



**MAHATMA GANDHI UNIVERSITY
KOTTAYAM**

B.Sc. BIOTECHNOLOGY

**SCHEME AND SYLLABUS
OF
CORE AND COMPLEMENTARY COURSES**

AS PER THE NEWLY INTRODUCED C.B.C.S PROGRAMME

2017

CONTENTS

Acknowledgement	3
Introduction	3
Objectives	3
Duration of thecourse	4
Evaluation	4
Scheme	5-7
Syllabus	8-47

(Prepared by Board of Studies and Faculty)

ACKNOWLEDGEMENT

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INTRODUCTION

The BSc Biotechnology Programme offered by M G University provides core and complementary courses as per the regulations of UGC. In the first semester programme, students are introduced to the basics of Life Sciences and the evolution of Biotechnology as a multidisciplinary branch of science. In connection with this, a methodology paper is incorporated in the first semester. As knowledge in Genetics, Cell and Molecular Biology, Biochemistry and Microbiology is essential to explore the principles of Biotechnology, these areas are incorporated as courses in various semesters of the programme. rDNA technology and Biotechnological approaches in Plant Science, Animal science and Environmental Science are constituted as separate courses. Properly designed experiments are incorporated in all semesters to provide ample opportunity for the students to gain sufficient practical knowledge in the subject. Extreme care has also been taken to incorporate essential principles of Environmental services and Ecology into the newly designed curriculum. The syllabus also comprises of choice based courses, electives and complementary courses that are being instrumental in expanding the knowledge domain of the subject.

OBJECTIVES

The syllabus has been designed with the following objectives:

- The curriculum should provide a platform for understanding basic life science along with advanced topics of Biotechnology.
- The curriculum should be able to make the students competent in both theoretical and practical aspects of the subject.
- The curriculum should carry multiple options in terms of electives for incorporating innovative ideas generated in this field.
- The interdisciplinary nature of the subject is to be incorporated to have option for employment and higher studies.

DURATION OF THE COURSE

Duration of the course is two years. Each year is divided into two semesters.

EVALUATION

The scheme involves external and internal evaluation which is conducted according to the regulations of MahatmaGandhi University.

SCHEME OF THE PROGRAMME

Sem.	Sl.No.	Course	Inst.Hrs.	credits	
I Sem		Common 1 English	5	-	4
	Core1	BT1CRT01 Basic Life Sciences	5	-	4
	core 2	BT1CRT02 Methodology in Biotechnology	5	-	4
	Core 3	BT1CRP01 Practical-L-Basic Life Sciences	-	2	2
	Compl.-1	Biochemistry-1	2	-	2
	Compl.-2	Microbiology-1	2	-	2
	Compl.-3	Practical Biochemistry-1	-	2	1
	Compl.-4	Practical Microbiology -1	-	2	1
		Total			20
II Sem		Common 2 English	5	-	4
	Core 4	BT2CRT03 Cell Biology	4	-	4
	Core 5	BT2CRT04 Elementary Chemistry for Biology	4	-	3
	Core 6	BT2CRT05 Evolution & Developmental Biology	2	-	2
	Core 7-	BT2CRP02 Practical- Cell Biology	2	-	2
	Compl.-5	Biochemistry-2	2	-	2
	Compl.-6	Microbiology-2	2		2
	Compl.-7	Practical Biochemistry-2	2	-	1
	Compl.-8	Practical Microbiology-2	2	-	1
					21
III Sem.	Core - 8	BT3CRT06 Immunology	5	-	4
	Core 9	BT3CRT07 Genetics	5	-	4
	Core10	BT3CRT08 Biostatistics and Computer application	4	-	3
	Core-11	BT4CRP03- Practical- Immunology and Genetics.	3	-	3
	Comp.-9	Biochemistry-3	2	-	2

	Compl.-10	Microbiology-3	2	-	2	
	Compl.-11	Practical Biochemistry-3		2	1	
	Compl.-12	Practical Microbiology-3		2	1	
					20	
Sem.		Course	Inst..Hrs.		Credits	
			T	L		
IV Sem	Core12	BT4CRT09Molecular Biology	5	-	4	
	Core13	BT4CRT10 Enzymology	4	-	4	
	Core14	BT4CRT11 Biophysics and Bioinformatics	4	-	3	
	Core15	Practical Molecular biology and Enzymology	-	4	3	
	Compl.13	Biochemistry-4	2	-	2	
	Compl.14	Microbiology-4	2	-	2	
	Compl.15	Practical Biochemistry-4	-	2	1	
	Compl.16	PracticalMicrobiology-4	-	2	1	
	Total				20	
V Sem.	Core 16	BT5CRT12 Recombinant DNA technology	6	-	4	
	Core17	BT5CRT13- Environmental Biotechnology	4	-	4	
	Core 18	BT5CRT14 Animal Biotechnology	6	-	4	
	Core 19	BT5CRP05 Practical rDNA Technology and Environmental Biotechnology		5	4	
	core 20	Open Course(A/B/C)	4	-	3	
		Total				19
VISem.	Core21	BT6CRT15Plant Biotechnology	5	-	4	
	Core22	BT6CRT16 Industrial Biotechnology	5	-	4	
	Core23	BT6CBT01-Choice Based Course(A/B/C)	5	-	4	
	Core24	BT6CRP06 Practical Environmental Biotechnology and Plant Biotechnology	5	-	4	
	Core25	BT6CRP07 Project and viva voce	-	5	4	
						20
		Total credits				120

Open course

BT5OPT01A- Tissue culture techniques
BT5OPT01B - Biotechnology for sustainable development
BT5OPT01C - IPR and patents

Choice based Course

BT6CBT01A - Bioinformatics
BT6CBT01B - Nanotechnology
BT6CBT01C - Diseases and Diagnostic Biotechnology

Complimentary Course

BT1CMT01 Cell Biology
BT2CMT02 Genetics
BT3CMT03 Molecular Biology and Recombinant DNA Technology

The programme includes a study tour/field visit and the report about the same should be submitted by each student.

SEMESTER I

Core 1 - BT1CRT01 BASIC LIFE SCIENCES

Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 30Hrs

Nutrition-digestive system, mechanism of digestion-enzymes, absorption of carbohydrate, lipid and proteins, storage and mobilization of food reserves , respiration, respiratory system – structure, function, mechanism, Hb - structure and function, regulation of respiration.

Module II: 15 Hrs

Lymphatic system, lymph – functions, Excretion - structure of kidney and nephron, glomerular filtration, urine-normal and abnormal constituents

Module III 15 Hrs

Nervous coordination: Structure of neuron, transmission of nerve impulse, Synapse; structure and function, neurotransmitters: Types and functions.

Module IV: 15 Hrs

Absorption and transport of water: Theories on absorption, macro and micro nutrients, transpiration, Photosynthesis: photosystems, cyclic and noncyclic photophosphorylation, calvin cycle, Rubisco, CAM plants

Module V: 15Hrs

Plant growth regulators-auxin, cytokinin, gibberellin, ethylene, abscisic acid, plant movements-tropic,tactic and nastic movements, photoperiodism, vernalisation.

References:

1. Medical Physiology –A C Guyton, J E Hall, Saunders/ Elsevier pub.
2. Animal Physiology for BSc and MSc- Mohan p Arora, Himalaya Pub, india
3. Medical Physiology- A. B.SMahapatra- Current Books International, IndiaPub.
4. Foundation course in Biology- Agarwal, Ane books.
5. Text Book of Plant Physiology - V Verma, Ane Books
6. Fundamentals of Plant Physiology - V.K.Jain, S Chand Pub.,New Delhi, India.
7. Essentials of Modern Biology - R C Sobti and VL Sharma, Ane books, New Delhi
8. Plant Anatomy, - B. P. Pandey. S. Chand & Company Ltd. New Delhi
9. Animal physiology- B S Thyagi, S Chand Publishers., India

Core 2 - BT1CRT02 METHODOLOGY IN BIOTECHNOLOGY
Total hours of instruction: 90 Hours/ week: 5 Credit : 4

Module I: 15Hrs

Biotechnology - Definitions, multidisciplinary nature, scope, History of Biotechnology , trends, scope of research, milestones in the development of Biotechnology, Biotechnology in ancient world.

