test of significance, Procedure for testing hypothesis, types of hypothesis- Null hypothesis and Alternate hypothesis.

References :

1. Gupta K.C, Bhamrah, H.S and G.S.Sandhu (2006) Research Techniques in Biological Sciences. Dominant Publishers and Distributors, New Delhi.
2. Khan and Khanum, (1990) Fundamentals of biostatistics.Press, Chicago,
3. Rastogi, V.B (2009) Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.
4. Ackoff, R.L. (1962) Scientific Method, New York : John Wiley Press.
5. Aggarwal. S.K.(2009) Foundation Course in Biology, 2nd Ed.. Ane's Student Edition. Ane Books Pvt. Ltd.
6. Anderson, J, Durston, B.H. and Poole, M. (1992). Thesis and assignment writing. Wiley Eastern Ltd.
7. Best, J.W.and K.V. James, (1986) Research in Education.5th Edn. Prentice- Hall of India Pvt.Ltd.
8. Campell, R. (1990). Statistics for biologists. CBS Publishers and distributors.
9. Day, R.A. (1993). How to write and publish a scientific paper. Cambridge University Press.
10. Day, R.A. (2000) Scientific English: A guide for Scientists and other Professionals. Universities Press.
11. Fischer, R.A.(1960)The Design of Experiment. 7th rev.edn. New York: Hafner Publishing Co.,
12. Hawkins C. and Sorgi, M. (1987). Research: How to plan, speak and write about it. Narosa Publishing House.
13. Killick, H.J. (1971). Beginning ecology. Ibadan University Press.
14. Kleinbaum, D.G. and M.Klein (2009) Survival analysis-Statistics for Biology & Health 2nd Ed. Springer International ed.
15. Knudsen J. W (1966) Biological Techniques: Collecting,Preserving, and Illustrating Plants and Animals.
16. Kothari, C.R. and G.Garg. (2014) Research Methodology. Methods and Techniques. 3rd edn.

17. Marie, M. (2005). Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers.
18. Norman T.J. (2007) Bailey Statistical methods in biology, Cambridge University press.
19. Roberts, M. T. King and M. Reiss.(1994) Practical Biology for Advance Level. Thomas Nelson and Sons Ltd. Surrey, UK.
20. Ruxton, G.D. and Colegrave, N. (2006), Experinmental design for the life sciences. Oxford University Press.
21. Sateesh, M.K. (2008) Bioethics and Biosafety; I.K. International Publishing House .
22. Taylor D.J. Green N.P.O and Stout G.W. (2008). Biological science (3rd edition- R.S. Oper Ed). Cambridge University press.

PRACTICAL

RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

2 credits

PART A. RESEARCH METHODOLOGY

Animal collection Tools, Techniques & Estimation

1. Quadrate study
2. Transect study
3. Sampling Methods
4. Species area curve
5. Simpson index

PART B - BIOPHYSICS

6. Study of simple and compound light microscopes
7. Micrometry –calibration and measurement of microscopic objects –low power
8. Camera Lucida (draw a few diagrams using Camera Lucida)
9. Paper chromatography (demonstration only)
10. Instrumentation – demonstration (write notes on principle, equipment and its use)
 - pH Meter
 - Colorimeter/ Spectrophotometer

Centrifuge

PART C BIOSTATISTICS

1. MS Excel : To create mean and median, Construction of bar diagram, Pie diagram and Line graphs.
2. MS Access: To create grade of students
3. Internet: Access a web page on any biological topic.
4. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
5. Range and standard deviation for a biological data
6. Correlation using any biological data.
7. Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.

SEMESTER V.

CORE COURSE 13 ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS

(54 Hrs)

Objectives

To instill the basic concepts of Environmental Sciences, Ecosystems, Natural Resources, Population, Environment and Society

To make the students aware of natural resources, their protection, conservation, the factors polluting the environment, their impacts and control measures.

To teach the basic concepts of toxicology, their impact on human health and remedial measures

To create a consciousness regarding Biodiversity, environmental issues & conservation strategies

To develop the real sense of Human rights – its concepts & manifestations

MODULE 1 ECOSYSTEM

12 Hrs

Basic concepts of ecosystem Components of ecosystem: Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers), Ecological pyramid- number, biomass, energy, **Functions of ecosystem:** Productivity-Food chain-Food web-Energy flow-Laws of Thermodynamics.Types of Ecosystem: Terrestrial-Forest-Grassland-Desert, Aquatic-Marine-Fresh water, Wetland &Biome **Concept of limiting factors:** Liebig's and Shelford's laws of limiting factors.

Biogeochemical cycles: Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle.

Renewable resources (solar,wind, hydroelectric, biomass and geothermal) **and Non renewable resources** (mineral and metal ore, fossil fuels)

MODULE 2 CONCEPTS OF POPULATION AND COMMUNITY

8 Hrs

Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves

Animal interactions: Positive- Commensalism- Mutualism-Protocooperation, Negative-Predation-Parasitism-Competition-Antibiosis

Characteristics of a community: Species diversity- richness, evenness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.

MODULE 3 BIODIVERSITY AND ENVIRONMENTAL ISSUES

16 Hrs

Introduction to Biodiversity: Types of biodiversity- Alpha, Beta and Gamma diversity. **Concept and importance of Biodiversity:** Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity, India as a mega-diversity nation, Biodiversity hotspots

Global Environmental Issues: Ozone depletion, Greenhouse effect, Global warming, Climate change, Carbon trading, carbon credit; Carbon sequestration, Acid rain, Oil spills, Nuclear accidents, IPCC/UNFCCC.

