

# Syllabus

## B.Sc. Biotechnology I<sup>st</sup> Year

### PREAMBLE

In view of the increasing demand for training manpower in the area of Molecular Biology, Genetic Medicine and Biotechnology, it was consensus of the committee (Faculties & experts) that this course should be broad based and should be able to give a good insight into modern biology and important component of hands-on training to the students. Thus by nature it will be an interdisciplinary course. The course curriculum for U.G. program under choice based for B.Sc. in Biotechnology (Hons.) presented in this document follows the nationwide exercise undertaken by the UGC as part of curriculum restructuring initiative.

SEMESTER- I							
Paper code	Courses offered (Core course)	Course name	Credit		Marks		
			Theory	Practical *	Theory	Practical	Total
BBT - 1001	CC - 1	Chemistry 1	4	2	100	150	500
BBT - 1002	CC - 2	General biochemistry - I	4	2	100		
BBT-1003 /AECC - 01	Ability Enhancement Compulsory Course	English communication – I	2	-	50		
BBT- 1004 / GE-01	Generic Elective (elect any one)	1004 (A): Biotechnology and Human Welfare	4	2	100		
		1004(B): I.P.R. Entrepreneurship Bioethics & Biosafety	4	2	100		
SEMESTER- II							
Paper code	Courses offered	Course name	Theory	Practical *	Theory	Practical	Total
BBT - 2001	CC - 3	Mammalian physiology	4	2	100	150	500
BBT - 2002	CC - 4	Plant physiology	4	2	100		
BBT- 2003 /AECC - 02	Ability Enhancement Compulsory Course	English communication –II	2	-	50		
BBS-2004 / GE-02	Generic Elective (elect any one)	2004 (A): Gene Organization, Expression and Regulation	4	2	100		
		2004 (B): Developmental Biology	4	2	100		

# SYLLABUS

## SEMESTER-1

### C1 CHEMISTRY

Paper Code (BBT 1001)

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 40

#### Unit 1: Chemical Energetics (10 Lectures)

Review of the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

#### Unit 2: Chemical Equilibrium and Ionic Equilibrium (10 Lectures)

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between  $\Delta G$  and  $\Delta G^\circ$ , Le Chatelier's principle. Relationships between  $K_p$ ,  $K_c$  and  $K_x$  for reactions involving ideal gases.

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

#### Unit 3: Stereochemistry (10 Lectures)

Writing of Fischer projection, Newmann and Sawhorse projection and Wedge formulae. Interconversion of one type of structural representation into another type. **Conformations:** Restricted rotation about single bonds, Various conformations of ethane, butane, ethane-1,2-diol and cyclohexane. Relative stability of different conformations in terms of energy difference is to be discussed for all these compounds. **Geometrical Isomerism:** Requirements for a molecule to show geometrical isomerism, CisTrans and E/ Z notation along with CIP rules for geometrical isomers. **Optical Isomerism:** Optical activity, specific and molar rotation, chirality, enantiomerism, diastereoisomerism, racemic mixtures and their resolution by salt formation method. Relative and absolute configuration: D / L nomenclature system for configuration of carbohydrates (difference between d/l and D/L notations). Threo and Erythro designation. R and S- configuration (upto two chiral centres).

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## Unit 5: Substitution Reactions and Spectroscopy (10 Lectures)

**Free radical substitution reactions:** Halogenation of alkanes, allylic compounds and alkyl benzenes.

**34 Nucleophilic substitution reactions:** Mechanism of SN1 and SN2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group), Electrophilic Substitution Reactions (aromatic compounds): General mechanism of electrophilic substitution reactions (nitration, halogenation, sulphonation, Friedel Crafts alkylation and acylation), directive influence of substituents.

**Introduction to spectroscopy:** Electromagnetic radiation, fundamental definitions, electromagnetic spectrum, introduction to concepts of absorption and emission spectroscopy, Beer-Lambert law. **IR Spectroscopy:** Fundamental and non-fundamental molecular vibrations, IR spectrum, Study of hydrogen bonding. Electronic Spectroscopy: Electronic transitions, singlet and triplet states, dissociation and predissociation. **Laws of photochemistry:** Fluorescence and phosphorescence. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions.

### Recommended Texts:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 9th Ed., Oxford University Press (2011).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Chang, R. Physical Chemistry for the Biosciences. University Science Books (2005).
6. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
7. R. T. Morrison & R. N. Boyd: Organic Chemistry, Pearson Education

### Practicals

**Organic preparations:** Carry out the following preparations using 0.5 - 1 g of starting compound. Recrystallize the product and determine the melting point of the recrystallized sample.