Module II: 20Hrs

Conventional and modern biotechnology: Fermentation- definition. Conventional fermentation practices- marine fermented products, Definition and scope of Bioprocess technology, recombinant DNA technology, Bioinformatics and biorobotics, Genetically modified organisms: merits and demerits. Blue biotechnology, Green biotechnology, White Biotechnology..

Module III: 25Hrs

Major Biotechnology institutes and companies in India, Global trend of biotechnology industry. Introduction to Good Laboratory Practices (GLP), Quality control in manufacturing, Good Manufacturing practices (GMP), Marketing of Biotechnological products, Impact of Biotechnology on society, Biotechnology and IPR.

Module IV: 15Hrs

Human genome project- an introduction, Cloning: technology , merits and demerits. Cloning of buffalo in India, Biotechnology in space research, Artificial cell: synthesis, types and applications.

Module V: 15 Hrs

Nanobiotechnology, applications of nanobiotechnology in medicine and health, Classification of nanomaterials, application of nano crystals, DNA chip, nanobiosensors - DNA sensors, Quantum dots.

References:

1. Biotechnology - B. D Singh, Kalyan Publishers, New Delhi
2. A Text Book of Biotechnology - R. C Dubey, S Chand and Company Pub:
3. Biotechnology - U. Sathyanarayana, Books and Allied Pvt. Ltd. Kolkata.
4. Prescott/Harley/Klein's Microbiology - Joanne Willey, Linda Sherwood and Chris Woolverton.
5. Cell and Molecular Biology. 8th Edition. - EDP De Robertis and EMF De Robertis, Lippincott Williams and Wilkins Publication
6. Biotechnology and Ethics: A blueprint for the future, - Daniel Callahan President, Hastings Center, Center for Biotechnology, North Western University.
7. Biotechnology: Issues, Ethics and Regulation, - Tina M. Prow, Communication Specialist, Office of Agricultural Communication and Education
8. Biotechnology and Ethics: A blueprint for the future, - Daniel Callahan President, Hastings Center, Center for Biotechnology, North Western University
9. Nanobiotechnology :Concepts, Applications and Perspectives - C M Neimeyer and C. A. Mairkin, Wiley, US.
10. Biomaterial Science. An introduction to materials. - Ratner BD, Hoffman AS, Schoen FJ and Lemons JE. Elsevier, 2004.
11. Nanotechnology in Catalysis. Volume 3, - David J. Lockwood. Springer science, 2007
12. Introduction to Nanotechnology - John Wiley and Sons, 2008.

SEMESTER II

Core 4 – BT2CRT03CELL BIOLOGY

Total hours of instruction: 72 Hours/ week: 4 Credit: 4

Module I: 8Hrs.

History and development of cell biology. Universal features of cell. Chemical components of cell. Cell theory. General organization of eukaryotic and prokaryotic cell. Evolution of eukaryotic cell. Plant cell and animal cell.

Module II: 15Hrs

Cell Membrane -.Chemical composition, ultra structure - fluid mosaic model, functions - Membrane transport - active, passive, facilitated - symport, antiport. Cell-cell interaction - selectins, integrins, cadherins, cell junction - tight junction, gap junction.

Module III:12Hrs.

Nucleus-structure and function, nuclear membrane, nucleolus, chromatin-euchromatin, heterochromatin, chromosomes - structure of a typical metaphase chromosome - centromere, telomere, chromomere, satellite DNA, nucleosome organization -histones, linker DNA, giant chromosomes, chromosome banding.

Module IV 22Hrs

Structure and functions of cell organelles - ER, Golgi complex, Ribosomes, Mitochondria, Chloroplast, Lysosome, Peroxisome. Cytoskeleton - Microtubules, Microtubular organelles, Microfilaments, Intermediate filaments.

Module V: 15Hrs.

Cell cycle - stages, Mitosis, Meiosis, Regulation of cell cycle - MPF, cyclins. Cell death - Necrosis and apoptosis. Cancer cells - characteristics of cancer cells, Cell Signaling - cyclic AMP, G protein, RTK receptors - convergence, divergence and cross talk.

References

1. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc
2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
3. Fundamentals of Genetics, B D Singh, Kalyani Publishers
4. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart, Suzuki and Miller, Freeman's and Co, New York
5. Principles of Genetics: A.G.Gardner, John Wiley and sons.
6. Cell and Molecular Biology by Gerald Karp, Academic Press
7. World of the Cell , Becker, Reece, Poenie, The Benjamin/Cumming's Pub.
8. Cell Biology , Lodish et al, W H Freeman and Co.,NewYork.
9. Cell Biology , Thomas D Pollard and W.C.Earnshaw, Saunder's Publishers

Core 5- BT2CRT04ELEMENTARY CHEMISTRY FOR BIOLOGY
Total hours of instruction: 72 Hours/ week: 4 Credit: 4

Module I: 12 Hrs

Bohr atom model, Limitations, De broglie Equation, Heisenberg uncertainty principle, Schrodinger equation, Atomic orbitals. Quantum numbers and significance. Lattice energy of ionic compounds, applications

Module II: 15 Hrs

VSEPR theory, Hybridization involving s, p, d orbitals – sp, sp², sp³, dsp², sp³d, sp³d². Molecular orbital theory, Hydrogen bonding in H₂O, structure of water molecule, intermolecular forces, ion-dipole, dipole-dipole, dipole-induced dipole, induced dipole-induced dipole interactions.

Module III: 20 Hrs

Mole concept, Determination of molecular weight by gram molecular volume relationship, problems based on mole concept, Solutions, colligative properties, Methods of expressing concentrations, strength, Normality, Molarity and Molality, ppm. Standardization of solutions, pH, buffer systems, dissociation constant, pK value, Preparation of standard solution of acids and bases, problems related to acid base titrations, volumetric experiments - acidimetry, alkalimetry, permanganometry, dichrometry, iodometry.

Module IV: 15Hrs

Rates of reactions - various factors influencing rate of reactions - Order and molecularity - zero, first, second and third order reactions. Derivation of integrated rate equations (single reactant only), fractional life time, its relation to initial concentration of reactants for various orders, units of rate constants. Influence of temperature on reaction rates, Arrhenius equation, calculation of Arrhenius parameters, Collision theory of reaction rate.

Module V: 15 Hrs

Structure of organic compounds - Conformation and configuration, Rotation about carbon-carbon single bond, conformations of ethane. Isomerism, types, Geometrical isomerism, Optical isomerism: explanation with examples.

References:

1. University General Chemistry. By C.N. R. Rao. McMillan India Ltd Publication.
2. Principles of Physical Chemistry By B R Puri ,L R Sharma &M S Pathania, ISBN: 978-93-82956-01-3, ISBN: 978-93-82956-01-3ishal Pub. Co
3. A Text Book of Physical chemistry By A.S.Negi&S.C.Anand, New Age International, New Delhi.
4. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
5. Organic chemistry- A Bhal and B S Bhal, S Chand Pub.
6. Modern Inorganic Chemistry, R. D Madan, S. Chand and company, 13Th edition, 2005.
7. Concise Inorganic Chemistry 5 th Ed., J.D. Lee, Blackwell Science Ltd

**Core 6- BT2CRT05 EVOLUTIONARY BIOLOGY AND DEVELOPMENTAL
BIOLOGY**

Total hours of instruction: 36 Hours/ week: 2Credit: 2

Module I: 8Hrs.

History, theories on evolution, prebiotic environment and molecular evolution, origin of life, Miller - Urey experiment, Darwinian theory of evolution and its postulates.

References:

Module II: 6 Hrs.

Selection, speciation- allopatric and sympatric, adaptive radiation, role of mutation, modern theories of evolution, micro and macroevolution, Relationship among organisms and evidences of evolution.

Module III: 6 Hrs

Human evolution: Unique features of humans. Rama pithecus, Australopithecus afarensis, Homo erectus, Homosapiens(Neanderthals), Homo sapiens sapiens.

Module IV: 10Hrs

Plant development: Structure of flower, stages of flower development, androecium, gynoecium, micro and megasporogenesis, stages of seed germination, structure of monocot and dicot embryos, seed dormancy, polyembryoni.

Module V: 6Hrs.

Embryo development in animals; spermatogenesis, fertilization, Cleavage, morula, blastula, formation of germ layers, formation of gastrula, fatemap, parthenogenesis.