National Environmental issues: Deforestation, forest fire, pollution(air, water, soil, noise thermal, nuclear- brief account only) solid waste management, sewage, drinking water crisis and water logging,

Toxic products and disaster: Types of toxic substances – degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster

Flood, drought, cyclone, earthquake and landslide (Management and mitigation)

Local Environmental issues: Landscape alteration, sand mining, quarrying, changing crop pattern, conversion of paddy lands,

Threats to water resources of Kerala: Degrading Mangrove and wetland ecosystems of Kerala, RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc. Impact of tourism on Environment.

MODULE 4 CONSERVATION OF BIODIVERSITY

12 Hrs

Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept. Conservation reserves

Concept of threatened fauna – IUCN categories - extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern and data deficient. Red and Green Data Books.

Man–animal conflict (Tiger, Elephant, Dog, Monkey) – causes and concern

Water conservation- rainwater harvesting, watershed management

Environment education

Environmental laws (Brief account only): The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, Indian Forests Act (Revised) 1982. The Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, 1989, The Forest (Conservation) Act, 1980, The Wildlife Protection Act, 1972, Biodiversity Act, 2002.

MODULE 5 HUMAN RIGHTS

6 Hrs

Introduction, main concepts associated with Human Rights, Different types of human rights,

Manifestations & phenomena, Role of agencies in promoting human rights, Mechanisms for checking violations of human rights, National human right commission, Constitutional provisions related to Human rights.

References

- Erach Bharucha 2008 (UGC). Text Book of Environmental Studies of Undergraduate course. University Press.
- J.B Sharma (2009), Environmental studies' - 3rdEd. University science Press
- Misra S.P., Pandey S.N. 2009 Essential Environmental Studies, Ane books Pvt. Ltd.
- P.D Sharma (2012), Ecology and Environment' - 11th Ed. Rastogi Publications
- R.B Singh & Suresh Mishra Paulami Maiti (1996), Biodiversity – Perception, Peril and Preservation' — PHI Learning , Environmental Law in India: Issues and Responses
- Rajagopalan, R. 2005. *Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.
- Paul R.C., 2000. Situations of Human Rights in India. Efficient offset printers. .
- Arun Kumar Palai (1999) National Human Rights Commission of India, Atlantic publishers
- Sharma P.D. (2005) Environmental biology and Toxicology, Rastogi publication
- Meera Asthana and Astana D.K. 1990 Environmental pollution and Toxicology Alka printers.
- Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders College Publishing, Philadelphia
- Alan Beeby, 2006 Anne – Maria Brennan First Ecology, Ecological principles and Environmental issues . International students edition Sec. edition Oxford University Press.
- Robert Ricklefs (2001). The Ecology of Nature. Fifth Edition. W.H. Freeman and Company.
- Stiling Peter (2002). Ecology: Theories and applications. Prentice Hall of India pvt.Ltd. New Delhi.
- Landis, Wayne and Hing-ho Yu, Boca Raton, 1995. Introduction to Environmental Toxicology: Impacts of chemicals upon Ecological systems: Lewis Publishers.

SEMESTER 5 PRACTICAL

ENVIRONMENTAL BIOLOGY & TOXICOLOGY

36 HRS

CREDIT 1

1. Estimation of dissolved Oxygen
2. Estimation of carbon di oxide
3. Estimation of soil organic carbon (Demonstration only)
4. Identification of marine/ fresh water planktons
5. Counting of plankton using plankton counting chamber
6. Study of equipments – Secchi disc, Plankton net
7. Study of sandy shore fauna, rocky shore fauna.
8. Study of animal Association
9. Visit to any two important areas of bio diversity: 1. Forest, 2.Sea shore, 3. Mangrove, 3. Wet lands, 4. Bird sanctuary, 5. Wild life sanctuary, 6. Sacred groves
10. Field study (compulsory)

SEMESTER V.

CORE COURSE 14

CELL BIOLOGYAND GENETICS

54 Hrs

Credits 3

Objectives

1. To understand the structure and function of the cell as the fundamentals for understanding the functioning of all living organisms.
2. To make aware of different cell organelles, their structure and role in living organisms.
3. To develop critical thinking, skill and research aptitudes in basic and applied biology
4. To emphasize the central role of genes and their inheritance in the life of all organisms.

CELL BIOLOGY

22 HRS

Module I

6 Hrs

Introduction of cell and Diversity of cells: History, Cell theory, Prokaryotes, Eukaryotes, Mycoplasmas, Virus, Virions and Viroids, Prions.

Cell membrane & Permeability: Molecular models of cell membrane (Sandwich model, Unit membrane model, Fluid mosaic model). Cell properties - permeability, Transport [Diffusion, Osmosis, Passive transport, Active transport, bulk transport], Cell coat and Cell recognition.

Module II

10 Hrs

Cell Organelles :Structure and functions of following cell organelles: Endoplasmic reticulum - Structure and functions. Ribosomes (Prokaryotic and Eukaryotic) Golgi complex - Structure and functions. Lysosomes - Polymorphism - GERL concept, functions. Mitochondria - Structure and functions. Nucleus: Structure and functions of interphase nucleus, Nuclear membrane, pore complex, structure and functions of nucleolus

Chromosomes – Structure & organization, Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.

Module III

6 Hrs

Cell Communication: Basic principles of cell communications, Cell signaling (in brief), Types of signaling, Mention signaling molecules (neurotransmitters, hormones, Growth Factors, Cytokines Vitamin A and D derivatives),

Cell Division: Cell cycle - G₁, S, G₂ and M phases, Mitosis and Meiosis. The difference between Mitosis and Meiosis.

References:

1 Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*

2. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition.

John Wiley and Sons.Inc.

