SEMESTER- IV

HCT 4.1: ENDOCRINOLOGY AND REPRODUCTION

Total: 64 Hrs

A. Endocrinology:

Unit-I: Introduction:
16 Hrs
Historical developments in endocrinology; Classification of hormones; Techniques in endocrinology.
Comparative account of endocrine glands: fish to mammals; Hypothalamus, Pituitary, Adrenal, Pancreas; Histology, Cells and their secretions.
Positive and negative feedback of hormone action; Calcium and Glucose homeostasis.
Hormone receptors - Types and structure.

Unit-II: Biosynthesis, mechanism of hormone action and growth factors:
16 Hrs
Biosynthesis of peptide hormone - Insulin; General mechanism of action of peptide hormone;
Signal transduction.
Biosynthesis of steroid hormones - Corticosteroids, Sex steroids; General mechanism of action of steroid hormones; Termination of hormone action.
Biosynthesis of Catecholamines, Thyroid hormones and Prostaglandins.
Growth factors - IGFs; Neurotrophic growth factors; Hematopoietic growth factors; Epidermal
growth factors; Transforming growth factors; Fibroblast growth factors; Cytokines, Chalone.

B. Reproduction:

Unit-III: Female reproductive system:
16 Hrs
Anatomy of female reproductive system; Histo-architecture of ovary; Phases of estrous and menstrual cycles and their Hormonal regulation. Structure of the Ova, Molecular events during fertilization; Types of implantation, sequential events and hormonal regulation, Placenta –Types and endocrine functions of placenta.
Pregnancy, parturition and lactation:
Endocrine regulation of pregnancy and Parturition; Lactation – Development of mammary glands, Endocrine regulation of lactation.

Unit-IV: Male reproductive system, fertility and sterility:
16 Hrs
Anatomy of male reproductive system, Histo-architecture of testis, Spermatogenesis, hormonal control of spermatogenesis. Functions of Sertoli and Leydig cells, Spermiation.
Male accessory reproductive glands:
Structure, functions and hormonal regulation of epididymis, vas deference, prostate gland, seminal vesicle, and cowper's glands; Biochemistry of semen; Biology of spermatozoa.
Fertility Control and Sterility:
Fertility control in male and females – Natural methods, Barrier methods, Intrauterine devices, Hormonal contraceptives, Surgical and Immunological approaches. ARTs – Induction of ovulation, IVF, Embryo transfer, GIFT, ZIFT, Surrogate mother and Gestational carrier.

HCP-4.1: PRACTICAL COURSE IN ENDOCRINOLOGY AND REPRODUCTION

BASED ON HCT-4.1

1. Display of endocrine glands in fish and rat/mice
2. Mounting of pituitary and pineal gland in fish and rat / mice
3. Study of procedure for adrenalectomy in rat
4. Study of histo-architecture of endocrine glands
    A. Pituitary of mammals (Rat)
    B. Ovary of mammals(Rat)
    C. Testis of mammals(Rat)
    D. Adrenal, thyroid, pancreas glands of mammals (Rat)
5. Preparation of permanent histological slides of endocrine glands
6. Hormone assays and working principles of RIA & ELISA
7. Protocol of histochemistry – Localization of steroid dehydrogenase
8. Study of male and female reproductive system in Rat
9. Study of procedure for bilateral orchiectomy and overactomy in Rats
10. Study of histo-architecture of mammalian testis, epididymis, vas deferens, seminal vesicle, prostate gland, cowper's gland
11. Study transverse section of testis in fish, amphibian, reptiles and birds.
12. Study of spermatozoa count
13. Identification of normal and abnormal spermatozoa on the basis of morphology and motility.
14. Study of estrus cycle in rats
15. Study of histo-architecture of mammalian ovary, uterus, fallopian tubule,
16. Study transverse section of ovary in fish, amphibian, reptiles and birds.
17. Folliculogenesis, follicular atresia and corpus luteum
18. Any other practical depending on the feasibility

REFERENCE BOOKS RECOMMENDED:

1. Molecular Endocrinology by Bolander F.F. Academic Press International, 1989.
2. Vertebrate Endocrinology by Norris D.O. 2nd Edition, Lea and Febiger
3. Comparative Endocrinology by Turner and Bugnara
4. Endocrinology by Mac E Hadley. Prentice – Hall International
5. Text Book of Endocrinology 6th Edition by Williams R.H. Saunders Company
6. Knobil E and Neil Encyclopedia of Reproduction Vol. I – IV Academic Press
7. Knobil E and Neil The Physiology of Reproduction Vol. I & II Raven Press Ltd., 1994.
8. Saidapur Reproductive Cycles of Vertebrates Allied Publications New Delhi
9. Adashi et al: Reproductive Endocrinology, Surgery and Technology, Lippincott-Raven publishers, 1996.
10. Findlay, J.K.: Molecular Biology of the Female Reproductive System, Academic Press, San Diego, 1994.
11. Lamming (eds.): Marshall's Physiology of Reproduction. Longman, Green & Co., 1984.
12. Mann & Lutwak-Mann: The Male Reproductive Function and Semen, Springer-Verlag, 1981.
13. Paulson et al(eds.): Andrology: Male Fertility and Sterility, Academic Press, 1986.
14. Yen et al (eds): Reproductive Endocrinology, W.B. Saunders,1999.

HCT-4.2: ENVIRONMENTAL BIOLOGY

Total: 64 Hrs

Unit-I:
16 Hrs
Introduction to environmental biology:
History, definition, importance, divisions and awareness of environmental biology.
Ecosystem and ecological succession:
Concept, types, structure, components and productivity and functions of different ecosystems. Ecological succession: Definition, primary and secondary succession, Influence of anthropogenic activities on succession.
Population growth and regulation:
Concepts of population growth, exponential growth, types of population growth. Population Regulation; physical and biological factors regulating population; Population pyramids and population explosion.

Unit-II:
16 Hrs
Natural resources and conservation:
Concept and classification of natural resources; Non-renewable resources; land, soil and mineral resources; Renewable resources; water, forest, wildlife, range lands, agriculture, livestock, aquaculture. Energy resources (Renewable and Non-renewable); Recourse management and conservation.
Environmental legislation and wildlife conservation:
Laws related to Environmental protection, Wildlife Protection Act, Enforcement agencies.

Unit-III:
16 Hrs
Animal biodiversity:
Global and Indian biodiversity; Levels of biodiversity- genetic, species, ecosystem diversity; Endangered species; Values of biodiversity- consumptive, productive, social, ethical, aesthetic (ecotourism) and health values; Conservation of biodiversity- *ex-situ* and *in-situ*; Mega-biodiversity centers- National parks, sanctuaries and biosphere reserves, biodiversity hotspots; Threats to biodiversity; Human-wildlife conflicts; Organizations associated with biodiversity management.

Unit-IV:
16 Hrs
Climate change:
Composition and structure of atmosphere; Climate- catastrophes and driving forces; Human caused climate change- ozone layer depletion, greenhouse gases and global warming, acid rain; Strategies for dealing with global warming.
Environment and human health:
Types of environmental health hazards- infectious organisms, Toxicants- chemicals, natural and synthetic toxins, heavy metals; Bioaccumulation and bio-magnification; Toxicity measurement-animal testing; environmental legislation and protection.

HCP 4.2: PRACTICAL COURSE IN ENVIRONMENTAL BIOLOGY BASED ON

HCT-4.2

1. Estimation of pH of different water and soil samples using digital pH meter
2. Estimation of dissolved oxygen (DO) in different water samples
3. Estimation of free carbon dioxide in different water samples
4. Estimation of chlorides in different water samples
5. Estimation of total hardness of different water samples
6. Determination of Biological Oxygen Demand (BOD) in different water samples
7. Estimation of total alkalinity of different water samples
8. Estimation of total dissolved solids in different water samples
9. Estimation of dissolved sulphates in water by turbidometric method
10. Estimation of dissolved phosphates in different water samples by colorimetric method
11. Estimation of organic carbon content of different soil samples
12. Estimation of Chemical Oxygen Demand (COD) in water
13. Any other practical depending on feasibility.

REFERENCE BOOKS RECOMMENDED:

1. Environmental Science: Earth As a Living Planet. Bodkin D B and Keller E A. John Willey & Sons, 1995.
2. Environmental Science, 5th Edition. Cunningham W P McGraw – Hill Publications
3. Environmental Science: Systems and Solutions, McKinney. Jones & Barlett Publishers, 1998.
4. Eilson, KS. Animal Physiology: Adaptions and Environment, 4th Edition Cambridge University Press.
5. Fundamentals of Ecology, Odum, E.
6. Environmental Biology, Sharma P D. Rastogi Publications.
7. Air Pollution Rao MN & Rao HVN TATA-MacGraw Hill Publishing Company, 1999.
8. APHA, AWWA and WEF. Standard Methods for Examination of Water and Waste Water, XVIII Ed, American Public Health Association. NY, USA, 1992.
9. Hosetti, B.B. A Text Book of Applied Aquatic Biology, Daya Publishing House, Delhi, 2001.
10. Nandini, .N. Sunitha N. and T. Sucharita. Environmental Studies, Sapna Book House Bangalore, 2010.
11. Prashant, M.S. and B.B. Hosetti, Basic Elements of Environmental Science, Pratiksha Publisher, Jaipur, 2010.
12. G.T. Miller. Resource Conservation and Management, Wadsworth Publishing Company, Belmont California,1989.
13. Nebel, B.T. and Wrigly R.T. Environmental Science, VI Ed. Prentice Hall New Jersey, USA, 1998.

