Sacred Heart College (Autonomous)

Department of Zoology

Master of Science [Zoology]

Course plan

Academic Year: 2016 – 17

Semester III

COURSE PLAN: BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

COURSE OBJECTIVES

- To learn the biophysical properties and functioning of life processes
- To introduce the tools and techniques available for studying biochemical and biophysical nature of life
- To equip the learner to use the tools and techniques for project work/ research in biology

Teacher 1 (18 Hours)

Sessions	Topic	Method	Remarks/Reference
	BIOPHYSICS		
	Module I. Diffusion and Osmosis		
1	Diffusion -Kinetics of diffusion, Fick's law of diffusion and diffusion coefficient	ICT Enabled (ppt&images, video clippings)	
2	Biological significance in animals and plants, Facilitated diffusion, Gibbs-Donnanequillibrium	ICT Enabled (ppt&images, charts, video clippings)	
3	Osmosis- osmotic concentration and osmotic pressure, Van't Hoff's laws	ICT Enabled (ppt&images, video clippings)	
4	Biological significance of osmosis in animals and plants	ICT Enabled (ppt& animations, images, video clippings)	
	Module II. Biophysics of Cell Membrane		
5	Membrane Transport - endocytosis, exocytosis,	ICT Enabled (ppt&images, video clippings)	
6	Membrane Transport - endocytosis, exocytosis,	ICT Enabled (ppt&images, video clippings)	
7	CIA I	1 hr; descriptive answers only	
8	Porins facilitated diffusion, porter molecules;	ICT Enabled (ppt&images, video clippings)	
9	Facilitated transport:symport,antiport, uniport,anionporter,glucose porter;	ICT Enabled (ppt&images, video clippings)	
10	Active transport: proton pumps,	ICT Enabled (ppt&images, charts, video clippings)	
11	Na+ K+ pumps and Ca++ pumps, ionic channels.Artificial membranes.	ICT Enabled (ppt&images, video clippings)	
	Module III. Bioenergetics		

12	Reversible thermodynamics and irreversible thermodynamics;Systems - open, closed and isolated.		
13	Redox couple and redox potential. Chemo-bioenergetics: electron transport and oxidative phosphorylation	ICT Enabled (ppt&images, charts, video clippings)	
14	**CIA- II**	**2 hrs**	
15	Chemiosmotic theory and binding change mechanism of ATP synthesis.	ICT Enabled (ppt&images, video clippings)	
	Module IV. Radiation Biophysics		
16	Interaction of radiation with matter - Photoelectric effect, ion pair production, absorption and scattering of electrons	ICT Enabled (ppt&images, video clippings)	
17	Biological effects of radiation: effect on nucleic acids, proteins, enzymes and carbohydrates. Cellular effects of radiation : somatic and genetic.		
18	Cellular effects of radiation : somatic and genetic		

	Teacher 2 (18 Hours)		
Session	**Topic**	**Method**	**Remarks/Reference**
s			
	INSTRUMENTATION & BIOLOGICAL TECHNIQUES		
	Module 1 : Microscopy		
1	Differential Interference contrast (Nomarsky) microscopy	ICT Enabled (ppt&images, video clippings)	
2	Confocal microscope,	ICT Enabled (ppt&images, charts, video clippings)	
3	Electron microscope - TEM, SEM	ICT Enabled (ppt&images, video clippings)	
4	Scanning Tunnelling and Atomic Force Microscopes.	ICT Enabled (ppt& animations, images, video clippings)	
	Module 2 : Chromatography		
5	Paper chromatography,	ICT Enabled (ppt&images, video clippings)	
6	Thin layer chromatography	ICT Enabled (ppt&images, video clippings)	
7	CIA I	1 hr; descriptive answers only	
8	Ion exchange chromatography.	ICT Enabled (ppt&images, video clippings)	
9	Gel permeation chromatography,	ICT Enabled (ppt&images, video clippings)	
10	Affinity chromatography,Gas chromatography	ICT Enabled (ppt&images, charts, video clippings)	

11	High pressure liquid chromatography (HPLC)..	ICT Enabled (ppt&images, video clippings)	
	Module VII: Electrophoresis		
12	Paper electrophoresis		
13	Gel electrophoresis, Polyacrylamide gel electrophoresis (PAGE) - SDS and non SDS ,	ICT Enabled (ppt&images, charts, video clippings)	
14	CIA- II	2 hrs	
15	Disc electrophoresis, High voltage electrophoresis, immunoelectrophoresis.	ICT Enabled (ppt&images, video clippings)	
	Module VII. Nanotechnology		
16	Introduction to Nanobiology. Nanosensors and Nanomedicines.	ICT Enabled (ppt&images, video clippings)	
17	Revision		
18	Evaluation of the course		

Teacher 3 (18 hours)

Module IV. Colorimetry, Spectrophotometry and Spectroscopy (5 hrs.)			
Sl.No	**Topic**	**Method of Teaching**	**Remarks**
1	Principle and applications of colorimetry	Lecture with Power Point Presentation	
2	Principle and applications of spectrophotometry.	Lecture with Power Point Presentation	
3	Spectroscopy: Flame emission spectroscopy	Lecture with Power Point Presentation	
4	Atomic absorption spectroscopy	Lecture with Power Point Presentation	
5	Nuclear Magnetic- resonance spectroscopy (NMR).	Lecture with Power Point Presentation	
	First Internal Examination **Module V. Centrifugation (3 hrs.)**		
6	Basic principles of sedimentation, Types of centrifuges, Analytical and Preparative centrifugation.	Lecture with Power Point Presentation	
7	Differential Centrifugation	Lecture with Power Point Presentation	
8	Density gradient centrifugation	Lecture with Power Point Presentation	