3. Koshy Thomas & Joe Prasad Mathew (Editors) (2011) *Cell Biology and Molecular Biology*.
4. Sarada K & Mathew Joseph (Editors) (1999) *Cell Biology, Genetics and Biotechnology*,
- .5. Thomas A.P (Editor) (2011) *Cell & Molecular Biology The Fundamentals*. Green leaf publications. TIES. Kottaya
6. Rastogi S. C. (1998) *Cell Biology*. Tata Mc.Graw Hill Publishing Co., New Delhi.
- 7.Powar C.B. (1983) *Cell Biology* (Himalaya Pub. Company)
8. Ali, S (2014) *The Cell: Organization Function and Regulatory Mechanisms* ,Pearson
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco. 4
10. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.
11. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
12. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- .13. Gupta, P. K (2002) *Cell and Molecular Biology*, (2ed), , Rastogi Publications., Meerut
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15. Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants (1991) *cell structure and function*. Saunder's College Publication
16. James Darnell. (1998) *Molecular Biology*.Scientific American Books Inc.

GENETICS

32 Hrs

Module I

10 Hrs

MendelianGenetics: Mendel's experiments- Monohybrid Cross, Dihybrid Cross, Mendel's Laws, Test Cross, Back Cross and Reciprocal Cross. Chromosome Theory of Inheritance

Interaction of genes: Allelic: Incomplete Dominance (Four O Clock Plant). Co- Dominance (Skin colour in Cattle) Lethal Alleles: Dominant lethal gene [Creeper chicken] and recessive lethal gene

[cystic fibrosis].

Non Allelic: Complementary (Flower colour in Sweet Pea), Supplementary (Coat colour in mice), Epistasis - dominant (Plumage in poultry) and recessive (Coat colour in mice). Polygenes (Skin colour inheritance in man), Pleiotropism (Vestigial wing gene in *Drosophila*).

Multiple alleles – ABO Blood group system, Rh group and its inheritance. Erythroblastosis foetalis.

Module II

12 Hrs

Sex determination: Chromosome theory of sex determination (Autosome and Sex chromosomes), male heterogamy and female heterogamy, (xx-xy, xx-xo, ZZ-ZW, ZZ-ZO), Genic Balance theory of Bridges. Barr bodies, Lyon's hypothesis, Gynandromorphism, sex mosaics, intersex (*Drosophila*), Hormonal [free martin in calf] and Environmental (Bonelia) influence on Sex determination

Recombination and Linkage: Linkage and recombination of genes based on Morgan's work in *Drosophila*, Linked genes, Linkage groups, Chromosome theory of Linkage, Types of linkage- complete and incomplete. Recombination, cross over value, chromosome mapping. [Definition]

Sex Linked inheritance : Characteristics of Sex Linked inheritance, X Linked inheritance of man (Hemophilia), Y linked inheritance [Holandric genes] , Incompletely Sex Linked genes or pseudoautosomal genes (Bobbed bristles in *Drosophila*), Sex limited genes (Beard in man) and Sex influenced genes (inheritance of baldness in man).

Module III

10 Hrs

Mutation: Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations. [Addition, Deletion and substitution].

Human Genetics: Karyotyping, Normal Human chromosome Complement, Pedigree analysis, Aneuploidy and Non- disjunction. Autosomal abnormalities (Down syndrome, Cry du chat syndrome) Sex chromosomal abnormalities (Klinefelters syndrome, Turner's syndrome) Single gene disorder (Brief mention) Autosomal single gene disorder [sickle cell anaemia), Inborn errors of metabolism such as phenylketonuria, alkaptonuria, , Albinism. Multifactorial traits – polygenic disorder- cleft lip and cleft palate.

Genetic Counseling, Eugenics and Euthenics -Brief account only

References:

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3. Sarada K & Mathew Joseph (Editors) (1999) *Cell Biology, Genetics and Biotechnology*,
4. Shirley Annie Oommen, Sampath Kumar S., and Jinsu Varghese (Editors) (2012), *Gene toGenome*. Zoological Society of Kerala, Kottayam.
5. Singh,B.D.(2006). *Biotechnology*.Kalyani Publishers, New Delhi.
6. Thomas A. P (Editor), (2012). *Genetics and Biotechnology- The Fundamentals*. Green Leaf Publications, TIES, Kottayam.
7. Vijayakumaran Nair K. (2012). *Genetics and Biotechnology*. Academica, Trivandrum.
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9. Brown C.H., Campbell I and Priest F, G. (1987). *Introduction of Biotechnology*. Blackwell Scientific Publishers, Oxford.
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11. Hartl, L.D. and E.W.Jones. (2009). *Genetics: Analysis of Genes and Genomes* (7th edn) Jones and Barlett Publishers Inc, USA.
12. Primrose, S.B., Twyman, R.M. and Old, R.W. (2001). *Principles of Gene Manipulation* (6th edn.) Blackwell Science Ltd., London.
13. Sobti, R.C. and Pachauri, S.S. (2009). *Essentials of Biotechnology*. Ane's Book Pvt. Ltd.New Delhi.
14. Sinnat Dunn & Dobzhansky 1959. *Principles of Genetics* (T.M.H. New Delhi)

SEMESTER V

PRACTICAL CELL BIOLOGY AND GENETICS

**36 Hrs
2 Credits**

PART A: CELL BIOLOGY

1. Squash preparation of onion root tip for mitotic stages

2. Mounting of polytene chromosome (Drosophila/Chironomous.) Demonstration
3. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone)
4. Identification of cell organelles
5. Preparation of temporary whole mount.
6. Preparation of permanent whole mount (demonstration)
7. Preparation of human blood smear and identification of Leucocytes

PART B :GENETICS

1. Genetic problems on Monohybrid, Dihybrid Crosses and Blood group inheritance
2. Study of normal male and female human karyotype (use photographs or Xerox copies)
3. Abnormal human karyotypes - Down, Edwards , Klinefelter and Turner syndromes (use photographs or Xerox copies)
4. Sexing of Drosophila.
5. Study of Barr body in human buccal epithelium

SEMESTER V.