SCT- 4.1a: TOOLS AND TECHNIQUES IN BIOLOGY

Total: 64 Hrs

Unit-I:
16 Hrs

Microscopy, principle & applications. Light microscope and phase contrast microscope, Fluorescence microscope, Electron microscope, Confocal microscopy. General principle and applications of Colorimeter, Spectrophotometer, Ultra centrifuge, Flame photometer, Beer and Lamberts law.

Unit-II:
16 Hrs

Computer aided techniques for data presentation, data analysis and interpretation. Cryotechniques: Cryopreservation of cells, tissues, organs and organisms. Cryosurgery, Cryotomy, Freeze fracture and freeze drying.
Separation techniques. Chromatography, principle type and applicants, Electrophoresis, Principles, types and applications PAGE and agarose gel electrophoresis. Organelle separation by centrifugation.

Unit-III:
16 Hrs

Radioisotope and their biological applications. Sample preparation for radioactive counting of biological samples and Autoradiography. Immunological techniques: Immunodiffusion (Single & Double) and immunoelectrophoresis.
Techniques immunodetection: Immunocyto / histochemistry, immunoblotting, immunodetection, immunofluorescence. Surgical techniques: Organ ablation (eg. Ovariectomy, adrenalectomy), Perfusion techniques, Stereotaxy, Indwelling catheters, Biosensors.

Unit-IV:
16 Hrs

Histological techniques: Principles of tissue fixation, Microtomy, Staining, Mounting and Histochemistry. Cell culture techniques: Design and functioning of tissue culture laboratory, Culture media, essential components and Preparation. Cell viability testing.
Cytological techniques: mitotic and meiotic chromosome preparations from insects and vertebrates. Molecular cytological techniques- In situ hybridization (radio labelled and non-radio labelled methods), FISH, Restriction banding. Molecular biology techniques: Southern, Northern, Western Blotting, DNA Sequencing- Polymerase chain reaction (PCR).

SCP-4.1a: PRACTICAL COURSE IN TOOLS AND TECHNIQUES IN BIOLOGY

BASED ON THE SCT- 4.1a

1. Principles and applications of different microscopes.
2. Preparation of different media for cell and tissue culture
3. Study of different sterilization techniques
4. Demonstration of Instruments used in Modern Biology
5. Demonstration of following chromatography techniques-
    a. Thin layer chromatography.
    b. Column chromatography.
    c. Paper chromatography.
6. Study of working principle and applications of spectrophotometer; colorimeter, P^H
7. Study of working principle and applications of centrifugation technique.
8. Protein estimation by Lowry's Method.
9. Microtomy method of histological slide preparation.
10. Estimation of DNA from Animal tissue
11. Estimation of RNA from Animal tissue.
12. Demonstration of Agarose Gel Electrophoresis
13. Demonstration of PolyAcrylamide Gel Electrophoresis (PAGE)
14. Any other practical depending on feasibility.

REFERENCE BOOKS RECOMMENDED:

1. Introduction to Instrumental Analysis-Robert Braun-McGraw Hill.
2. A Biologist Guide to Principles and Techniques of Practical Biochemistry-K, Wilson and K.H. Goulding ElBS Edn.
3. Essentials of Biophysics, P Narayanan, New Age Int. Pub. New Delhi. 2000.
4. Clark &Swizer. Experimental Biochemistry. Freeman, 2000.
5. Principles and Practice of Bio-analysis, R F Venn, Taylor and Francis, 2003.
6. Locquin and Langeron. Hand Book of Microscopy. Butterwaths, 1983.
7. Boyer. Modern Experimental Biochemistry. Benjamin, 1993.
8. Freifelder. Physical Biochemistry. Freeman, 1982.
9. John R.W. Masters. Animal Cell Culture- A practical approach. IRL Press.
10. Robert Braun. Introduction to Instrumental Analysis. McGraw Hill
11. David W. Mount's "Bioinformatics" .Cold Spring Harbor Press; ISBN 0879697121.
12. James Tisdall. Beginning Perl for Bioinformatics: An Introduction to Perl for Biologists. Publisher: O'Reilly Media. October, 2001.