	Module VI. Radioisotope Detection and Measurement (2 hrs.)		
9	Dosimetry: Ionization chamber, GM counter	Lecture with Power Point Presentation	
10	Solid and liquid scintillation counters, Autoradiography.	Lecture with Power Point Presentation	
	Module VIII. Assays (2 hrs.)		
11	Radio ImmunoAssay, Enzyme Linked Immuno Sorbant Assay (ELISA).	Lecture with Power Point Presentation	
12	Different types of ELISA	Lecture with Power Point Presentation	
	Module IX. pH meter (1 hr.)		
13	Principle and working. Types of pH meters.	Lecture with Power Point Presentation	
	Module X. Biological and Histological Techniques (5 hrs.)		
14	Fixation, preparation of temporary and permanent slides, whole mounts, smears, squashes and sections. Microphotography.	Lecture with Power Point Presentation	
15	Specimen preparation for TEM	Lecture with Power Point Presentation	
	Second Internal Examination		
16	Specimen preparation for SEM, shadow casting, freeze fracturing, freeze etching, negative staining.	Lecture with Power Point Presentation	
17	Cytochemical and histological methods- Microtome techniques, fixation, staining.	Lecture with Power Point Presentation	
18	Cytochemistry of nucleic acids, detection of carbohydrates, proteins and lipids.	Lecture with Power Point Presentation	

ASSIGNMENTS AND SEMINARS

Applications of Colorimetry
Applications of RIA
Applications of HPLC
Technique of HPLC
Applications of Gas Chromatography
Methodology of GC
Radiation and matter interactions
Applications of NMR Methodology
of ELISA
Applications of AAS

Additional Reading List

1. Lehninger, A.L.1971. *Bioenergetics*. W.A. Benjamin, London,UK.
2. Narayanan, P. 2000. *Essentials of Biophysics*.New Age International (P) Ltd. Publishers, New Delhi.
3. Pearse, A.G.E. 1980. *Histochemistry*. Vol.& Vol. II. Churchill Livingstone, NY, USA.
4. Pradeep T. 2007. *NANO: The Essentials. Understanding Nanoscience and Nanotechnology*.Tata McGraw Hill Education Pvt. Ltd., New Delhi.
5. Roy, R.N. 1996. *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta

COURSE PLAN: ANIMAL PHYSIOLOGY

COURSE OBJECTIVES

- To study and compare the functioning of organ systems across the animal world
- To give an over view of the comparative functioning of different systems in animals
- To learn more about human physiology

Sessions	Topic	Method	Remarks/Reference
	Module I. Nutrition		
1	Nutrition in animals, mechanisms of food intake in different animals.	ICT Enabled (ppt & images, video clippings)	
2	Neuronal and hormonal regulation of nutritional intake, hunger drive, thirst.	ICT Enabled (ppt & images, charts, video clippings)	
3	Obesity- causes and consequence, outline of hormonal involvement.	ICT Enabled (ppt & images, video clippings)	
4	Leptin: synthesis, secretion and its role in adipogenesis.	ICT Enabled (ppt & animations, images, video clippings)	
	Module II. Circulation		
5	Circulatory mechanisms and fluid compartments, movement of body fluids by somatic muscles, open system, closed system, lymph channels.	ICT Enabled (ppt & images, video clippings)	
6	CIA I	1 hr; descriptive answers only	
7	Circulatory shock, Circulatory arrest.	ICT Enabled (ppt & images, video clippings)	
8	Types of hearts – chambered heart, tubular heart, ampullar heart, lymph heart, neurogenic and myogenic heart.	ICT Enabled (ppt & images, video clippings)	
9	Pace makers and specialized conducting fibers.	ICT Enabled (ppt & images, video clippings)	
10	Cardiac cycle, cardiac output, blood pressure, effect of drugs on heart beat, effects of exercise on cardiaovascular physiology.	ICT Enabled (ppt & images, charts, video clippings)	

11	ECG - its principle and significance. Blood buffers, Human congenital heart diseases.	ICT Enabled (ppt & images, video clippings)	
	Module IX. Endocrinology		
12	Invertebrate endocrine system	ICT Enabled (ppt, images, animations & video clippings)	
13	Invertebrate endocrine system	ICT Enabled (ppt & images, charts, video clippings)	
14	vertebrate endocrine system.	ICT Enabled (ppt & images, video clippings	
15	vertebrate endocrine system.	ICT Enabled (ppt & images, video clippings	
16	Endocrine glands.	ICT Enabled (ppt & images, video clippings	
17	Synthesis of hormones	ICT Enabled (ppt & images, video clippings	
18	physiologic role of hormone	ICT Enabled (ppt & images, video clippings	
19	control of hormone action.	ICT Enabled (ppt & images, video clippings	
20	Mechanisms of hormone action.	ICT Enabled (ppt & images, video clippings	
21	Neuro-endocrine regulation of hormone action.	ICT Enabled (ppt & images, video clippings	
22	Neuro-endocrine regulation of hormone action.	ICT Enabled (ppt & images, video clippings	
23	Bioamines,	ICT Enabled (ppt & images, video clippings	
24	Ecosanoids	ICT Enabled (ppt & images, video clippings	
25	Chalones	ICT Enabled (ppt & images, video clippings	
26	Lumones,	ICT Enabled (ppt & images, video clippings	
27	Phytohormones,	ICT Enabled (ppt & images, video clippings	
28	Synthetic hormones..	ICT Enabled (ppt & images, video clippings	
29	CIA- II	2 hrs	
	Module VIII. Reproductive physiology		
30	Anatomy and histology of adult testis	ICT Enabled (ppt & images, video clippings	
31	Anatomy and histology of adult ovary.	ICT Enabled (ppt & images, video clippings)	

32	Reproductive cycles of mammals and their hormonal control.	ICT Enabled (ppt & images, video clippings	
33	Physiology of implantation, pregnancy, parturition and lactation.	ICT Enabled (ppt & images, video clippings	
34	Impact of senescence and age on reproduction.	ICT Enabled (ppt & images, video clippings)	
35	Revision		
36	Evaluation of the course		