CORE COURSE - 15: EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

54 Hrs

Credits 3

Objectives:

- To acquire knowledge about the evolutionary history of earth - living and nonliving
- To acquire basic understanding about evolutionary concepts and theories
- To study the distribution of animals on earth, its pattern, evolution and causative factors
- To impart basic knowledge on animal behavioural patterns and their role

Prerequisite:

- Basic knowledge on principles of inheritance and variation
- Knowledge on molecular basis of inheritance
- Basic understanding on the mechanism and factors affecting evolution
- Knowledge on origin and evolution of man

PART I - EVOLUTION

30 Hrs

Module I - Origin of life**8 Hrs**

Theories - Panspermia theory or Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis, Endosymbiosis.

Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment;

Direct evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.

Module II - Theories of organic evolution**9 Hrs**

Lamarckism and its Criticism, Weismann's Germplasm theory, Darwinism and its Criticism, Neo-Darwinism, Theory of De Vries,

Population genetics and evolution: Hardy-Weinberg Equilibrium, gene pool, gene frequency.

Factors that upset Hardy-Weinberg Equilibrium, Effects of genetic drift on population:

Bottleneck effect and founder effect

Module III – Nature of evolution**13 Hrs**

Species and Speciation: Species concept, subdivisions of species (sub species, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous and allopatric speciation), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation

Isolation: Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution

Microevolution, Macroevolution (Adaptive radiation -Darwin finches) Mega evolution, Punctuated equilibrium, Geological time scale, and Mass extinction (brief account only). Evolution of Horse

PART II - ETHOLOGY**14 Hrs****Module IV– Introduction****1 Hr**

Definition, History and scope of ethology

Module V – Learning, imprinting and behaviour**9 Hrs**

Types of learning with examples; patterns of behaviors – types of rhythms, navigation, homing instinct, hibernation, aestivation; pheromones- types and their effect on behavior, hormones and their action on behavior (aggressive and parental behavior)

Module VI – Social organization**4 Hrs**

Social organization in insects (ants) and mammals (monkey), Courtship behaviour and reproductive strategies

PART III - ZOOGEOGRAPHY**10 Hrs**

Module VII – General Topics**4 Hrs**

Continental drift theory, Types and means of animal distribution, Factors affecting animal distribution; insular fauna – oceanic islands and continental islands,

Module VIII - Zoogeographical realms**6 Hrs**

Palearctic region, Nearctic region, Neotropical region, Ethiopian region, Oriental region, Australian region (brief account with physical features and fauna, Wallace's line, Weber's line, Biogeography of India with special reference to Western Ghats

References:**EVOLUTION**

1. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
2. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
3. Bendall, D. S. (ed.) (1983). Evolution from Molecules to Man. Cambridge University Press, U.K.
4. Bull J.J and Wichman H.A..(2001). Applied Evolution. Annu. Rev. Ecol. Syst. 32:183-217
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10. Coyne J.A. and Allen Orr H. (2004). Speciation, Sinauer Associates
11. Ridley, M. (2004), Evolution 3rd Edition. Blackwell Publishing
12. Rob Desalle and Ian Tattersall (2008). Human Origins: What Bones and Genomes Tell Us about Ourselves. Texas A&M University Press, USA.
13. Strickberger, M.W. 2000. Evolution. Jones and Bartlett, Boston.

ETHOLOGY

1. Agarwal. V. K. (2009). Animal Behaviour. S. Chand and Company Pvt. Ltd., New Delhi.
2. Bonner, J.T. (1980). The Evolution of Culture in Animals. Princeton University Press. NJ, USA.

3. David McFarland. (1999). Animal Behaviour. Pearson Education Ltd. Essex, England.
4. Dawkins, M.S. (1995). Unravelling Animal Behaviour. Harlow: Longman.
5. Dunbar, R. (1988). Primate Social Systems. Croom Helm, London.
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7. Aubrey M. and Dawkins M.S. (1998). An Introduction to Animal Behaviour. Cambridge University Press, UK.
8. Sherman P.W and Alcock J., (2001) Exploring Animal Behaviour- Readings from American Scientist 3rd Edn. Sinauer Associates Inc. MA, USA. (Module 10 & 11).
9. Wilson, E.O. (1975). Sociobiology. Harvard University Press, Cambridge, Mass. USA. (Module 9).

ZOOGEOGRAPHY

1. Briggs, J.C. (1996). Global Biogeography. Elsevier Publishers. (Module VI and VII).
2. Chandran Subash M.D. (1997). On the ecological history of the Western Ghats. Current Science, Vol.73, No.2.146-155.
3. Chundamannil Mammen. 1993, History of Forest management in Kerala. Report No.89. Kerala Forest Research Institute, Peechi, India.
4. Daniels, R.J.R and Vencatesan J. (2008), Western Ghats Biodiversity. People Conservation; Rupa & Co. New Delhi. India.
5. Mani, M.S. (1974). Ecology and Biogeography of India; The Hague: .Dr. W. Junk b.v. Publishers,
6. Nair, C.S. (1991). The Southern Western Ghats: A Biodiversity Conservation Plan. INTACH, New Delhi.
7. Ramesh, B.R and R Gurukkal (2007), Forest Landscapes of the Southern Western Ghats, India- Biodiversity, Human Ecology and management Strategies. (French Institute of Pondicherry) India.
8. Tiwari, S. (1985), Readings in Indian Zoogeography (vol.1). Today & Tomorrow Printers & Publishers

PRACTICAL EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

36 Hrs

Credit 1

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm

3. Show the discontinuous distribution of (lung fishes, camel, elephant)
4. Providing a map trace the route of HMS Beagle
5. Providing a map mark any two continental/oceanic islands.: Greenland, Madagascar, New Zealand, New Guinea, Maldives, Iceland, Hawaii – any two
6. Contributions of scientists (showing photos) - Any four
7. Identification of different stages of horse evolution
8. Study on Homology and Analogy
9. Study on connecting links (*Peripatus*, *Archaeopteryx*, *Protopterus*, *Echidna*)
10. Pheromone traps
11. Skinner box & T Maze
12. Experiment to demonstrate phototaxis and chemotaxis using *Drosophila*/House fly
13. Identification of behaviour (Grooming/courtship dance of flamingos/stickle back fish/ Tail wagging dance/ Aggressive behaviour/ Auto/Allo grooming, Flehmen response) showing pictures (Any five)

SEMESTER V.