SCT-4.1b: HISTOLOGY AND HISTOCHEMISTRY

Total: 64 Hrs

Unit-I:
16 Hrs

Introduction: Histology; Histochemistry and Histopathology: Objectives and applications.

Tissue fixation: Objectives, methods, chemical fixatives-types and chemistry of fixation; Physical methods-: freezing and microwave fixation; choice of fixatives, fixation artifacts.

Dyes: Natural and Synthetic dyes, Classification of dyes.

Unit-II:
16 Hrs

Functional morphology (mammalian):

Histological organization of GI tract- stomach and intestine, lungs, kidney, spleen, thymus, Bone and bone marrow.

Histochemistry:

Principles and methods of application and utility of classical histochemical Techniques: for localization of glycoproteins (PAS), nucleic acids (Feulgen) and steroid dehydrogenase activity.

Unit-III:
16 Hrs

I**mmunohistochemistry**:

Principles, method of application of Immuno-histochemistry and immunofluorescence techniques for localization of proteins in endocrine cells (Pituitary cell types or islet of Langherhans); In-situ hybridization of nucleic acids.

Unit-IV:
16 Hrs

Histopathology:

Morphological alterations in cells due to disease, types of degeneration clouding, hyaline, hydrophic and fatty degeneration. Etiology, pathogenesis and histopathology of Liver cirrhosis and atherosclerosis, Neuropathology of alcoholism and methanol poisoning.

Histopathology of tumors: Malignant and non-malignant, types of carcinoma, histopathology of breast and prostate tumors.

SCP-4.1b: PRACTICAL COURSE IN HISTOLOGY AND HISTOCHEMISTRY OF

BASED ON THE SCT- 4.1b.

I. Histology:
1. Microtomy and staining: Hematoxylin-eosin - Demonstration
2. Histology: Observations of permanent slides of mammalian organs – stomach, intestine, spleen, liver, kidney, lungs, testis, epididymis, vas deferens, ventral prostate, seminal vesicle, ovary, uterus and Fallopian tube.
3. Sectioning and staining of mammalian tissues for histological and histochemical studies –Intestine, Liver, Kidney, Ovary and Testes
4. Histology of following tissues: 1) Foetal skin 2) Tongue-filiform, fungiform, circumvallate and foliate papillae.
5. Study of histology of Salivary gland, Hyaline cartilage, Spleen,Thymus, Adrenal ,
6. Study of histology of Trachea, Cowper's gland, Lymph gland, Thyroid, Seminal vesicles, Retina.

II. Histometry:
7. Histometrical measurements of a few organs.

III. Histopathology:
8. Study of histopathological changes (permanent slides) – gastric ulcers, cirrhosis of liver, breast tumors, cyctic follicles of ovary, pancreas in diabetics, cryptorchid testis and leukemia.

IV. Histochemical observations of :

9. Localization of proteins by Mercury Bromo-phenol Blue.
10. Localization of lipids by Sudan Black B.
11. Localization of carbohydrates by Periodic acid Schiff's Reagent
12. Localization of DNA in tissues by Feulgen.
13. Any other practical depending on feasibility

REFERENCE BOOKS RECOMMENDED:

1. Berne. R.N. and Levy. M.N. Principles of Physiology. Mosby Year Book, 1996.
2. Bloom and Fawcett. D. Text Book of Histology 10th Edn. 1972.
3. David H.C. Histology 9th Edn. Horper International Publication, 1987.
4. Histochemistry, Harper and Row: London and John Weatherwill Inc. Tokyo Incl
   Mission:USA.
5. McManus J.F.A. and Mowry R.W. Staining Methods, 1960.
6. Pearse A G E. Histochemistry Vol.1 & 2. Churchill Livingstone: London, 1968.

HCPJ- 4.1: PROJECT / INTERNSHIP

1. All students shall participate in some research based studies/ work/ Internship leading to the submission of a comprehensive report in the form of Dissertation for the award of the M.Sc. Degree in Zoology in consultation with the allotted Research supervisor.

2. HCPJ-4.1: Project Work/Internship commences from the beginning of III semester and ends with IV semester. The project work /Internship caries **150 marks**

    a) **IA - 20 marks** (based on the participation and contribution of the students)
    b) **Submission of certified Dissertation – 80 Marks**
    c) **Presentation and Viva-Voce – 50 marks**