1. To prepare acetanilide by the acetylation of aniline.
2. To prepare p-bromoacetanilide.
3. Benzoylation of aniline or  $\beta$ -naphthol by Schotten-Baumann reaction
4. Hydrolysis of benzamide or ethyl benzoate.

### Thermochemistry:

1. Determination of heat capacity of a calorimeter for different volumes.
2. Determination of the enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of integral enthalpy of solution of salts (endothermic and exothermic).

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### **pH-metric and potentiometric measurements:**

1. Preparation of sodium acetate-acetic acid buffer solutions and measurement of their pH.
2. Potentiometric titrations of (i) strong acid vs strong base (ii) weak acid vs strong base
3. Determination of dissociation constant of a weak acid.

## **C2 CELL BIOLOGY**

### **Paper Code (BBT 1002)**

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 60

#### **UNIT I (10 Periods)**

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

#### **UNIT II (10 Periods)**

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

#### **UNIT III (10 Periods)**

Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure.

#### **UNIT IV (10 Periods)**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

#### **PRACTICALS**

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.

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3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads. 8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions

#### **SUGGESTED READING**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

### **AECC1 ENGLISH**

#### **Paper Code (BBT 1003)**

(Credits 4: Theory-4)

Lectures: THEORY: 20

#### **Introduction:**

Theory of Communication, Types and modes of Communication Language of Communication: - Verbal and Non-verbal (Spoken and Written) - Personal, Social and Business - Barriers and Strategies - Intra Personal, Inter Personal and Group Communication

#### **Speaking Skills:**

Monologue - Dialogue - Group Discussion - Effective Communication/ Mis- Communication - Interview - Public Speech Reading and Understanding - Close Reading - Comprehension - Summary Paraphrasing - Analysis and Interpretation - Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

#### **Writing Skills:**

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Documenting - Report Writing - Making notes - Letter Writing

### **SUGGESTED READING**

Stream A (For students who have studied English up to Class XII):

1. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brat iBiswas
2. Fluency in English Part II Oxford University Press, 2006 3. Business English, Pearson, 2008.

## **GE1 BIOTECHNOLOGY AND HUMAN WELFARE**

**Paper Code (BBT 1004 [A])**

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 40

### **UNIT I (10 Periods)**

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

### **UNIT II (10 Periods)**

Agriculture: N<sub>2</sub> fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

### **UNIT III (10 Periods)**

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB..

### **UNIT IV (05 Periods)**

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

### **UNIT V (05 Periods)**

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

### **PRACTICALS**

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Perform of ethanolic fermentation using Baker's yeast

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2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics (any two)

#### **SUGGESTED READING**

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Shree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

### **GE2 I.P.R. ENTREPRENEURSHIP BIOETHICS & BIOSAFETY**

#### **Paper Code (BBT 1004 [B])**

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 60

#### **UNIT-I (10 Periods)**

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

#### **UNIT II (10 Periods)**

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

#### **UNIT III (10 Periods)**

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

#### **UNIT IV (10 Periods)**

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

#### **PRACTICALS**

1. Proxy filing of Indian Product patent

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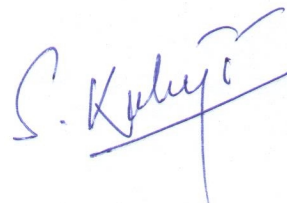
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

#### **SUGGESTED READING**

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd. 5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

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## SEMESTER-2

### C3 MAMMALIAN PHYSIOLOGY

Paper Code (BBT 2001)

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 40

#### UNIT I: Digestion and Respiration (10 Periods)

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice Respiration: Exchange of gases, Transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen dissociation curve, Chloride shift.

#### UNIT II: Circulation (10 Periods)

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

#### UNIT III: Muscle physiology and osmoregulation (10 Periods)

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.


#### UNIT IV: Nervous and endocrine coordination (10 Periods)

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

#### PRACTICALS

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC
5. Demonstration of action of an enzyme
6. Determination of Haemoglobin

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### **SUGGESTED READING**

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.