CORE COURSE VIII

HUMAN PHYSIOLOGY, BIOCHEMISTRY AND ENDOCRINOLOGY

54 Hrs

Credits 3

Objectives:

1. This course will provide students with a deep knowledge in biochemistry, physiology and endocrinology.
2. Defining and explaining the basic principles of biochemistry useful for biological studies for illustrating different kinds of food, their structure, function and metabolism.
3. Explaining various aspects of physiological activities of animals with special reference to humans.
4. Students will acquire a broad understanding of the hormonal regulation of physiological processes in invertebrates and vertebrates.
5. By the end of the course, students should be familiar with hormonal regulation of physiological systems in several invertebrate and vertebrate systems.

6. This also will provide a basic understanding of the experimental methods and designs that can be used for further study and research.
7. The achievement of above objectives along with periodic class discussions of current events in science, will benefit students in their further studies in the biological/physiological sciences and health-related fields, and will contribute to the critical societal goal of a scientifically literate citizenry.

HUMAN PHYSIOLOGY

31 Hrs

Module I

8 Hrs

Nutrition: Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, P, Fe, I), vitamins (sources and deficiency disorders). Importance of dietary fibre and antioxidants. Balanced diet, Recommended Dietary Allowance (RDA). Nutrition during pregnancy and lactation, Infant nutrition, Malnutrition (PEM).

Digestion: Anatomy and histology of digestive glands (liver, pancreas, salivary, gastric and intestinal). Digestion and absorption of carbohydrates, proteins and fats. Nervous and hormonal control of digestion.

Module II

8 Hrs

Respiration: Phases of respiration (external respiration, gas transport and internal respiration). Respiratory pigments: Haemoglobin, Myoglobin (Structure and Function). Transport of respiratory gases - transport of oxygen, oxyhaemoglobin curve, factors affecting oxyhaemoglobin curve, transport of carbon dioxide, (chloride shift). Control of respiration. Respiratory disturbances (Hypoxia, Hypercapnia, Asphyxia). Physiological effect of smoking, carbon monoxide poisoning, Oxygen therapy and artificial respiration.

Circulation: ESR, Haemopoiesis, blood pressure, ECG. Haemostasis (blood coagulation) – clotting factors, intrinsic and extrinsic pathways, anticoagulants and its mechanism of action. Cardiovascular diseases (Jaundice, Atherosclerosis, Myocardial infarction, Thrombus, Stroke). Angiogram and angioplasty.

Module III

5 Hrs

Excretion: Histology of Bowman's capsule and tubular part. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current

mechanism. Acid – base balance, hormonal regulation of kidney function. Renal disorders (kidney stone, acute and chronic renal failure, and dialysis). Homeostasis: Definition, concept and importance in biological system. Thermal regulation and thermal adaptation in homeotherms.

Module IV

10 Hrs

Nerve physiology: Ultra structure of neuron. Nerve impulse production (resting membrane potential, action potential), transmission of impulse along the nerve fiber, interneuron (synaptic) transmission, neuromuscular junction and transmission of impulses. Neurotransmitters (acetyl choline, adrenalin, dopamine). EEG. Memory, Neural disorders (brief account on Dyslexia, Parkinson's disease, Alzheimer's disease, Epilepsy).

Muscle physiology: Ultra structure of striated muscle, muscle proteins (myosin, actin, tropomyosin, troponin), Muscle contraction and relaxation-Sliding Filament Theory, cross bridge cycle, biochemical changes and ATP production in muscle, Cori cycle. Kymograph, Simple muscle twitch, muscle fatigue, tetanus, rigor mortis.

BIOCHEMISTRY

15 Hrs

Module V

5 Hrs

Carbohydrates: Basic structure, biological importance and classification of monosaccharides, oligosaccharides, polysaccharides with examples.

Proteins: Basic structure and classification of amino acids; structure, biological importance and classification of proteins with examples.

Lipids: Structure of fatty acid, saturated and unsaturated fatty acid, biological importance and classification of lipids with examples.

Vitamins and minerals: Major fat soluble and water soluble vitamins. Important minerals and trace elements required for living organisms. Biological importance of vitamins and minerals.

Enzymes: Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes. Michaelis–Menten enzyme kinetics.

Module VI

10 Hrs

Carbohydrate metabolism: Glycogenesis, Glycogenolysis, Gluconeogenesis, Hexose monophosphate Shunt, Glycolysis, Citric Acid Cycle, Electron Transport Chain and ATP synthesis. Ethanol metabolism.

Protein metabolism: Deamination, Transamination, Transmethylation, Decarboxylation, Ornithine cycle.

Lipid metabolism: Biosynthesis of fatty acids, Beta oxidation, physiologically important compounds synthesized from cholesterol.

ENDOCRINOLOGY

Endocrinology and reproduction **8 Hrs**

Module VII **8 Hrs**

Endocrine physiology: Hormones – classification and mechanism of hormone action. Major endocrine glands(Histology is not included) their hormones, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland),. Homeostasis and feedback mechanism.