References:

1. Microbial Ecology.Fundamentals and Applications. Atlas and Bartha, Pearson Education , Benjamin Cummingspublishingcompany.Inc.New Jersey
2. Essential Environmental Studies - S. P. Misra, S. N. Pande, Ane Books Pvt.Ltd.
3. Ecology and environment - Sharma P.D , Rastogi publications.
4. Organic Evolution - N.Arumugam , ISBN 9788189941178 , Saras publication
5. A manual of Developmental biology - VijayakumarNair.K and George .P.V, Acadamia Publication, Javahar Nagar, TVM- 41
6. Developmental Biology- Muller, Springer Pub., Netherlands
7. Chordate embryology, - P.S. Varma and V.K.Agarval, S Chand and Co.& Ltd

Core 3- BT1CRP01 PRACTICAL-BASIC BIOLOGY AND CHEMISTRY

Total hours of instruction: 36 Hours/ week: 2 Credit: 3

1. Cross section of Anther
2. Pollen tube germination
3. Demonstration of various developmental stages of chick embryo
4. Method of expressing concentration of solutions- calculations based on Normality and Molarity
5. Standardization of the concentration of acids/alkali based on volumetric titrations
6. Qualitative analysis of the organic compounds
7. Tests for –Hydrocarbons, alcohol, aldehydes, ketones, aniline, amide

References:

1. A practical guide to developmental Biology, - Melissa A. Gibbs, Oxford University Press
2. Practical Chemistry - A. O. Thomas

Core 7- BT2CRP02 PRACTICAL- CELL BIOLOGY

Total hours of instruction: 36 Hours/ week: 2 Credit: 2

1. Examination of different kinds of cells - Prokaryotic and eukaryotic cell
2. Blood grouping
3. Cell counting methods:
 - a) Haemocytometer: WBC, RBC
 - b) Differential counting using Leishman's stain
4. Micrometry:
 - a) Calibration using ocular micrometer
 - b) Finding out average cell size
5. Squash Preparation
 - a) Study of mitotic stages
 - b) Measurement of Chromosome length.
7. Staining of mitochondria.

References:

1. Laboratory investigation in cell and molecular biology. - AllynBregman, 1996. John Wiley & Sons.
2. Microbiology Laboratory Manual - Cappuccino, Sherman, Pearson Education
3. A Text book of Practical Physiology - CLGhai, Jaypee Brothers Publishers (P) LTD New Delhi.
4. Medical Laboratory Technology. Procedure Manual for Routine Diagnostic Tests - Volume I, Kanai L Mukherjee; Tata McGraw - Hill publishing Company. Ltd New Delhi

SEMESTER III

Core 8 - BT3CRT06 IMMUNOLOGY

Total hours of instruction: 90,Hours/ week: 5 Credit: 4

Module I: 20Hrs

Introduction to immunology. Types of immunity: nonspecific- physiological and cellular barriers, acquired immunity- characteristics, Antigen, Haptens and Adjuvants , Antibody. Structure and types of immunoglobulins, distribution and function.

Module II: 25Hrs

Organs of immune system - primary and secondary. Cells of immunesystem. Immuneresponse. Humoral and cell mediated immunity. MHC structure and function. Autoimmunity and hypersensitivity.

Module III 15Hrs

Antigen- antibody interactions: Affinity, avidity, cross reactivity, Precipitation reaction: radial immune diffusion, Ouchterlony double diffusion. Agglutination reaction, agglutination titer, Incomplete agglutinins, complement fixation, ELISA, Immunocytochemistry.

Module IV: 15Hrs

Transplant immunity. Immunology of malignancy. Immunohaematology. Blood groups and blood grouping. A, B, Rh antigens and antibodies, Rh typing. Bombay group,

Module V: 15Hrs

Immunization: Passive and active .Vaccines, types and applications. DNA vaccines, Polyclonal antibodies and monoclonal antibodies.

References:

1. Essential Immunology - Ivan M. Roitt and Peter J delves, Blackwell Publishing
2. Immunology - Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, and Janis Kuby, W H Freeman and Co.
3. Immunobiology - Charles A. Janeway Jr., Paul Travers, Mark Walport and Mark J. Shlomchik, Garland Publishing.
4. Essential Clinical Immunology – Helen Chappel and Mansel Haeney, ELBS/Blackwell Scientific Publications
5. Introduction to Immunology – John W, Kimball Maxwell, Mac Millan International Edition.
6. Text book of Microbiology – R. Ananthanarayanan and C K Jayaram Panicker. Orient Longman.

Core 9- BT3CRT07 GENETICS

Total hours of instruction: 90, Hours/ week: 5Credit: 4

Module I: 20hrs

The birth of genetics, symbols and terminology, Mendel's experiments, Principle of segregation, Monohybrid cross, Principle of independent assortment, Dihybrid ratio, Dominance, Recessiveness, Codominance, Semidominance, lethal, multiple alleles, ABO blood typing, gene interactions - epistasis, pleiotropy, polygenic inheritance. Testcross, Back cross.

Module II: 15hrs

Linkage, crossing over, sex determination - autosomes and sex chromosomes, chromosomal basis of sex determination (XX-XY, XX-XO, ZZ-ZW types) mechanism of sex linked inheritance, sex influenced, sex limited gene expression, dosage compensation

Module III 15 hrs

Extrachromosomal inheritance - mitochondria and chloroplast, Types of Mutation - Mutagens, Variation in chromosome number - euploidy, aneuploidy, polyploidy, addition, deletion, transition, transversion, nonsense, missense mutation. Significance of mutation in evolution.

Module IV: 25 Hrs

Human genetics - Karyotype study & Pedigree analysis, Chromosomal anomalies and human disorders - autosomal anomalies - Down's syndrome and Edwards syndrome, Sex chromosome anomalies - Klinefelters syndrome, Turners syndrome, Genetic disorders - Sickle cell anaemia and phenyl ketonuria, Genetics of cancer .

Module V: 15hrs

Population genetics - genetic variation, allele frequencies, random mating, Hardy Weinberg equilibrium, assortive mating, genetic equilibrium

References:

1. Principles of genetics - E J Gardner John Wiley India Publication
2. Genetics –M W Strick Berger , macmillan,
3. Fundamentals of Genetics - Peter. J. Russel, Harper Collins Pub.
4. Genetics, Principles and analysis- Daniel L. Hartin and Elizabeth W. John , Jones and Bartlett Pub. US.
5. Human Genetics, - 2 nd& 3 rdEdn. S. D. Gangane. Elsevier/ Paras publications.
6. Essentials of Human Genetics, - 4 thEdn. S. M. Bhatnagar, M. L. Kothari and L. A. Mehta.
7. Text book of genetics, - Veer BalaRastogi, KNRN Pub
8. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, - P. S. Verma, V.K. Agarwal., S Chand pub
9. Genetics- - P. S. Verma, S Chand pub

CORE10 BT3CRT08 BIOSTATISTICS AND COMPUTER APPLICATION

Total hours of instruction: 36Hours/ week: 2Credit: 4

Module I: 8 Hrs

Nature, application and limitation of statistics in life science. Statistical population, Qualitative and quantitative data, Data collection: Primary and secondary. Sampling , Classification, Measures of asymmetry. Correlation and regression.

Module II 5 Hrs

Tabulation and representation of data. Diagrammatic and graphical representation, Analysis of data, Measures of central tendency. Measures of dispersion.

Module III 8 hrs

Probability theory and distribution. Binomial, Poisson and Normal. Testing of hypothesis, t-test, Chi-square test, F-test. Non parametric tests. Analysis of variance -ANOVA. Concept of ANOVA, Basic principles, ANOVA technique.

Module IV: 8Hrs

Introduction to Computers. Low level and high level languages. Binary number system. Flow chart and programming techniques. Introduction to data structures and database concepts. Introduction to Internet and its applications.

Module V: 7Hrs

Introduction to MS office software, Word processing, spread sheet and software. Computer oriented statistical techniques. Frequency table of single discrete variable Bubble sort, Computation of mean variance and Standard deviation.