Sessions	**Topic**	**Method**	**Remarks/Reference**
	Module III. Respiration		
1	Pulmonary ventilation, respiratory muscles, surfactants.	ICT Enabled (ppt & images, video clippings)	
2	Respiratory centers and periodic breathing. Regulation of respiration.	ICT Enabled (ppt & images, charts, video clippings)	
3	Respiration in unusual environment - foetal and neonatal respiration, high altitude, diving.	ICT Enabled (ppt & images, video clippings)	
4	Structure and functioning of respiratory pigments.	ICT Enabled (ppt & animations, images, video clippings)	
5	Metabolic rate : basal metabolic rate and its measurement.	ICT Enabled (ppt & images, video clippings)	
6	CIA I	1 hr; descriptive answers only	
	Module IV. Osmoregulation and Excretion		
7	Osmoregulation in fresh water, marine and terrestrial animals. Excretion in vertebrates.	ICT Enabled (ppt & images, video clippings)	
8	Physiology and regulation of urine formation.	ICT Enabled (ppt & images, video clippings)	
9	Hormonal regulation of urine formation.	ICT Enabled (ppt & images, video clippings)	
10	Regulation of water balance, electrolyte balance and acid-base balance..	ICT Enabled (ppt & images, charts, video clippings)	
11	Dialysis, artificial kidney, kidney transplantation	ICT Enabled (ppt & images, video clippings)	
	Module V. Nerve Physiology		

12	Neuroanatomy of the central and peripheral nervous system.	ICT Enabled (ppt, images, animations & video clippings)	
13	Electrical and chemical transmission. Synaptic transmission.	ICT Enabled (ppt & images, charts, video clippings)	
14	Modifications of synaptic transmission during fatigue, acidosis, alkalosis, hypoxia and drugs.	ICT Enabled (ppt & images, video clippings	
15	Mechanism of excitatory and inhibitory pathway.	ICT Enabled (ppt & images, video clippings	
16	Neuromuscular Junction: organization and properties of neuromuscular junction,	ICT Enabled (ppt & images, video clippings	
17	neuromodulators	ICT Enabled (ppt & images, video clippings	
18	Neural control of muscle tone and posture.	ICT Enabled (ppt & images, video clippings	
	Module VI. Sensory and Effector Physiology		
19	Classification of somatic senses and somatic receptors, exteroceptors, interoceptors, modality of sensation, secondary sense cells, transduction, relationship between stimulus, intensity and response, sensory coding.	ICT Enabled (ppt & images, video clippings	
20	Chemical senses: taste, smell, mechanism of reception. Mechanoreceptors: hair cell, organs of equilibrium,	ICT Enabled (ppt & images, video clippings	
	vertebrate ear, mechanism of hearing, electro and thermoreceptors.		
21	Physiology of vision.	ICT Enabled (ppt & images, video clippings	
22	Pain: pain receptors, headache and thermal senses, pain suppression (analgesia).	ICT Enabled (ppt & images, video clippings	
23	Tactile sensation: touch receptors, transmission of signals,	ICT Enabled (ppt & images, video clippings	

24	special problems of premature infants,Physiological role of touch and environment in premature infants- Kangaroo care, infant massage, supportive environment.	ICT Enabled (ppt & images, video clippings	
	ModuleVII. Muscle Physiology		
25	Red and white muscles,	ICT Enabled (ppt & images, video clippings	
26	muscle proteins.	ICT Enabled (ppt & images, video clippings	
27	Effect of exercise on muscles.	ICT Enabled (ppt & images, video clippings	
28	Catch muscle and fibrillar muscle.	ICT Enabled (ppt & images, video clippings	
29	CIA- II	2 hrs	
	Module VIII. Thermoregulaion		
30	Comfort zone, body temperature - physical, chemical,	ICT Enabled (ppt & images, video clippings	
31	neural regulation, acclimatization.	ICT Enabled (ppt & images, video clippings)	
32	Impact of temperature on the rate of biological functions.	ICT Enabled (ppt & images, video clippings	
33	Temperature compensation and temperature regulation in poikilotherms and homiotherms.	ICT Enabled (ppt & images, video clippings	
34	Adaptations for extreme environments.	ICT Enabled (ppt & images, video clippings)	
35	Revision		
36	Evaluation of the course		

ASSIGNMENTS

	Date of submission/completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)**	**Weighttage**
1	Session 10	Individual assignment	
2			
3			
4			

Additional Reading List

- Ganong, W.F 1987. Review ofMedical physiology. Appleton and lang, Norwalk.

- Guyton, A.C. 1996**.** Text Book of Medical physiology. Prism Books Pvt.Ltd.Bangalore
- Hill, W.R., Wyse, G.A and Anderson, M. 2007. Animal Physiology (2nd edn). Sinauer Associates Inc. Publishers, MA, USA.
- Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India,New Delhi.

COURSE PLAN: PG ZOOLOGY SEMSTER 3
Cell and Molecular Biology

COURSE OBJECTIVES

- To help study the structural and functional details of the basic unit of life at the molecular level
- To motivate the learner to refresh and delve into the basics of cell biology
- To introduce the new developments in molecular biology and its implications in human welfare

Basic References

Cooper, G.M. and Hausman, R.E. 2009. The cell: A Molecular Approach (5thedn). Sinauer Associates, Inc, ASM Press, Washington DC.
Karp, G. 2010. C*ell and Molecular Biology* (6thedn). John Wiley and Sons,Inc.NJ,USA. Pierce, B.A. 2008. Genetics: A conceptual approach. W H Freeman and Company.