References:

Albert L. Lehninger, Michael Cox and David L. Nelson; 2004; Biochemistry Lehninger.

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Arthur C. Guyton and John E. Hall; 2016; Text Book of Medical Physiology: Guyton, 13th edition; Elsevier

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Bhagavan, N.V.. 2007. Medical biochemistry, fourth edition Academic Press,

Awapara J, 1968. Introduction to Biological chemistry. Prentice Hall. New Jersey

Geetha N. 2014. Textbook of Medical Physiology:. Paras Medical Publishers, 3rd edition

Jain, A K.; 2016; Textbook of Physiology., Avichal Publishing Company

Martin, C.R. 1985.Endocrine Physiology: Oxford University Press.

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PRACTICAL

HUMAN PHYSIOLOGY, BIOCHEMISTRY AND ENDOCRINOLOGY

36 Hrs

Credit1

HUMAN PHYSIOLOGY

- 1). Determination of haemoglobin content of blood
- 2). Total RBC count using Haemocytometer
- 3). Total WBC count using Haemocytometer
- 4). Estimation of microhaematocrit
- 5). Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.
- 6). Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use)
- 7). Measurement of blood pressure using sphygmomanometer(demonstration only)

BIOCHEMISTRY

1. Qualitative analysis of protein, glucose, starch and lipids.
2. Chromatography – Determination of Rf value of amino acids and identification of amino acids (Identify the Amino Acids using different solvent front and solute front)

ENDOCRINOLOGY

1. Cockroach – Corpora cardiaca & Corpora allata (Demonstration)
2. Effect of adrenalin on heart beat of Cockroach (Demonstration)

SEMESTER VI.

CORE COURSE 17 DEVELOPMENTAL BIOLOGY

54 Hrs

3 Credits

Objectives:

1. To achieve a basic understanding of the experimental methods and designs that can be used for future studies and research.
2. To provide the students with the periodic class discussions of current events in science which will benefit them in their future studies in the biological/physiological sciences and health-related fields
3. To contribute to critical societal goal of a scientifically literate citizenry.

Module 1

10 Hrs

Introduction: Definition, Scope of developmental biology, sub-divisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.

Reproductive Physiology: Gonads- anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Estrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, parturition and lactation. Reproductive health and importance of sex education.

Egg types: Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and noncleidoic eggs. Polarity and symmetry of egg.

Fertilization: Mechanism of fertilization-(Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, Activation of Ovum, Migration of Pronuclei and Amphimixis,), Significance of fertilization, Polyspermy, Parthenogenesis- Different types and significance.

Module II

14 Hrs

Cleavage: Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.

Blastulation: Morula, blastula formation, types of blastula with examples.

Fate maps: Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.

Gastrulation: Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation. Concept of germ layers and derivatives.

Cell differentiation and gene action: Potency of embryonic cells (Totipotency, Pleuripotency, Unipotency of embryonic cells). Determination and differentiation in embryonic development, Gene action during development with reference to Drosophila (maternal effect genes), Zygotic genes.

Module III

20 Hrs

Embryology of Frog: Gametes, fertilization, cleavage, blastulation, fatemap, gastrulation, neurulation, notogenesis. Differentiation of Mesoderm and Endoderm, Development of eye. Metamorphosis of frog, Hormonal and environmental control.

Embryology of chick: Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak, Salient features of 18 hour, 24 hour, 33 hour & 48 hour chick embryo. Extra embryonic membranes in chick.

Human development: Fertilisation, cleavage, blastocyst, implantation, placenta. Gestation, parturition and lactation. Human intervention in reproduction, contraception and birth control. Infertility, In vitro fertilization (test tube baby)

Module IV

5 Hrs

Experimental embryology: Spemann's constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning, stem cell research. Ethical issues.

Teratology / Dysmorphology, Developmental defects: Teratogenesis, important teratogenic agents. (Radiations, chemicals and drugs, infectious diseases) genetic teratogenesis in human beings,

Developmental defects: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).

Module V

5 Hrs

General topics: Classification and functions of placenta in mammals. Prenatal diagnosis (Amniocentesis, Chorionic villi sampling, Ultra sound scanning, Foetoscopy, Maternal serum alpha-fetoprotein, Maternal serum beta-HCG). Regeneration in animals.

References:

Anthony S. Fauci, Eugene Braunwald, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo, J. Larry Jameson and Joseph Loscalzo; 2008; Harrison's Principles of Internal Medicine; Churchill Livingstone 17th Ed.

Balinsky B.I.; 1981 An Introduction to Embryology, W.B. Saunders and Co.

Berrill, N.J.; and Kars, G.; 1986. Developmental biology, McGraw Hills

Dutta 2007 Obstetrics, Churchill Livingstone 17 Ed

Majumdar N. N -1985 Vertebrate embryology; Tata McGraw-Hill, New Delhi

Melissa A & Gibbs, 2006; A practical Guide to Developmental Biology, Oxford university press (Int. student edition)

Scott F. Gilbert; 2003; Developmental biology; Sinauer Associates Inc., U.S.; 7th Revised edition.

Vijayakumarn Nair, K. & George, P. V. 2002. A manual of developmental biology, Continental publications, Trivandrum

Taylor D J, Green NPO & G W Stout. (2008) Biological Science third edition. Cambridge university press. Ref pp 748 biology 755

PRACTICAL**DEVELOPMENTAL BIOLOGY****36 Hrs****Credit 1****Model/Chart/ Slide may be used**

12. Embryological studies- Blastula (frog, chick)
13. Embryo transfer, cloning, gastrula (frog, chick)
14. Amniocentesis
15. Embryotransfer technology, cloning
16. Study of placenta- pig and man
17. 18 hour, 24 hour, 33 hour and 48 hour chick embryo.