References:

1. Introduction to Biostatistics – Sokal & Rohlf (1973) Toppan Co Japan
2. Fundamentals of biostatistics. Veerbala Rastogi. (2008) Ane books
3. Norman, T.J. Bailey (2007) Statistical methods in biology, 3rd edition. Cambridge university press
4. The programmer's Book of Rules. - Ladin BRC and Ledin V. Lifetime learning Publishers
5. Computer programming. - Rajaraman V. Prentice hall India Publication
6. Research Methodology - Methods and techniques. - C.R Kothari , New age international.
7. Biostatistics, Arora PN and PK Malhotra, Himalaya Publishing House.
8. Biostatistics, Computer application and Bioinformatics. V. Kumaresan , N. Arumugam, A. Gopi , A. Meena , R. Sundaralingam , ISBN 9789382459910
9. Introduction to Computers- peter Norton, Tata mac Graw Hill Pub.

Core11 BT4CRP03– Practical- Immunology

1. Slide agglutination test
2. Bacterial agglutination test
3. Haemagglutination test
4. Precipitation in tube-Capillary test
5. Precipitation in gel-Immunodiffusion (Demonstration only)
6. Immunoelectrophoresis (Demonstration only)
7. Blood grouping by slide agglutination method

Reference

1. Introduction to Immunology – John W, Kimball Maxwell, Mac Millan International Edition.
2. Text book of Microbiology – R. Ananthanarayanan and C K JayaramPanicker. Orient Longman.

SEMESTER IV

Core 12: BT4CRT09 MOLECULAR BIOLOGY

Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 25Hrs

History of significant discoveries in Molecular Biology, Experiments demonstrating DNA as the genetic material, RNA as genetic material, Structure of DNA and RNA, Physico-chemical properties of DNA, Organization of DNA in viral, prokaryotes and eukaryotic chromosome

Module II: 10Hrs

Genes - Concept of gene, Gene structure, split genes, Structure of prokaryotic genes, eukaryotic genes -structure, reading frame and regulatory elements, micro satellites, C-value paradox. Cytoplasmic genome - chloroplast and Mitochondrial DNA.

Module III: 15Hrs

DNA replication - Meselson and Stahl experiment, Replication in prokaryotes and eukaryotes, Structure and function of enzymes involved in DNA replication. DNA repair: Mismatch repair, excision repair.

Module IV 20 Hrs

Transcription in prokaryotes and eukaryotes - initiation, elongation and termination, Transcription products, Types of RNA - mRNA, rRNA, tRNA and sn RNA. Genetic code, properties of genetic code, start codon and termination codon. Wobble Hypothesis. Translation - translation of prokaryotic and eukaryotic mRNA - initiation, elongation and termination.

Module V: 20Hrs

Regulation of Gene expression - Regulatory protein, promoters, activators, repressors, operon concept, positive and negative regulation, Molecular details of Lac and Trp operon, Transposable elements - IS elements, composite and non composite transposons, SINES and LINES.

References:

1. Introduction to Molecular Biology - P. Paoletta; Mc. Graw Hill, New York
2. Fundamentals of Biochemistry, - J.L. Jain, Sanjay Jain, Nitin Jain, S. Chand Publishers
3. Genetics. A Molecular approach. 2nd Edn. - Peter J. Russel.
4. Principles of genetics - Snustad and E J . Gardner, John Wiley publishers.
5. Molecular Biology of the gene - Watson, Baker, Ganu, Bell, Levene, Losiek (Pearson Publication)
6. Cell and Molecular Biology by Gerald Karp, Academic Press
7. World of the Cell , Becker, Reece, Poenie, The Benjamin/Cumming's Pub.
8. Cell Biology , Lodish et al, W H Freeman and Co., New York.
9. Cell Biology , Thomas D Pollard and W.C. Earnshaw, Saunder's Publishers

Core13- BT4CRT10 ENZYMOLOGY

Total hours of instruction: 72

Hours/ week: 4

Credit: 4

Module I: 15Hrs

Enzyme nomenclature and classification. Isolation of enzymes. Extraction of soluble and membrane bound enzymes. Purification of enzymes: precipitation, dialysis, chromatography and electrophoresis; criteria for enzyme purity.

Module II: 15Hrs

Structure and properties of enzymes, active site, specificity, specific activity, Multi enzyme complex, Enzyme unit, Mechanism of enzyme action. Coenzymes and their action, Factors affecting enzyme activity.

Module III: 12 Hrs

Kinetics of enzyme substrate reactions, Michaelis - Menton equation, MM plot, Lineweaver - Burk plot. Regulation of enzyme activity-methods.

Module IV: 15Hrs

Inhibition of enzymes, inhibitors, types of inhibition, Mechanism of inhibition -competitive, uncompetitive and noncompetitive and allosteric inhibition. Cooperativity, Ping-Pong mechanism.

Module V: 15 Hrs.

Clinical and industrial application of enzymes, immobilization of enzymes, Biosensors, Synthetic enzymes, Ribozymes, Abzymes, Enzymes involved in genetic engineering and biodegradation, Enzyme engineering

References:

1. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis Stevens (2000) Publisher: Oxford University Press, USA ISBN: 019850229X ISBN-13: 9780198502296, 978-0198502296
2. Enzyme Kinetics and Mechanisms by Taylor Publisher: Springer ISBN: 8184890478 ISBN-13: 9788184890471, 978-8184890471
3. Biochemistry (2004) by Donald Voet, Judith G. Voet **Publisher:** John Wiley & Sons
4. Enzyme Mechanism by P.K. Shivraj Kumar (2007) **Publisher:** RBSA Publishers ISBN: 8176114235 ISBN-13: 9788176114233, 978-8176114233

5. Biochemistry 6th Edition (2007) by Jeremy M. Berg John L. Tymoczko Lubert Stryer **Publisher:** B.i. publications Pvt. Ltd **ISBN:** 071676766X
ISBN-13: 9780716767664, 978-716767
6. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K **Publisher:** Pearson **ISBN:** 0131977369,
7. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner (2007) **Publisher:** Horwood Publishing Limited

Core 14 - BT4CRT11 BIOPHYSICS AND BIOINFORMATICS

Total hours of instruction: 72 Hours/ week: 4Credit: 4

Module I: 25Hrs

Laws of thermodynamics, Role of water in living organisms, Enthalpy, Entropy, Freeenergy Basic principles and biological significance of Osmosis, diffusion, adsorption, surfacetension, colloids, radioactivity. .

Module II: 10Hrs

Colorimetry and Spectrophotometry, spectroscopy - UV, visible, IR.GM counter, Scintillation counter.

Module III: 15 Hrs

Stabilizing forces in macromolecules, Protein conformation - primary, secondary, tertiary and quaternary structure, folding - chaperones, DNA conformation and Polymorphism.

Module IV: 10Hrs

Introduction to Bioinformatics, Definition, history, important Biological databases and their Sequence format: NCBI, GEN BANK, EMBL, SWISSPROT, PDB, Drug bank.

Module V:12Hrs

Tools for global and local alignment studies, FASTA, BLAST, CLUSTAL, MUSCLE Applications of bioinformatics: phylogenetic analysis, homology modeling, structure prediction.

References:

1. Bioinformatics - sequence and genome analysis, David W Mount, Cold Spring Harbor Laboratory.
2. Biophysics - Vasanthapattabhi, N. Gautham. Kluwer Aca. Pub: Narosa Pub. House.
3. Text book of Biophysics - R.N. Roy, New central Book Agency Pvt. Ltd.
4. Biophysical Chemistry - Upadhyay.
5. Biochemistry - Donald Voet and Judith G Voet: John Wiley Sons, Inc.
6. Biophysics- R N Roy, New Central Agency
7. Algorithms in Bioinformatics - Benson, Ane Books

Core-15 BT4CRP04 – PRACTICAL - MOLECULAR BIOLOGY

Total hours of instruction: 36 Hours / Week-4 Credit: 4

1. DNA Isolation
2. Separation of DNA by Agarose gel electrophoresis (Demonstration only)
3. Staining of barr body.
4. Problems in mendelian law, linkage, population genetics

References:

1. Molecular gene cloning - Sambrook and Maniatis, Cold Spring Harbour Laboratory.
2. Practical Skills in Biomolecular sciences - Rob Reed, Dand Holmes, JanathanWeyers, Allan Janes, Long man England.
3. Laboratory investigation in cell and molecular biology. - AllynBregman, 1996. John Wiley & Sons

Core-15 BT4CRP04 – PRACTICAL - ENZYMOLOGY

Total hours of instruction: 36 Hours / Week-4Credit: 4

1. Estimation of enzyme activity - amylase assay
2. Estimation of clinically important enzymes - SGPT, SGOT
3. Factors affecting enzyme activity
 - a. effect of p H on enzyme activity
 - b. effect of temperature on enzyme activity
 - c. effect of metal ion on enzyme activity
 - d. effect of inhibitors on enzyme activity
4. Immobilization of enzymes

References:

1. Practical Biochemistry - David Plummer
2. Modern experimental Biochemistry- Rodney Boyer, Pearson education.

SEMESTER-V

Core 16- BT5CRT12 RECOMBINANT DNA TECHNOLOGY

Total hours of instruction: 108 Hours/ week: 6 Credit: 4

Module I: 25Hrs

Introduction to genetic engineering.Steps of genetic engineering. Enzymes in genetic engineering - Restriction endonucleases, DNA ligases, Adapters, Linkers, alkaline phosphatase, polynucleotide kinase, Terminal transferase, S1 nuclease, RNAase H, DNA polI, Klenow fragment, Taq polymerase, Reverse transcriptase.