Teacher 1

Sessions	Topic	Method	Remarks
	Module VI. Cellular Reproduction 4 hrs		
1.	Cell cycle: Steps in cell cycle, Control of cell cycle.	ICT Enabled (ppt & images, video clippings); discussion	
2.	Checkpoints in cell cycle	ICT Enabled (ppt & images, video clippings); discussion	
3.	Control of cell division and cell growth.	ICT Enabled (ppt & images, video clippings); discussion	
4.	Apoptosis- extrinsic and intrinsic pathways, significance	ICT Enabled (ppt & images); discussion	
	Module III. Cell Organelles 6 hrs		
5.	Endoplasmic reticulum	ICT Enabled (ppt & images); Seminar	
6.	Golgi complex	ICT Enabled (ppt & images); Seminar	
	I- CIA	**1 hr**	

7.	Vesicular transport of secretory products	ICT Enabled (ppt & images); Seminar	
8.	Lysosomes - Role in autophagy	ICT Enabled (ppt & images); Seminar	
9.	Ribosome	ICT Enabled (ppt & images); Seminar	

10.	Mitochondria.	ICT Enabled (ppt & images); Seminar	
	Module VIII. Gene Expression 10 hrs		
11.	Intoduction to transcription and translation	Discussion	
12.	Transcription in prokaryotes	ICT Enabled (ppt) Discussion	
13.	Transcription in eukaryotes- mRNA	ICT Enabled (ppt) Discussion	
14.	Transcription in eukaryotes- rRNA, tRNA	ICT Enabled (ppt) Discussion	
15.	Post transcriptional modifications	ICT Enabled (ppt) Discussion	
	II- CIA	**2 hrs**	
16.	Translation in prokaryotes	ICT Enabled (ppt) Discussion	
17.	Translation in prokaryotes - termination	ICT Enabled (ppt) Discussion	
18.	Translation in eukaryotes- initiation	ICT Enabled (ppt) Discussion	
19.	Translation in eukaryotes-elongation	ICT Enabled (ppt) Discussion	
20.	Translation in eukaryotes- termination	ICT Enabled (ppt) Discussion	

Teacher 2

Sessions	**Topic**	**Method**	**Remarks/Reference**
	Module I. Cellular Membranes 6 hrs.		

1.	A brief historical overview on the study of cell membrane structure	Lecture	
2.	Fluid mosaic model	ICT Enabled (ppt & images); discussion	

3.	Chemistry of cell membrane – membrane lipids, carbohydrates, proteins and the roles they performed.	ICT Enabled (ppt & images); discussion	
4.	Dynamic nature of the plasma membrane	ICT Enabled (ppt & images, video clippings); discussion	
5.	Membrane fluidity, lipid raft	ICT Enabled (ppt & images, video clippings); discussion	
	Module V. Cell Signaling 13 hrs		
6.	An overview of cell signaling system,	ICT Enabled (ppt & images); discussion	
7.	Extracellular messengers (signaling molecules)		
8.	Cell surface Receptors: G- Protein coupled receptors, Receptor tyrosine kinases (RTK),	ICT Enabled (ppt & images, video clippings); discussion	
9.	Ion channel receptors, Cytokine receptors (Tyrosine kinase linked receptors).		
10.	Second messengers: Cyclic-AMP, Cyclic-GMP, Inositol 1,4,5-trisphosphate (IP3), Di-acyl glycerol (DAG).	ICT Enabled (ppt & images); discussion	
11.	Signaling pathways: G-protein coupled receptor (GPCR) pathway –GPCR pathway in sensory perception	ICT Enabled (ppt & images, video clippings); discussion	

12.	Signaling pathways: cyclic AMP pathway	ICT Enabled (ppt & images, video clippings); discussion	
13.	Signaling pathways: Receptor protein tyrosine kinase and Ras-MAP kinase pathway	ICT Enabled (ppt & images, video clippings); discussion	
14.	**CIA-I**		
15.	Signaling pathways: Calcium phosphatidyl- inositol pathway, Phospho Inositide 3-kinase (PI-3 kinase).	ICT Enabled (ppt & images, video clippings); discussion	
16.	Regulation of signaling pathways - Convergence, divergence and crosstalk among different pathways.	ICT Enabled (ppt & images); discussion	
17.	New strategies for combating cancer: Immunotherapy, Gene therapy, Inhibiting cancer promoting proteins, Inhibiting formation of new blood vessels.	ICT Enabled (ppt & images, video clippings); discussion	
	Module XI. Gene Regulation 12 hrs		
18.	Gene regulation in prokaryotes	ICT Enabled (ppt & images); discussion	
19.	Lac operon		

20.	Repression and attenuation	ICT Enabled (ppt & images); discussion	
21.	General introduction to gene regulation in eukaryotes	ICT Enabled (ppt & images, video clippings); discussion	
22.	Gene regulation in eukaryotes at transcriptional level	ICT Enabled (ppt & images, video clippings); discussion	
23.	Gene regulation in eukaryotes at post transcriptional level	ICT Enabled (ppt & images, video clippings); discussion	
24.	Gene regulation in eukaryotes at translational levels	ICT Enabled (ppt & images, video clippings); discussion	

25.	CIA-II		
26.	Chromatin-remodelling complexes	ICT Enabled (ppt & images); discussion	
27.	Riboswitches	ICT Enabled (ppt & images); discussion	
28.	RNA interference (RNAi).	ICT Enabled (ppt & images); discussion	
29.	Revision & Evaluation of the course – 3 hrs	ICT Enabled (ppt); discussion	
30.	**Seminar 5 hrs**		