18. Candling method.
19. Vital staining- demonstration.
20. Male and female reproductive organs in cockroach
21. Calculate the fecundity of fish.
22. Calculate the gonado-somatic index of given fish.

SEMESTER VI.

CORE COURSE 18. MICROBIOLOGY & IMMUNOLOGY

54 Hrs

MICROBIOLOGY

Module I

10 Hrs

Introduction: History and scope of microbiology. Outline classification of Microbes.
(bacteria, fungus & virus)

Methods in Microbiology: Sterilization and disinfection - physical and chemical methods.

Culture media – selective media, enrichment media, differential media. Plating techniques and isolation of pure colony. Culture preservation techniques: refrigeration, deep freezing, freezing under liquid nitrogen, lyophilization.

Module II

15 Hrs

Morphology and fine structure of bacteria: Size, shape, cilia, pili, flagella, capsule, cell wall and its composition. Cytoplasmic membrane, protoplast, spheroplast, intracellular membrane systems, cytoplasm, vacuoles, genetic material, cell inclusions, bacterial spores.

Bacterial growth Curve, Staining techniques – gram staining.

Bacterial Reproduction Sexual – (conjugation, transduction) and Asexual (budding, fragmentation). Virology: Structure of virus; Human, animal, and bacterial virus. Viral replication, cultivation of animal viruses.

Module III

8 Hrs

Infections & Diseases: Types of infections – primary, secondary and nosocomial infections.

(Brief Account only) Contagious diseases – epidemic, endemic and pandemic, mode of Transmission – food, water, air, vectors and carriers.

Diseases: Epidemiology, symptomology, diagnosis and treatment. Bacterial - Clostridium tetany (tetanus), Viral – HIV virus (AIDS), fungal – *Candida albicans* (candidiasis).

IMMUNOLOGY

Module IV

9Hrs

Introduction to Immunology: Innate and acquired immunity, passive (natural and artificial) and active immunity (Natural and Artificial). Mechanisms of innate immunity - barriers, inflammation, phagocytosis.

Lymphoid organs: Primary (Thymus, Bone marrow) and secondary lymphoid organs (lymph nodes, spleen).

Lymphocytes: T and B cells, Natural killer cells, memory cells, macrophages.

Module V

9Hrs

Antigens, Types of antigens, haptens, adjuvants, immunoglobulin structure, classes and functions of immunoglobulins.

Types of Immunity- , humoral & cell mediated immunity Monoclonal & polyclonal antibodies

Antigen – antibody reactions, Precipitation test, Agglutination test, VDRL WIDAL, ELISA.

Auto immune diseases: Pernicious Anemia, Rheumatoid Arthritis. Immunodeficiency -

AIDS. Hyper sensitivity- Type I, (E.g. Anaphylaxis) II(Transfusion reaction) , III (Arthus reaction) and IV (Mantoux Test) (in brief).

Vaccines

3 Hrs

Introduction Types of vaccines, Current Vaccines, Recent trends in vaccine preparation

References

1. Ananthanarayan R & Jayaram Paniker C K. (2009) Text Book of Microbiology Orient

Longman Private Ltd.

2. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.
3. Kuby J, Kindt T., Goldsby R. and Osborne B. (2007). Kuby immunology
4. Sharma K. (2005) Manual of Microbiology: Tools and Techniques, Ane books
5. Susan Panicker & George Abraham (Editors) (2008), Micro Biology and Immunology, Zoological Society of Kerala, Kottayam.
6. Coleman: (2002). Fundamentals of Immunology
7. Darla J. Wise & Gordon R. Carter: (2004): Immunology A Comprehensive Review Iowa state University Press. A Blackwell science company,
8. Hans G. Sch, Legal General Microbiology, Seventh Ed. Cambridge Low Price Ed.
9. Helen Hapel, Maused Harney Siraj Misbah and Next Snowden: (2006) Essentials of Clinical Immunology Fifth Ed. Blackwell Publishing Company,
10. Heritage, J, E.G.V. Evas and R.A.Killungten (2007): Introductory Microbiology Cambridge University Press
6. Ivan Roitt I (2002) Essentials of Immunology ELBS.

MICROBIOLOGY AND IMMUNOLOGY

PRACTICAL

72 Hrs

2 Credits

1. Instruments –Autoclave, Hot air oven, Bacteriological incubator – Laminar air flow
2. Preparation of solid and liquid media for microbial cultures.
(Ingradients, pH and method of preparation) (Demonstration)
 - (a) Solid media (1) Nutrient agar (2) Mac Conkey's agar
 - (b) Liquid Media(1) Nutrient broth (2) Peptone water.
3. Culture methods (Demonstration)

- (a) Streak plate technique and isolation of pure colonies.
- (b) Lawn culture (c) Pour plate culture (d) Liquid culture
- 4. Examination of microbes in living condition
 - Hanging drop method for demonstrating motility of bacteria.
- 5. Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve bacteria.
- 6. Antibiotic sensitivity test (demonstration only)
- 7. Streak plating (individual performance)
- 8. Preparation of a fungal smear – Lactophenol cotton blue staining and mounting
- 9. Determination of ABO blood groups and Rh factor (Antigen – antibody Reaction)
- 10. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man

SEMESTER VI.

CORE COURSE 19

BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY

BIOTECHNOLOGY

20 HRS

Module I

11 Hrs

Introduction: Scope, Brief History, Scope and Importance

Tools and Techniques in Biotechnology: Enzymes (restriction endonucleases, ligases, linkers & adapters), Vectors-[Plasmids, Phage vectors, Cosmids, Artificial Chromosomes] Host cells. Basic steps & techniques in rDNA technology

Gene Libraries, Construction of genomic library and cDNA Library. PCR technique and DNA amplification, Brief description of screening methods – Probes, Nucleic Acid hybridization, In situ Hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization. Methods of transfer of desired gene into target cell. Blotting Techniques- Southern, Northern, Western blotting. DNA Finger printing (DNA Profiling) and its application. Molecular markers - RFLP

Module II

9 Hrs

Animal Cell Culture: Brief account on methods, substrates, media and procedure of animal cell culture, Stem Cells, types and potential use, Organismal Cloning- reproductive & therapeutic- brief account only.