Module II: 20Hrs

Gene cloning vectors. Plasmid vectors - features, pUC and pBR322. Bacteriophage vectors - Lambda, M13. Cosmids.Vectors for animal and plant cell.Shuttlevectors.YAC.BAC.

Module III: 20 Hrs

Gene transfer methods - CaCl₂ mediated, Electroporation, Microinjection, Lipofection. Particle Bombardment, *Agrobacterium* mediated gene transfer. Shotgun and cDNAcloning.Genomic library.

Module IV: 18 Hrs

Screening and Selection of recombinants, Colony hybridization, Marker genes, reporter genes, Insertional inactivation, Blue-white screening and Blotting techniques, Southern, Northern and Western.

Module V:25 Hrs.

DNA sequencing.Chromosomewalking.Application of genetic engineering -.Recombinant insulin. Transgenic plants - Herbicide and pest resistance. Super bug-calabolic plasmids, BT cotton.Molecularpharming.Gene therapy.

References:

1. Principles of Gene manipulation and Genomics. - S.B. Primrose and R.M. Twyman. Blackwell Publication
2. Biotechnology - Fundamentals and applications. - S.S. Purohit and S.K. Mathur.Agrobotanica publications.
3. Gene Cloning and DNA analysis. - T.A. Brown. Blackwell Publication.
4. Recombinant DNA - Genes and Genomes. - James D. Watson, Any A candy, Richard M.M, Jan A Witkowski. W.H. Freeman and Company Publication.
5. Genes X- Lewin, Jones and Bartlett learning.
6. Cell and Molecular Biology by Gerald Karp, Academic Press
7. Genomes: T A Brown, John Wiley & Sons

CORE 17- BT5CRT13- ENVIRONMENTAL BIOTECHNOLOGY

Total hours of instruction: 72

Hours/ week: 4

Credit: 3

Module I: 12Hrs

Concept, structure, components and function of ecosystem - producer, consumer, decomposer, abiotic components. Ecological succession, Food chains, food webs, energy flow in ecosystem. Biogeochemical cycles - nitrogen cycle, carbon cycle. Energy resources: Renewable and non renewable energy resources, use of alternate energy resources.

Module II: 15Hrs

Environmental pollution- air, soil and water pollution with suitable case studies, global warming, green house effect, acid rain, smog, hazards of nuclear fallout. Ozone layer depletion, depletion of natural resources, Pesticide pollution

Module III: 20Hrs

Characteristics of waste water –COD, BOD, TOC, Suspended solids, Total dissolved solids, chlorides, acidity, alkalinity. Bacteriological analysis of drinking water, presumptive, completed and confirmed tests, Coagulation, Disinfection by chlorination, Biodegradation of organic compounds. Types of reactions in biodegradation. Biodegradation of hydrocarbons, cellulose and lignin. Molecular biology of biodegradation,

Reference:

1. Microbial ecology: Fundamentals and Applications - Atlas and Bartha, Pearson Education
2. Environmental Chemistry - Anil Kumar. De Wiley Eastern Ltd. New Delhi

Module IV: 15Hrs

Treatment of waste water, primary, secondary and tertiary treatment. Biological treatment of waste water- aerobic methods, floc and film based processes Activated sludge process, Trickling filter process, Aerobic pond. Anaerobic process- Methanogenesis, Single and double stage reactors. Solid waste management- anaerobic treatment and land filling. Composting.

Module V: 10Hrs

Environmental laws: Environment protection act, Air and Water (Prevention and control of Pollution) Act, Wild life protection Act, Forest conservation Act.

References:

1. Biocatalysts and biodegradation - Lawrence P Wackett and Douglas Hershberger. ASM Press, Washington
2. Environmental Chemistry - Anil Kumar. De Wiley Eastern Ltd. New Delhi
3. Microbial ecology: Fundamentals and Applications - Atlas and Bartha, Pearson Education
4. Biotechnology: The Science and Business - V. Mopses and R.E. Capes
5. Environmental Science: Earth as living planet - Daniel B Bottein and Edward. A. Keller, John Wiley Sons.
6. Essential Environmental Studies - S. P. Misra, S. N. Pande, Ane Books Pvt.Ltd.
- 7.. Ecology and environment - Sharma P.D

Core 18 - BT5CRT14 ANIMAL BIOTECHNOLOGY

Total hours of instruction: 108 Hours/ week: 6 Credit: 4

Module I: 10 Hrs

History of animal cell culture. Basic requirements of animal cell culture. Laboratory setup and equipment's.

Module II: 18Hrs

Culture media - natural, synthetic and serum containing media. Role of hormones. Preparation and sterilization of media. Importance of growth factors of the serum.

Module III: 25 Hrs

Primary cell cultures - Anchorage dependent and anchorage independent cells secondary cell cultures - Transformed animal cells, Established/continuous cell lines. Characteristics of cells in culture. Maintenance of cell lines, commonly used animal cell lines-their origin and characteristics.

Module IV: 25 Hrs

Cell differentiation. Stem cells. Organ culture or 3D culture. Large scale culture of cell lines - monolayer culture, suspension culture and immobilized culture. Bioreactors for large scale culture of cells. Insect and virus cell culture.

Module V: 30 Hrs

Application of animal cell culture - Production of monoclonal antibody, Production of vaccines. Production of specific metabolites. Transgenic animals - Transgenic Mice, fish and cow. Knock-out and Knock-in Technology. Animal cell culture for medical and cancer research.

References:

1. Animal cell culture (IIIrd edition) A practical approach. - John R.W. Masters
2. Animal Biotechnology. - R. Sasidhara.
3. Animal biotechnology – Raja, Florence Periera. Dominant publishers New Delhi. 2006.
4. In vitro cultivation of animal cells. - Open University, Netherlands. New Delhi, Butter Worth - Heinemann, 1994.
5. Insect Cell Cultures: Fundamental and Applied Aspects. - Edited by Just M. Vlak, Cornelis D. de Gooijer, Johannes Tramper, Herbert G. Miltenburger. Kluwer Academic Publishers, New York.

BT5OPT01- Open Course - Paper -I (A/B/C)
BT5OPT01A -TISSUE CULTURE TECHNIQUES

Total hours of instruction: 72 Hours/ week: 4 Credit: 3

Module I: 12Hrs

Introduction to plantcell and tissue culture Construction, Design and basic requirements of plant tissue culture lab

Module II: 15Hrs

Introduction to animal cell culture. Construction, Design and basic requirements of animal cell cultureLaboratory.

Module III: 15Hrs

Plant cell culture medium - Media preparation and methods of sterilization and standardization. Surface sterilization of explants. Factors affecting plant cell culture. Callus culture

Module IV: 15Hrs

Animal cell culture medium - Media preparation and methods of sterilization. Surface sterilization of primary explants. Factors affecting animal cell culture.

ModuleV:15Hrs

Animal cloning, Medical, industrial and agricultural applications of animal cell and plant cell culture.