Teacher 3

Sessions	**Topic**	**Method**	**Remarks**
	Module II. Cell junctions, Cell adhesion and Extracellular matrix - 8 hrs		
1	Chemical nature of Extracellular matrix; Cellular interactions – with other cells, with extracellular matrix,	ICT Enabled (ppt & images, video clippings); discussion	
2	Chemical nature of Extracellular matrix.	ICT Enabled (ppt & images, video clippings); discussion	
3	Interaction of cells with extracellular matrix: Integrins.	ICT Enabled (ppt & images, video clippings); discussion	
4	Focal adhesion and hemidesmosomes.	ICT Enabled (ppt & images, video clippings); discussion	
5	CIA 1	1 Hr	
6	Interaction of cells with other cells: Selectins,	ICT Enabled (ppt & images, video clippings); discussion	

7	Immunoglobulins, Cadherins,	ICT Enabled (ppt & images, video clippings); discussion	
8	Adherens Junctions and desmosomes.	ICT Enabled (ppt & images, video clippings); discussion	

9	Tight junctions	ICT Enabled (ppt & images, video clippings); discussion	
10	Gap junctions and Plasmodesmata	ICT Enabled (ppt & images, video clippings); discussion	
	Module VII. Cancer 8 hrs		
11	Basic properties of a cancer cell.	ICT Enabled (ppt & images, video clippings); discussion	
12	Types of cancer, Causes of cancer	ICT Enabled (ppt & images, video clippings); discussion	
13	CIA 2	2 Hrs	
14	Genetics of cancer	ICT Enabled (ppt & images, video clippings); discussion	
15	Tumor suppressor genes	ICT Enabled (ppt & images, video clippings); discussion	
16	Oncogenes	ICT Enabled (ppt & images, video clippings); discussion	
17	New strategies for combating cancer: Immunotherapy, Gene therapy, Inhibiting cancer promoting proteins, Inhibiting formation of new blood vessels.	ICT Enabled (ppt & images, video clippings); discussion	
18	Revision & Evaluation of the course	ICT Enabled (ppt); discussion	

ASSIGNMENTS

	Date of submission/completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)**	**Weighttage**
1	Session 10	Individual assignments	

Seminar

	Date of completion	**Topic of Seminar& Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)**	***Weighttage***
1	**Session 10**	**Individual Seminar**	

Additional Reading List

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. And Walter, P. 2008. *Molecular Biology of the Cell*. Garland Science.- Taylor and Francis group, USA.
2. Becker, W.M.,Kleinsmith, L.J. and Hardin, J. 2007. *The World of the Cell*. Pearson, New Delhi.
3. Clark, D.P. 2010. *Molecular Biology*. Elsevier Publishers, London.
4. Griffiths, A.J.F., Wesler, S.R., Carroll, S.B. and Doebley, J. 2008. *Introduction to Genetic Analysis.* W H Freeman and Company,USA
5. Hyde, D.R. 2010.*Genetics and Molecular Biology*. Tata McGraw Hill Education Private Ltd., New Delhi.
6. Klug, W.S. and Cummings, M.R. 2004. *Concepts of Genetics*. Pearson International, New Delhi.
7. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2011. *Lewin's Genes X*. Jones and Bartlett publishers,NY.
8. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. 2007. *Molecular Cell Biology* (6th edn). W H Freeman & Company.
9. Snustad, D.P. and Simmons, M.J. 2010. *Principles of Genetics*. John Wiley and Sons.
10. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. 2009. *Molecular Biology of the Gene.* Pearson.

COURSE PLAN: PG
ZOOLOGY SEMSTER
3
Microbiology and Biotechnology

72 Hours (4 hrs/week)

Credit – 4

COURSE OBJECTIVES

- To provide an over view of the microbial world, its structure and function
- To familiarize the learner with the applied aspects of microbiology
- To give students an intensive and in-depth learning in the field of biotechnology
- To understand the modern biotechnology practices and approaches with an emphasis in technology application, medical, industrial, environmental and agricultural areas
- To familiarize the students with public policy, biosafety, and intellectual property rights issues related to biotechnology

Basic Reference

Jacquelyn G. Black. *Microbiology: Principles and Explorations*
Laning, M Prescot. John,P. Harley and Donald A Klein. 2008. *Microbiology* (7thedn). McGraw Hill International,NJ, USA Das, H.K. 2007. *Text book of Biotechnology*.Wiley India Pvt. Ltd. New Delhi

aculty 1

Sessions	Topic	Method	Remarks
	MICROBIOLOGY		
	Module I. Introduction to Microbiology		
1	Methods of Microbiology, Main group of microorganisms, general characters.	ICT Enabled (ppt & images, video clippings); discussion	
2	Classification, approaches to microbial classification, outline classification, Bergey's manual.	ICT Enabled (ppt & images, video clippings); discussion	
	Module II. Functional Anatomy of Prokaryotic Cells		
3	Cell structure, plasma membrane, cytoskeleton, cytoplasm, nucleoid, cytoplasmic inclusions.	ICT Enabled (ppt & images, video clippings); discussion	

4	The prokaryotic cell envelope, peptidoglycan structure, gram positive and negative cell walls.	ICT Enabled (ppt & images, video clippings); discussion	
5	Components outside the cell wall: capsules, slime layers and s- layers, pili and fimbriae, flagella and motility.	ICT Enabled (ppt & images, video clippings); discussion	

6	The endomembrane system, mitochondria and chloroplasts, cell wall and pellicle in protists	ICT Enabled (ppt & images, video clippings); discussion	
	Module III. Microbial Metabolism		
7	Energy acquisition by chemotrophs and phototrophs,	ICT Enabled (ppt & images, video clippings); discussion	
8	glycolysis (Embden- Meyerhof pathway).	ICT Enabled (ppt & images, video clippings); discussion	
9	Fermentation, anaerobic oxidations, chemosynthesis.	ICT Enabled (ppt & images, video clippings); discussion	
10	Photosynthesis, carbon assimilation. Regulation of metabolism.	ICT Enabled (ppt & images, video clippings); discussion	
	Module IV. Nutrition and Growth		
11	Common nutrient requirements, nutritional types, growth factors, uptake of nutrients by the cell. Culture media.	ICT Enabled (ppt & images, video clippings); discussion	
12	Reproduction and exponential growth, the growth curve. Physical requirements for bacterial growth and influence of environmental factors on growth.	ICT Enabled (ppt & images, video clippings); discussion	
13	CIA I	1 Hr	
	Module V. Microbial Interactions and Microbial Ecology		