Applications of Biotechnology: Applications in Medicine(insulin, growth hormone, gene therapy), Agriculture(GM plants and biopesticides),Environment(bioremediation), Industry (Single Cell Protein) and applications of Fermentation Technology- lactic acid, vitamins, food and beverages.

Potential Hazards of Biotechnological Inventions: Risks related to genetically modified organisms (GMO) and biologically active products, Biological warfare & Biopiracy. Protection of biotechnological inventions.Intellectual Property Rights, Patenting and patent protection.

References

1. Singh B.D Biotechnology 2002. Kalyan Publishers New Delhi.
2. Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwell scientific publishers Oxford).
3. Colin Ratledge Bjorn Kristiansen, 2008. Basic Biotechnology 3 rd ed. Cambridge University.
4. Janarathanan S & Vincent S. 2007. Practical Biotechnology, Method of Protocols. University Press.
5. John E. Smith. Biotechnology Cambridge Low priced ed. (Third Ed) 2005 Madigan, Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed. Prentice Hall.
6. Singh B.D. Biotechnolgy 2002, Kalyan Publishers New Delhi.
7. Sudha Gangal 2007. Biotechnology Principles and & practice of Animal Tissue culture, Universities Press.

BIOINFORMATICS

14 Hrs

Module III

8 Hrs

Introduction: Definition, importance and role of bioinformatics in life sciences. Computational Biology.

Biological databases: Nucleotide sequence databases (NCBI- GENBANK, DDBJ and EMBL). Protein databases - structure and sequence databases (PDB, SWISSPROT and UNIPROT). Introduction to Sequences alignments: Local alignment and Global alignment, Pair wise alignment (BLAST and FASTA] and multiple sequence alignment. Phylogenetic Tree construction and Analysis

Module IV

6 Hrs

Molecular visualization software - RASMOL. Basic concepts of Drug discovery pipe line, computer aided drug discovery and its applications. Human Genome Project.

MOLECULAR BIOLOGY

20 Hrs

Module V

8 Hrs

Nature of Genetic Materials: Discovery of DNA as genetic material – Griffith's transformation experiments. Avery Macarty and Macleod, Hershey Chase Experiment of Bacteriophage infection, Prokaryotic genome; Eukaryotic genome. Structure and types of DNA & RNA. DNA replication. Modern concept of gene (Cistron, muton, recon, viral genes)., Brief account of the following-- Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons.

Module VI

12 Hrs

Gene Expressions: Central Dogma of molecular biology and central dogma reverse, one gene-one enzyme hypothesis, One gene-one polypeptide hypothesis Characteristics of genetic code, Contributions of Hargobind Khorana.

Protein synthesis [prokaryotic]: Transcription of mRNA, Reverse transcription, post transcriptional modifications, Translation, Post translational modifications.

Gene regulations: Prokaryotic(inducible & repressible systems) Operon concept -Lac operon and Tryptophan operon, Brief account of Eukaryotic gene regulation.

References

1. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006).Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Gupta, P. K (2002) Cell and Molecular Biology, (2ed), , Rastogi Publications., Meerut
4. James Darnell. (1998) Molecular Biology. Scientific American Books Inc
5. Thomas AP(Editor). 2011 Cell &Molecular Biology The Fundamentals. Green leaf publications .TIES Kottayam
6. Zoological Society of Kerala Study material. (2011) Cell and Molecular Biology

PRACTICAL SYLLABUS.

(BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY)

BIOTECHNOLOGY

1. Identify and comment on the item provided: (Western blotting / Southern blotting / Northern blotting / PCR)
2. Write down the procedure involved in DNA isolation

BIOINFORMATICS

1. Download/use print out/pictures of genome sequences of any 2 organisms. Identify and mention the characteristic features of both.
2. Download/ use print out/pictures of a protein sequence , identify it & comment on its amino acid composition
3. Download / use print out/pictures of a macromolecule. Write a brief note on the bioinformatics tool used to visualize its structure.

MOLECULAR BIOLOGY

1. Identify and comment on its molecular composition / structural orientation / functional significance (Any tissue / Cell organelles/ DNA, DNA replication, RNA different types using models or diagrams)

V1 SEMESTER.

CORE COURSE 20.

OCCUPATIONAL ZOOLOGY .

(APICULTURE, VERMICULTURE, QUAIL FARMING & AQUACULTURE)

54 Hrs

Credits 3

Objectives:

1. To equip the students with self employment capabilities.
2. To provide scientific knowledge of profitable farming.
3. To make the students aware of cottage industries.

Module 1. APICULTURE

18 Hrs

Definition, Different species of honey bees, Organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. Bee keeping methods and equipments, Management and maintenance of an apiary, Growth period, honey flow period and dearth period Division of the colony, uniting two colonies, , replacing old queen with new queen, swarming management, monsoon management. Enemies of bees. Diseases of bees,.Bee pasturage. Uses of honey bees, By-products of honey bees, Honey and wax composition. Testing the quality of honey.Extraction of wax, Uses of honey and wax.Royal jelly, Propolis. Apitherapy, Agencies supporting apiculture.

Activity :Visit to an apiculture unit.

Field visit and report submission - 10 Hrs

Field visit and report submission on any two items are taken for internal evaluation.

MODULE: 2. VERMICULTURE

8 Hrs