References:

1. Animal cell culture: A Practical Approach - John R.W. Masters. Pub
2. A text book of Animal Biotechnology- B Singh • S K Gautam • M S Chauhan • S K Singla. The energy and resources Institute.
3. Animal biotechnology – Raja, Florence Periera. Dominant publishers New Delhi, 2006.
4. In vitro cultivation of animal cells - Open University, Netherlands. New Delhi, Butter Worth - Heinemann, 1994
5. Plant tissue culture Theory and Practice - S.S Bhojwani and M.K. Razdan., Elsevier
6. Plant tissue culture - S.P. Misra.Ane Books India
7. Plant biotechnology - Ignacimuthu, Oxford and IBH pub.
8. R.Sasidhara, Animal Biotechnology MJP publishers-Chennai.
9. Plant biotechnology – J Hammond, et. al., Springer Verlag.
10. Practical application of plant molecular biology – R J Henry, Chapman & Hall.

BT5OPT01B - BIOTECHNOLOGY FOR SUSTAINABLE DEVELOPMENT

Total hours of instruction: 72Hours/ week: 4 Credit: 3

Module I: 15 Hrs

Natural raw materials: classification, physicochemical and biological properties, exploitation of the natural waste materials through biotechnology, preparation of nutritive and cost effective substrates for industrial application.

References:

1. Module II: 15Hrs

Chemical fertilizers - disadvantages. Biofertilizers- advantages, types. Nitrogen fixing organisms, *Azospirillum*, *Azolla*, *Rhizobium*, Lichens, *Cyanobacterium*. *Mycorrhiza*

References:

Module III: 15Hrs

Solid waste management - Composting, types, different stages in composting, types of composting - pile, windrow composting, microorganisms in composting, temperature profile in composting, advantages of composting, vermicomposting.

References:

1. Waste water Microbiology - Gabriel Bittan
2. Text Book of Biotechnology - R.C. Dubey
3. Essentials of Biotechnology - R.C. Sobi and Suparna S. Pachauri. Ane Books

Module IV: 15Hrs

Biopesticides, biofilters, biopolymers, biofuels, biosurfactants, mushroom cultivation, Biogas production, Waste to energy,

1. Essentials of Biotechnology - R.C.Sobi&Suparna S. Pachauri. Ane Books
2. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.

Modul V: 12Hrs

Biotechnology in aqua culture , development of probiotics, diagnostic probes, extraction of marine natural products through biotechnology.

References

1. Biotechnology - An introduction by Susan R Barnum, Thomsun Publishers.
2. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.
3. Waste water Microbiology - Gabriel Bittan
4. Applied Zoology - Zoological Society of India
5. Essentials of Biotechnology - R.C.Sobi&Suparna S. Pachauri. Ane Books
6. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.
7. Environmental biotechnology - R.A Sharma
8. Text Book of Biotechnology - R.C. Dubey
9. Advanced Environmental biotechnology - S.K. Agarwal
10. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.
11. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young (Editor in chief). ISBN-978-0-08-088504-9

BT5OPT01C -IPR AND PATENTS

Total hours of instruction: 72Hours/ week: 54 Credit: 3

Module I: 12Hrs

General guidelines for DNA research, containment facilities and biosafety practices, special guidelines in India.

Module II: 15Hrs

Forms of IPR - patent, design and copyright: Patents: different types of intellectual property, Introduction to patent law and conditions for patentability; Procedure for obtaining patents; Rights of a patentee; Patent infringements; Biotechnology patents and patents on computer programs; Patents from an international perspective.

Module III: 15Hrs

Copyright: Registration procedure and copyright authorities; Assignment and transfer of copyright, Copyright infringement and exceptions to infringement; Software copyright.

Module IV: 15Hrs

Contents of patent specification and the procedure for patents; (a) Obtaining patents; (b) Geographical indication; (c) WTO; Detailed information on patenting biological products; Plant breeders' and farmer's rights; Biodiversity; Budapest treaty; Appropriate case studies.

Module V: 15Hrs

IPR laws: Rights/protection, infringement or violation, remedies against infringement: civil and criminal; Indian Patent Act 1970 and TRIPS; IPR forms, IPR in India, patents, process of patenting, Indian and International agencies involved in patenting, GATT

References:

1. P. Narayanan, Intellectual Property Laws, Eastern Law House.2001
2. Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.2009
3. Intellectual Property Law containing Acts and Rules, Universal Law Publication Company.
4. John E. Smith, Biotechnology, 3rd Ed. Cambridge University Press.
5. Prithipal Singh, **An Introduction to Biodiversity**, Ane Books India, 2007.
6. B R Goel, **An Introduction to Biodiversity**, Arise Pub, 2006.
7. Nirmal Chandra Pradhan, **Basics of Biodiversity**, Anmol, 2008.
8. **Biodiversity and Environmental Biotechnology**- Padmanabh Dwivedi; S K Dwivedi and M C Kalita, Scientific, 2007. Chapman and Reiss, Ecology principles and applications. Cambridge University.
9. Environmental biology Jobs A. M., Routledge, London.
10. Fundamentals of ecology Odum E. P and Barret G W. W. B Saunders company, Philadelphia.

Core 19- BT5CRP05 PRACTICAL
RECOMBINANT DNA TECHNOLOGY AND ENVIRONMENTAL
BIOTECHNOLOGY

Total hours of instruction: 90

Hours/ week: 4

Credit: 3

1. Competent cell preparation
2. Transformation of the competent cell
3. Isolation of Plasmid
4. Enumeration of Total number of heterotrophic bacterial population in water samples
5. Bacteriological analysis of drinking water- Presumptive, completed and confirmed tests
6. Estimation of alkalinity
7. Estimation of acidity
8. Estimation of total solids, suspended and dissolved solids
9. Estimation of Dissolved oxygen
10. Estimation of Chemical oxygen demand
11. Estimation of Biological oxygen demand

References:

1. Biotechnology: Fundamentals and applications - S.S. Purohit and S.K Mathur, Agrobotanica publications.
2. Recombinant DNA: Genes and Genomes - James D Watson, Any A candy, Richard M.M, Jan A Witkowski. W.H. Freeman and Company Publication.
3. Gene Cloning and DNA analysis - T.A. Brown. Blackwell Publication.

SEMESTER VI

Core 21 BT6CRT15 PLANT BIOTECHNOLOGY
Total hours of instruction: 90 Credit:4 Hours/ week: 5

Module I: 15 Hrs

Plant tissue culture- a historical approach. Basic requirements and setting up of a plant tissue culture lab, hardening centre/green house.

Module II: 25Hrs

Tissue culture media. Media preparation. Role of growth hormones. Totipotency and cyto-differentiation, Various stages of micropropagation.

Module III: 20 Hrs

Types of culture-Callus culture, Suspension culture and single cell culture. Somaclonal variation. Organogenesis and Embryogenesis. Artificial seeds, Meristem culture. Haploid production-ovary, ovule, anther and pollen culture.

Module IV: 20 Hrs

Plant protoplast-isolation, culture and somatic hybridization. Cybrids and hybrids. Applications of protoplast culture. Maintenance and storage of plant cell. Germplasm conservation and gene bank.

Module V: 10 Hrs

Applications of plant cell culture. Gene transfer techniques in plants, Role of *Agrobacterium* in gene transfer. Ti plasmid, Binary vector, Ri plasmid

References:

1. Plant tissue culture Theory and Practice - S.S Bhojwani and M.K. Razdan., Elsevier
2. Plant tissue culture - S.P. Misra. Ane Books India
3. Plant Breeding - B.D. Singh.
4. Plant cell and tissue culture - S. Narayanaswamy
5. Plant biotechnology - Ignacimuthu, Oxford and IBH pub
6. Plant biotechnology – J Hammond, et. al., Springer Verlag
7. Practical application of plant molecular biology – R J Henry, Chapman & Hall

Core 22– BT6CRT16 INDUSTRIAL BIOTECHNOLOGY

Total hours of instruction: 90

Hours/ week: 5

Credit: 4

Module I: 15Hrs

Introduction to industrial biotechnology, Advantages of bioprocess over chemical process, Fermentation - definition, types -submerged and solid state, applications of fermentation. Industrially important microbial metabolites.

References:

1. Principles of Fermentation technology - Stanbury et al. Wiley publishers
2. Industrial Microbiology - Prescott

Module II: 20Hrs

Isolation and screening of industrially important microorganisms, primary and secondary screening. Methods of screening. Identification of the selected organism. Methods of strain improvement - Mutation, Protoplast fusion and Genetic Engineering.

References:

1. Principles of Fermentation technology - Stanbury et al. Wiley publishers
2. Industrial Microbiology - Prescott

Module III: 15Hrs

Medium designing in fermentation, Defined and undefined medium, carbon and Nitrogen sources. Precursors, inducers, inhibitors and antifoam agents. Effect of pH, temperature and salt concentration in fermentation. Optimization of the process of fermentation.