14	Symbiosis, commensalism. Mutualism between microbes, microbes and plants, microbes and animals.	ICT Enabled (ppt & images, video clippings); discussion	
15	Cooperation, competition, predation, antagonism. Parasitism, plant parasites, animal parasites.	ICT Enabled (ppt & images, video clippings); discussion	

	Module VI. Virology		
16	Properties of viruses**,** structure and chemical composition, genetic composition eclipse,	ICT Enabled (ppt & images, video clippings); discussion	
17	host interaction and specificity**.** Classification, RNA virus , DNA virus, plant virus, animal virus	ICT Enabled (ppt & images, video clippings); discussion	
18	bacteriophage, lysis and lysogeny, Viral replication. Virioids and prions. Nature and significance. Pathogenic virus, oncovirus.	ICT Enabled (ppt & images, video clippings); discussion	
	MODULE VII. Applied Microbiology		
19	Bacteria of air, water and soil.	ICT Enabled (ppt & images, video clippings); discussion	
20	Microbes associated with food production and spoilage,	ICT Enabled (ppt & images, video clippings); discussion	
21	microbiology of milk and dairy products	ICT Enabled (ppt & images, video clippings); discussion	

22	Epidemiology of human diseases	ICT Enabled (ppt & images, video clippings); discussion	
23	Mechanism of microbial pathogenicity. Normal microbial population on human body	ICT Enabled (ppt & images, video clippings); discussion	
24	Microbial diseases	ICT Enabled (ppt & images, video clippings); discussion	
25	Nosocomial infections.	ICT Enabled (ppt & images, video clippings); discussion	
26	Medical mycology.	ICT Enabled (ppt & images, video clippings); discussion	
27	Control of microorganism- physical, chemical and antimicrobial agents.	ICT Enabled (ppt & images, video clippings); discussion	
28	Biological weapons and bioterrorism.	ICT Enabled (ppt); discussion	
29	CIA II	2 Hrs	
	BIOTECHNOLOGY		
	Module 1. Introduction to Biotechnology		

30	Historical aspects, definitions and scope of Biotechnology. Biotechnology in India.	ICT Enabled (ppt); discussion	
	Module VII. Intellectual Property Rights, Biosafety and Bioethics		

31	Introduction to Intellectual Property Rights, Types of IP: Patents, Trademarks, Copyrights. Basics of Patents Types of patents; Indian Patent Act 1970; Recent Amendments.	ICT Enabled (ppt); discussion	
32	IPs of relevance to Biotechnology and few Case Studies (Rice, Neem, Curcumin).	ICT Enabled (ppt); discussion	
33	Introduction to History of GATT, WTO, WIPO and TRIPS.	ICT Enabled (ppt); discussion	
34	Biosafety concepts and issues. General guidelines for recombinant DNA research activity. Biosafety protocol 2000.	ICT Enabled (ppt); discussion	
35	Bioethics: Principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity *etc.* Ethics in post genomic era-genetic testing and genetic screening.	ICT Enabled (ppt); discussion	
36	Revision & Evaluation of the course	ICT Enabled (ppt); discussion	

Faculty 2

Sessions	**Topic**	**Method**	**Remarks**
	BIOTECHNOLOGY		
	Module II. Tools and Techniques in Recombinant DNA Technology		

1	Vectors: cloning and expression vectors	Discussion and lecture	
2	Vectors with combination features; PUC19 and Bluescript vectors, Shuttle vectors, viral vectors, BAC and YAC vectors	ICT Enabled (ppt) Lecture	

3	Shuttle vectors, viral vectors, BAC and YAC vectors	ICT Enabled (ppt) Lecture	
4	Restriction enzymes and DNA modifying enzymes.	ICT Enabled (ppt) Lecture	
5	Polymerase chain Reaction	ICT Enabled (ppt) Lecture	
6.	Chromosome walking	ICT Enabled (ppt) Lecture	
7	chromosome jumping, DNA foot printing.	ICT Enabled (ppt) Lecture	
	CIA I	ICT Enabled (ppt) Lecture	
8	Molecular Markers and Probes-SNP, VNTR, RAPD	ICT Enabled (ppt) Lecture	
9	RFLP, SSR, STMS, FISH and GISH.	ICT Enabled (ppt) Lecture	
10	DNA sequencing methods- Maxam and Gilberts chemical degradation method, Sanger and Coulson method, Automated DNA sequencers.	ICT Enabled (ppt) Lecture	
11	Site directed mutagenesis, molecular chimeras.	ICT Enabled (ppt) Lecture	

12	Cloning Methodologies- Gene isolation: Shot gun method, Genome libraries, cDNA libraries, Chemical synthesis	ICT Enabled (ppt) Lecture	
13	Blue-white screening, Colony hybridization methods, Reporter genes, Fusion proteins	ICT Enabled (ppt) Lecture	
	Module III. Animal Biotechnology		
14	Cell and Tissue culture: Basic techniques of mammalian cell culture	Lecture and Discussion	
	CIA I	2 hrs	
15	Growth media	Lecture and Discussion	
16	Manipulation of cultured cell and tissues	Lecture and Discussion	
17	Contamination: Source of contamination, Type of microbial contamination, Monitoring, Eradication of contamination	Lecture and Discussion	
18	Revision	Discussion	