## **C4 PLANT ANATOMY AND PHYSIOLOGY**

### **Paper Code (BBT 2002)**

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 40

#### **UNIT I: Anatomy (10 Periods)**

The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

#### **UNIT II: Plant water relations and micro & macro nutrients (10 Periods)**

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

#### **UNIT III: Carbon and nitrogen metabolism (10 Periods)**

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calvin cycle, CAM plants, photorespiration, compensation point Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

#### **UNIT IV: Growth and development (10 Periods)**

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization

### **PRACTICALS**

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of plasmolysis by Tradescantia leaf peel.
3. Demonstration of opening & closing of stomata

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4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.
6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

#### **SUGGESTED READING**

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4 th edition, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd. 8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4 th edition, Sinauer Associates Inc .MA, USA

### **AECC2 ENVIRONMENTAL SCIENCES**

#### **Paper Code (BBT 2003)**

(Credits 4: Theory-4)

Lectures: THEORY: 20

#### **Unit 1 : Introduction to environmental studies (2 lectures)**

Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

#### **Unit 2 : Ecosystems (6 lectures)**

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

#### **Unit 3 : Natural Resources (8 lectures)**

Renewable and Non-renewable Resources, Land resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on

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environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

#### **Unit 4 : Biodiversity and Conservation (8 lectures)**

Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation; Endangered and endemic species of India, Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

#### **Unit 5 : Environmental Pollution (8 lectures)**

Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks, Solid waste management : Control measures of urban and industrial waste. Pollution case studies.

#### **Unit 6 : Environmental Policies & Practices (7 lectures)**

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture 2/2, Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

#### **Unit 7 : Human Communities and the Environment (6 lectures)**

Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquake, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

#### **Unit 8 : Field work (Equal to 5 lectures)**

Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.

Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

Study of common plants, insects, birds and basic principles of identification.

Study of simple ecosystems-pond, river, Delhi Ridge, etc.

#### **Suggested Readings:**

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1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats
7. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
8. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.

## **GE2 GENE ORGANIZATION, EXPRESSION AND REGULATION**

**Paper Code (BBT 2004 [A])**

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 40

### **Unit 1 Structure of genes and chromosomes (Lectures : 6)**

Definition of a gene, chromosomal organization of genes in viruses, bacteria and eukaryotes. Supercoiling of DNA.

### **Unit 2 Replication of genomes (Lectures : 6)**

General features of DNA replication, properties of prokaryotic and eukaryotic DNA polymerases. Replication of DNA and telomeres in linear chromosomes. Replication of RNA genomes.

### **Unit 3 Recombination of DNA (Lectures : 4)**

Homologous genetic recombination, Holliday model, proteins and enzymes mediating recombination.

### **Unit 4 Gene mutations and repair (Lectures : 6)**

Molecular basis of mutations, multiple repair systems, mismatch repair, base excision repair, nucleotide excision repair, direct repair and translesion DNA synthesis.

### **Unit 5 Transcription of genes (Lectures : 6)**

General features of gene transcription, procaryotic and eukaryotic RNA polymerases, stages of transcription, initiation, elongation and termination. Inhibitors of transcription.

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### **Unit 6 RNA processing (Lectures : 3)**

Processing of eukaryotic mRNA, splicing of introns, alternate splicing and editing, ribosomal and tRNA processing.

### **Unit 7 Protein synthesis (Lectures : 5)**

Features of the genetic code, amino acylation of tRNAs, structure and assembly of ribosomes; three stages of protein synthesis - initiation, elongation and termination. Inhibitors of protein synthesis.

### **Unit 8 Regulation of gene expression (Lectures : 4)**

Regulation of transcription in prokaryotes, concept of operons. Lac operon - control by negative and positive regulatory proteins, Trp operon - control by attenuation. Regulation of transcription in eukaryotes, regulatory sequences - enhancers, silencers response elements, nucleosome alterations, DNA-protein interactions and RNA interference.

### **PRACTICALS**

1. Quantitative determination of DNA and RNA by absorbance at 260 nm and using A260/A280 ratio to distinguish between them.
2. To study the viscosity of DNA solutions.
3. Isolation of chromosomal DNA from E. coli.
4. Isolation of total RNA from yeast cells.

### **SUGGESTED READINGS**

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13; 978-1-4641-0962-1 / ISBN:10-14641- 0962-1.

## **GE2 DEVELOPMENTAL BIOLOGY**

### **Paper Code (BBT 2004 [B])**

(Credits: Theory-4, Practicals-2)

THEORY Lectures: 40

### **UNIT I: Gametogenesis and Fertilization (10 Periods)**

Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.

### **UNIT II: Early embryonic development (20 Periods)**

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Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

### **UNIT III: Embryonic Differentiation (20 Periods)**

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

### **UNIT IV: Organogenesis (10 Periods)**

Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germ layers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

### **PRACTICALS**

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of Anopheles.
4. Study of the developmental stages of Drosophila from stock culture/ photographs.
5. Study of different types of placenta.

### **SUGGESTED READING**

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

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