References:

1. Principles of Fermentation technology - Stanbury et al. Wiley publishers
2. Industrial Microbiology - Cassida

Module IV: 20Hrs

Bioreactor, typical bioreactor, Criteria for the designing of a bioreactor, parts of a bioreactor, Instrumentation of the bioreactor, types of bioreactors – Airlift fermenters, CSTR, Deep bed, Cyclone column and Tower reactors, Mode of culturing of microorganisms -Batch, continuous, fed batch culture systems.

References:

1. Biotechnology: The biological Principles. - Trevan et al., Tata McGraw Hill Edn.

Module V: 20Hrs

Methods of downstream processing- centrifugation, filtration and chromatographic techniques. Fermentative production of enzymes - amylase, protease, antibiotics - Penicillin, organic acids – glutamic acid, citric acid, alcohol, Immobilization of microbial cells.

References:

1. Principles of Fermentation Technology, P.F.Stanbury, A Whitaker and S.J.Hall, , 2008. Elsevier
2. Bioprocess Technology, P.T.Kalichelvan and I Arul Pandi, , 2009,MJP Publishers, Chennai.
3. Bioprocess Engineering,M.Shuler&F.Kargi (2002). Prentice Hall (I) Ltd., N.Delhi.
4. Bioprocess Technology- Kinetics and reactors ,Antan Moser and Philip Manor,.1998, Springer
5. Fermentation Microbiology and Biotechnology ,E.M.T. Mansi, C.F.A . Bryce. A.L..Dmain, A.R.Alliman. ,2009, Taylor and Francis. New York
6. Industrial Microbiology, Cassida L.E. 1968.John Wiley and Sons Publishers.
7. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India
8. Biotechnology: The biological Principles. Trevan et al., Tata McGraw Hill Edn.
9. Biotechnology - An introduction by Susan R Barnum, Thomsun

Core 23- BT6CBT01- CHOICE BASED COURSE (A/B/C)
BT6CBT01A –BIOINFORMATICS
Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 15 Hrs

Introduction to bioinformatics- definition, history and significance. Careers in bioinformatics, genomics, transcriptomics, proteomics.

Module II: 25Hrs

Collection and storage of database, Submission of sequences, biological databases, NCBI, EMBL, DDBJ, Genbank, PDB, Swissprot, Sequence formats- FASTA/Pearson and EMBL, Genpept, Phylip formats.

Module III: 25Hrs

Alignment of pairs and sequences: definition of sequence alignment- global alignment, local alignment, alignment of sequence pairs- dot matrix analysis, FASTA and BLAST, multiple sequence alignment CLUSTALW

Module IV: 15 Hrs

Computational biology, Rasmol, phylogenetic analysis, homology modeling, Protein function-structure prediction.

Module V : 10Hrs

Applications of Bioinformatics: pharmaceutical industry, immunology, agriculture, forestry, basic research, cheminformatics in biology, geoinformatics.

References:

1. Beginning Perl for Bioinformatics - James D. Tisdall; Paperback. Bioinformatics: Sequence and Genome Analysis - David W Mount. Cold Spring Harbour Lab Press, New York.
2. Bioinformatics and Molecular Evaluation - Paul G Higgs and Teresa K. Attwood, Blackwell Publishers
3. Algorithms in Bioinformatics – Benson, Anne books
4. Developing Bioinformatics Computer Skills - Cynthia Gibas, Per Jambeck.
5. Molecular Biophysics- Volkenstein M.V, Academic Press
6. Stephen Misener and S. A. Krawetz. Bioinformatics Methods and Protocols. Humana Press. 2000.
7. Rastogi, S.C, N. Mendiratta, P. Rastogi. Bioinformatics Methods and Applications. Prentice Hall of India, 2004.

CHOICE BASED COURSES
BT6CBT01B NANOTECHNOLOGY

Total hours of instruction: 90Hours/ week: 5 Credit: 4

Module I: 20Hrs

Nanotechnology-definition, advantages applications, material science, nanomedicine emerging trends, scope, research potential, Nanotechnology in India.

Module II: 25Hrs

Nanomaterials, types, examples, nanoemulsions, poly amino acid micelles, dendrimers, albumin designing of nanomaterials, selection of nanomaterials, physicochemical and biological properties, interaction of the drug with nanomaterials

Module III: 15Hrs

Drug delivery- principle, receptor mediated endocytosis, delivering systems, method of targeting, labeling of the carrier, mechanism and site of drug action, Blood brain barrier

Module IV: 15Hrs

Targeted diseases, cancer, respiratory disorders, cardiovascular problems, diabetics, AIDS. Enhanced permeability and retention effect, applications of short interfering RNA

Module V: 15 Hrs

Nanotechnology in clinical diagnostics and therapeutics- nanowires, nanoshells, quantum dots, dendrimers, liposomes, nanopyramids, nanogels.

References:

1. An Introduction to materials - B.D. Ratner, A.S. Hoffman, F.J. Schoen and J.E. Lemons. Biomaterial Science. Elsevier 2004.
2. Nanomaterials and Nanochemistry - C. Brechignas, P. Hoody and M. Lemani. Springer-Verlag. 2007.
3. Nanotechnology in Catalysis - David J. Lockwood. Volume 3, Springer Science, 2007.
4. Nanomaterials: Synthesis, Properties and applications. - A.S. Eddstein and R.C. Cammarate. Institute of Physics, U.K. 1998.
5. Introduction to Nanotechnology - John Wiley & sons 2008.
6. Microfabrication and Nano manufacturing - Jackson MJ, Taylor and Francis, Boca Raton, 2006.
7. Peptide - derivatized biodegradable nanoparticles able to cross the blood brain barrier. - Costantino L, Gandolfi F, Tosi G, Rivasi F, Vandelli MA, Forni F (2005). J Control Release 1981: 84-96.
8. Michaelis K, Hoffmann MM, Dries S, Herbert E, Alyautdin RN, Michaelis M, Kreuter J, Langer K (2006). Covalent linkage of apolipoproteins to albumin nanoparticles strongly enhances drug transport into the brain. J PharmacolExpTher 3: 1246-1253
9. Zhang D, Tan T, Gao L, Zhao W, Wang. P. (2007). Preparation of azithromycin nanosuspensions by high pressure homogenization and its physicochemical characteristic studies. Drug DevInd Pharm 33: 569-575.
10. Nanoscience and Nanotechnology - V.S. Muralidharan and A. Subramania. Anne Book Pvt. Ltd, New Delhi.

CHOICE BASED COURSES
BT6CBT01C DISEASES AND DIAGNOSTIC BIOTECHNOLOGY

Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 15 Hrs

Microbes and parasites: Historical introduction; Bacteria, Fungi, Viruses, Protozoas, Helminthes and Arthropods, Prions; Host-parasite relationship; Infection-mode of transmission in infection, factors predisposing to microbial pathogenecity, types of infectious diseases.

Reference:

1. Medical Microbiology (1997). Edited by Greenwood. D, Slack. R and Peutherer. J, ELST Publishers.
2. Bailey and Scott's Diagnostic Microbiology (2002). Betty A. Forbes, Daniel F. Sahn, Alice S. Weissefeld, Ernest A Trevino. Published by C.V. Mosby

Module II: 15 Hrs

Molecular genetics of Genetic Disorders-Heamoglobinopathies-Sickle cell aneamia, Beta Thalassaemia.Musculardisordrers-Duchenne's Muscular dystrophy.Triplet disorders-Fragile X syndrome, Huntington's disease, Myotonic dystrophy. Genetic disorders-cystic fibrosis, Alzheimers disease. Chromosomal disorders-autosomal,sex chromosomal.

Reference :

Module III: 20 Hrs

DNA diagnostics of genetic and Chromosomal disorders. Identifying disease genes-position independent strategies,positionalconing.PCR based diagnostics. Ligation chain reaction.Southern blot diagnostics. Array based genetic profiling. single nucleotide polymorphism. Karyotyping analysis,G-banding, FISH. Comparative genomic hybridization (CGH).