Faculty III

Sessions	Topic	Method	Remarks
	BIOTECHNOLOGY		
	Module III. Animal Biotechnology		
1	Cryopreservation - importance and process of cryopreservation, cryopreservation of embryos, Cryogenics.	ICT (ppt & images, video clippings) and discussion	
2	Transfection Methods: CaPO4 precipitation, Shotgun, Electroporation, Lipofection, Microinjection,Agrobacterium mediated gene transfer. Somatic cell nuclear transfer- reproductive cloning and therapeutic cloning.	ICT (ppt & images, video clippings) and discussion	
3	Gene knockout and knockin technology. Applications of transgenic animals.	ICT (ppt & images, video clippings) and discussion	
4	Stem cell culture : General and historical aspects, properties and types of stem cells, advantages and disadvantages, stem cell niche, application of stem cell technology in medicine.	ICT (ppt & images, video clippings) and discussion	
	Module IV. Biotechnology in Healthcare		
3	Disease prevention – DNA vaccines. Disease diagnosis - Probes, Monoclonal antibodies, detection of genetic disorders.	ICT (ppt & images, video clippings) and discussion	
4	Disease treatment - Therapeutic proteins, hormones and growth factors.RNAi,	ICT (ppt & images, video clippings) and discussion	
5	Drug targeting, Gene therapy. Forensic medicine.	ICT (ppt & images, video clippings) and discussion	
6	Biosensors-different types, applications - medical and non medical..	ICT (ppt & images, video clippings) and discussion	
7	Introduction to Biochips and their application in modern sciences	ICT (ppt & images, video clippings) and discussion	
8	I CIA	1 Hr	
	Module V. Biotechnology in Industry and Agriculture		

9	Metabolite production. Antibiotics, Organic acids, Amino acids, Vitamins, Upstream processing, downstream processing.	ICT (ppt & images, video clippings) and discussion	
10	Microbial enzymes and biotranformation- Microbial production of enzymes, fermentation	ICT (ppt & images, video clippings) and discussion	
11	Enzyme engineering and applications. Food industry- Single cell protein, probiotics.	ICT (ppt & images, video clippings) and discussion	
12	Transgenic plants- Plants with resistance to Pests, plants with increased shelf life.Biofertilizers and microbial inoculants	ICT (ppt & images, video clippings) and discussion	
13	Biotechnology of nitrogen fixation, biocontrol agents,		
14	Biopesticides, bioinsecticides Terminator gene technology –concept and basics.		
	Module VI. Environmental Biotechnology		

15	Sewage treatment. Solid waste management. Biodegradation of xenobiotic compounds.	ICT (ppt & images, video clippings) and discussion	
16	Bioremediation and Biorestoration. Microbial leaching and mining. Biofuels.	ICT (ppt & images, video clippings) and discussion	
17	Transgenics and environment.		
	CIA II		
18	Revision		

ASSIGNMENTS

	Date of submission/completion	**Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)**	**Weighttage**
1	Session 20	Individual assignments	

1. Arora,D.R. and Arora,B. 2008. *Text Book of Microbiology*. CBS Publishers and Distributers, New Delhi
2. Chakraborty, P. A.2009. *Text Book of Microbiology*. New Central Book Agency.New Delhi
3. Harma and Kanika.2009.*Manual of Microbiology Tools and Techniques*. Ane Books Pvt. Ltd. New Delhi
4. Ingraham, J. L. and Ingraham, C. A. 2000. *Microbiology* (2ndedn). Brooks/Cole-Thomson Learning,MA,USA
5. Talaro, Park.,Kathelee, N and Talaro,Arthur. 2002. *Foundations of Microbiology*.McGraw Hill Higher

Education,NY

6. Wheelis, Mark. 2010. *Principles of Modern Microbiology*. Jones and Bartlett Publishers,NY,USA.

Biotechnology

1. Dale, Jeremy W and Schantz, Malcom V. 2002. *From Gene to Genomes*. John Wiley and Sons Ltd,NY,USA
2. Doyle, Alan and Griffith Bryan J. 1999. *Cell and Tissue Culture- Laboratory Procedures in Biotechnology*.WileyInternational,NY.
3. Freshney, Ian, R. 2006. *Culture of Animal Cell* (5th edn).Wiley- Liss publications.
4. Pandian, T.T. and Kandavel, D.2008. *Text Book of Biotechnology*. I.K International Publishing House, New Delhi.
5. Primrose, S.B., Twyman, R.M., and Old, R.W. 2001. *Principle of Gene Manipulation (*6th edn). Blackwell Science Ltd, London.
6. Singh .B.D. 2006. *Biotechnology*. Kalyani Publishers, New Delhi.
7. Sobti R. C. and Pachauri, Suparna S. 2009. *Essentials of Biotechnology*. Ane Books Pvt. Ltd. New Delhi.

COURSE PLAN: IMMUNOLOGY

COURSE OBJECTIVES:

To provide an intensive and in-depth knowledge to the students in immunology
• To help the learner to understand the role of immunology in human health and well-being
• To familiarize the students the new developments in immunology

Basic Reference:

Abbas, A.K., Lichtman,A.K and Pober , J.S. 1997. Cellular and Molecular Immunology. W.B. Saunders Co. New York

Ashim K. Chakravarthy. 1998. Immunology. Tata McGraw-Hill, New Delhi.

Chakraborty, A.K. 2006. Immunology and Immunotechnology. Oxford University Press,New Delhi

Darla,J, Wise & Gordeon,R.Carter. 2004. Immunology- A Comprehensive Review. Iowa State University Press. A Blackwell Science Co,USA

David Male,Jonathan Brostoff, David Roth and Ivan Roitt. 2006. Immunology. Mosby, Edinburgh,UK

Goldsby, R.A.,Kindt, T.J. and Osborne, B.A.2000. Immunology (4th edn.). W.H. Freeman and Co. NY,USA.

Hannigan, B. M., Moore, C. B. T. and Quinn, D. G. 2010. Immunology. Viva Books, New Delhi.

Helen Chappel and Maused Harney, 2006. Essentials of Clinical Immunology (5th edn.) Blackwell Scientific Publications

Ivan M. Roitt, 2002. Essential of Immunology. ELBS, New Delhi.

Khan. F.H. 2009. The Elements of Immunolgy. Pearson Education.New Delhi.

Kuby J, 2000. Immunology (7th edn.). WH Freeman & Co. New York.

Richard Coico and Geoffrey Sunshine. 2009. Immunology: A short course. Wiley-Blackwell,CA,USA

Session	Duration	Topic	Method	Remarks
1	1 Hr.	Types of Immunity- Innate and acquired, Passive and active.	Lecture and animation videos	
2	1 Hr.	Pattern recognition receptors- scavenger receptors and Toll – like receptors	Lecture and animation videos	
3	1 Hr.	Humoral and cell-mediated immune responses	Lecture and animation videos	
4	1Hr.	Haematopoiesis	Lecture and animation videos	
5	1 Hr.	Bcell and T-cell maturation and differentiation	Lecture and animation videos	
6	1 Hr.	Antigen processing and presentation.	Lecture and animation videos	
7	1 Hr.	Monoclonal antibodies and abzymes	Lecture and animation videos	
8	1Hr.	Genetic model compatible with Ig structure	Lecture and animation videos	
9	1 Hr.	Multi- gene organization of Ig genes	Lecture and animation videos	
10	1 Hr.	Variable region gene arrangements. Generation of antibody diversity	Lecture and animation videos	
11	1 Hr.	Expression of Ig genes and regulation of Ig genes transcription	Lecture and animation	
			videos	

12	1Hr.	Antibody genes and antibody engineering	Lecture and animation videos	
13	1 Hr.	Antigen- Antibody reactions.	Lecture and animation videos	
14	1 Hr.	Biological consequences of antigen-antibody reaction	Lecture and animation videos	
15	1 Hr.	Terminal sequence of complement activation (MAC).	Lecture and animation videos	
16	1Hr.	Classical Pathway	Lecture and animation videos	
17	1 Hr.	Alternate Pathway	Lecture and animation videos	
18	1 Hr.	Lectin Pathway	Lecture and animation videos	
19	1 Hr.	Complement activation, Regulation of complement system	Lecture and animation videos	
20	1Hr.	Biological consequences of complement activation	Lecture and animation videos	
21	1 Hr.	Complement deficiencies	Lecture and animation videos	
22	1 Hr.		Lecture and animation	

			videos	

23	1 Hr.	Inflammatory Cells.	Lecture and animation videos	
24	1Hr.	Types of Inflammation- acute and chronic	Lecture and animation videos	
25	1 Hr.	Chemokines. Role of cytokines in immune system	Lecture and animation videos	
26	1 Hr.	Properties and functions of Cytokines	Lecture and animation videos	
27	1 Hr.	Therapeutic uses of cytokines	Lecture and animation videos	
28	1Hr.	Allergy and hypersensitivity. Genetics of allergic response in humans	Lecture and animation videos	
29	1 Hr.	Type 1	Lecture and animation videos	
30	1 Hr.	Type 11	Lecture and animation videos	
31	1 Hr.	Type 111	Lecture and animation videos	
32	1Hr.	Type 4	Lecture and animation videos	
33	1 Hr.	General organization and inheritance of MHC.	Lecture and animation	

			videos	

34	1 Hr.	MHC molecules and genes.	Lecture and animation videos	
35	1 Hr.	Genomic map of H-2 Complex in the mouse. HLA Complex in humans. MHC-peptide interaction.	Lecture and animation videos	
36	1Hr.	Expression of MHC molecules on different cell types. Regulation of MHC expression	Lecture and animation videos	
37	1 Hr.	MHC and graft rejection. MHC and disease susceptibility. Biological significance of MHC	Lecture and animation videos	
38	1 Hr.	HLA typing	Lecture and animation videos	
39	1Hr.	Immune response during bacterial (tuberculosis),	Lecture and animation videos	
40	1 Hr.	Parasitic (Malaria) and viral (HIV) infections	Lecture and animation videos	
41	1 Hr.	Congenital immunodeficiency diseases (SCID, WAS, CVI, Ataxia, CGD, LAD)	Lecture and animation videos	
42	1 Hr.	Acquired Immunodeficiency Disease (AIDS)	Lecture and animation videos	
43	1Hr.	Autoimmunity. Organ-specific autoimmune diseases. Systemic auto-immune	Lecture and animation videos	
		diseases		

44	1 Hr.	Animal models for autoimmune disease. Evidences implicating $CD4^+$ T cell, MHC and TCR in autoimmunity.	Lecture and animation videos	
45	1 Hr.	Induction of autoimmunity. Treatment of autoimmune diseases	Lecture and animation videos	
46	1 Hr.	Transplantation immunology. Immunologic basis of graft rejection. Clinical manifestation of graft rejection	Lecture and animation videos	
47	1Hr.	General and specific immunosuppressive therapy. Clinical transplantation. Tumour immunology	Lecture and animation videos	
48	1 Hr.	Vaccines, Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, Synthetic peptide vaccines, Multivalent subunit vaccines.	Lecture and animation videos	
49	1 Hr.	Serological Reactions. Radio-allergosorbent Test (RAST).Immunoprecipitation. Immunofluorescence. Flow cytometry and fluorescence. Immunoelectron microscopy	Lecture and animation videos	
50	1 Hr.	Radio-allergosorbent Test (RAST).Immunoprecipitation. Immunofluorescence.	Lecture and animation videos	
51	1Hr.	Flow cytometry and fluorescence. Immunoelectron microscopy	Lecture and animation videos	
52		Assignment on any research paper in Immunology		