Reference:

1. Forensic DNA typing 2nd Edn by John M Butler.Academic Press
2. Human Molecular Genetics 2.Tom Strachen and Andrew P read.Garland Publishers

Module IV: 20 Hrs

DNA typing- Specimen collection, acquisition processing and analysis. Disputed paternity analysis.Ancestry- Mitochondrial. Forensic Science-Standard STR testing, Y-STR testing, Mitochondrial sequencing, SNP testing.

Module V :20Hrs

Cancer diagnostics- Special karyotyping, Molecular testing of BRCA1 and BRCA 2.Tumor markers. Viral disease diagnostics-HIV, Avian Flu, Chikungunya, Swine fever-RT-PCR, ELISA, F-Ab testing, Immunoarrays, Electron microscopy.

Reference:

1. Cancer Diagnostics with DNA microarrays. Steen Knudsen.Wiley Publication
2. Current Medical diagnostics and treatment.Stephen J McPhee and Maxine A Papadakis. McGraw Hill Lange Publishers
3. Emerging infectious diseases By Felissa R. Lashley, Jerry D. Durham. Springer Publishing Company.Infectious disease epidemiology byNelson. Jones and Bartlett Publishers, Inc.

4. Genetics. A Molecular approach.2ndEdn. Peter J Russel.
5. Molecular diagnostics for the clinical laboratarian by William B Coleman and Gregory J Tsongalis.Humana Press Publishers.
6. Genes in Medicine Molecular biology and human genetic disorders.**Rasko, I., Downes,** C.S.Springer Publication.
7. Genes and Disease by Bathesda.NCBI.www.ncbi.nlm.nih.gov/books.
8. Essential Medical Genetics, 5th Edition.Michael Connor, M. Ferguson Smith.Wiley Publication.

Core 24 - BT6CRP06 -PRACTICAL

INDUSTRIAL BIOTECHNOLOGY AND PLANT BIOTECHNOLOGY

Total hours of instruction: 90

Hours/week:5

Credit: 4

1. Preparation of medium for plant tissue culture
2. Surface sterilization of explants
3. Inoculation and callus initiation of plant tissue culture
4. Meristem culture
5. Determine the potability of provided water sample by MPN technique.
6. Separation of plasmid by agarose gel electrophoresis
7. Isolation of industrially important microorganism
8. Secondary screening of industrially important microorganism
9. Fermentative production of microbial metabolites-Submerged
10. Immobilization of bacteria for metabolite production.
12. Screening of the amylase producing isolates from soil.

References:

1. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom Cultivation - K.R. Aneja; WishwaPrakashan, New Delhi.
2. Biotechnology Fundamentals and application - Purohit and Mathur, Agro botanical Publishers, New Delhi.
3. Biotechnology: Fundamentals and applications - S.S. Purohit and S.K Mathur, Agrobotanica publications
4. Practical Skill in Biomolecular Sciences - Rob Reed, David Holmes, Jonathan Weyers, Allan Jones. Logman publishers, U.K.
5. Microbiological Applications: A Laboratory Manual in General Microbiology - Harold. J. Benson, WCB publishers.
6. Plant, Cell, Tissue and Organ Culture Fundamental Methods - Gamborg and Phillips, Narosa Publishers.

BT1CMT01 COMPLEMENTARY COURSE 1

Cell Biology

Total hours of instruction: 36 Hours/ week: 2 Credit: 2

Module I: 5hrs

History and development of Cell Biology, Discovery of cell, Cell theory. General organization of prokaryotic and eukaryotic cell. Plant cells and animal cells.

Module II: 7hrs

Cell membrane- Molecular models of cell membrane, Fluid mosaic model, Chemical composition, Functions-Membrane transport-Active, passive, facilitated-symport, antiport. Cell junction-Tight junction, gap junction.

Module III: 12hrs

Cell organelles-Nucleus, Endoplasmic reticulum, golgi apparatus, lysosomes and peroxisomes, Cytoskeleton - microtubules, microfilaments and intermediate filaments.

Module IV: 5 hrs

Semi autonomous organelles-mitochondria: structure, oxidative phosphorylation, electron transport, chemiosmotic coupling. Chloroplast: structure, LHC, photosystems, cyclic and noncyclic photophosphorylation, Calvin cycle.

Module V: 7hrs

Cell cycle-Phases of cell cycle - G1, S, G2 & M. Mitosis-stages, Meiosis - stages, significance, synaptonemal complex, Regulation of cell cycle - MPF and cyclins, Cell death - Necrosis and apoptosis

References

1. The world of the Cell, 6 thEdn. - Becker – Klein smith Hardin
2. Cell and Molecular Biology - Gerald Carp, John Wiley and Sons, Inc
3. The Cell - Geoffrey M Cooper
4. Cell Biology - Smith and Wood
5. Cell and Molecular Biology, 8th Edn - EDP De Robertis and EMF De Robertis, Lippincott, Williams and Wilkins publication.
6. Molecular Cell Biology 6 thEdn - Lodish, Berk, Kaiser, Kreiger. Scott, Bretscher, Pleogh, Matsudaria. W. H Freeman and company publication.
7. Principles of genetics - Snustad and A.G. Gardner, John Wiky Pub

BT1CMT02 COMPLEMENTARY COURSE 2
GENETICS

Total hours of instruction: 36 Hours/ week: 2 Credit: 2

Module I: 5Hrs

The birth of genetics, symbols and terminology genes, alleles, genotypes, phenotypes, Dominance, Recessiveness, Wild type, Mutant type, Test cross, Backcross , Reciprocal cross.

Module II: 8 Hrs

Mendelian Genetics- Mendel's experiments, monohybrid cross, principle of segregation, dihybrid ratio, principle of independent assortment, codominance. Semidominance.

Module III: 10 Hrs

Gene interactions-Epistasis, Pleiotropy, Polygenic inheritance- Skin colour in man, Multiple alleles-ABO Blood typing, lethal genes, Sex determination-autosomes and allosomes, chromosome basis of sex determination-XX-XY,XX-XO, Barr body and Lyon hypothesis.

Module IV: 8Hrs

Linkage, crossing over- mechanism- hollidaymodel , sex linked, sex influenced and sex limited inheritance, Chromosome- size, shape, structure and types of chromosomes, chromosome banding, giant chromosomes.

ModuleV 5 Hrs

Extra chromosomal inheritance- mitochondrial and chloroplast.Euploidy, Nondisjunction and aneuploidy, polyploidy in plants.Gene mutation- addition, deletion, translocation, inversion, missense and nonsense.

References

1. Genetics: A Molecular approach. 2ndEdn - Peter J Russel.
2. Principles of genetics - Snustad and A.G. Gardner, John Wiley pub
3. Genetics - Strick Berger
4. Text book of genetics - Veer BalaRastogi
5. Genetics - Daniel L. Hartin and Elizabeth W. John 47

BT1CMT03 COMPLEMENTARY COURSE 3
MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY

Total hours of instruction: 36 Hours/ week: 2 Credit: 2

Module I: 5Hrs

Experiments demonstrating DNA as the genetic material, RNA as genetic material, Structure of DNA and RNA, Physico chemical properties of DNA, Packaging of DNA in eukaryotes - Histones and nucleosomes.

Module II: 10Hrs

Genes-concept of gene-introns and exons, structure of prokaryotic gene: operon, organization of operon, eukaryotic gene - structure, reading frame and regulatory elements - promoters and enhancers, Repair - direct, reversal, Base excision and nucleotide excision repair.

Module III: 10Hrs

Basics of recombinant DNA technology, restriction enzymes, steps in rDNA technology, vectors - pBR322,pUC,Lambda,M13.Ligation, Selection of recombinants - Insertional inactivation, Blue-white assay

Module IV: 7Hrs

Gene transfer methods - CaCl₂ mediated, Electroporation, Microinjection, Genomic library and C DNA library, Southern blotting. PCR, RFLP, RAPD techniques.

Module V: 4hrs

Applications of r DNA technology: Crop improvement, recombinant insulin, growth hormone,recombinant vaccine, superbugs, risks of GMO.

References

1. Gene Cloning and DNA Analysis - TA Brown, Blackwell publication.
2. Principles of Gene Manipulation and Genomics - SB Primrose RM Twyman, Blackwell publication.
3. Recombinant DNA: Genes and Genomes - James D Watson, Any A Candy, Richard MM, Jan A Witkoeski, WH Freeman and Company Publication.
4. Gene Biotechnology - SN Jogdand, Himalaya Publication