Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Biotechnology

Name of the Course: M.Sc. I (Sem.–I& II)

(Syllabus to be implemented from w.e.f. June 2020)

PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY, SOLAPUR

M. SC. BIOTECHNOLOGY

SYLLABUS (NEW CBCS PATTERN)
(w. e. f. June, 2020-21)

1) Title of the Course: M. Sc. BIOTECHNOLOGY –Part –I (Sem –I and II)

2) Introduction: This course provides a broad overview of biotechnology and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using biotechnology. The course structure is technology-centric where students basically learn technology and are taught necessary basic subjects for that purpose.

3) Objectives of the course:

The objectives of M. Sc. Biotechnology course are

- To provide an intensive and in-depth learning to the students in field of biotechnology.
- Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing business world.
- To develop awareness & knowledge of different organization requirement and subject knowledge through varied subjects and training methodology in students.
- To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

4) Advantages of the Course:

- Biotechnology has tremendous job potential. The successful students will be able to establish trading, industrial and consultancy organizations in pharmaceuticals, paper, fermentation, food processing & preservation, agriculture, environment protection and also their own industry for micropropagation of commercially important plants *in vitro*, transgenic plants, vaccine production, clinical pathology, genetic counseling, human karyotyping etc.
- Multinational companies dealing with production of tissue cultured and genetically modified plants, food products, leather, dairy, beverages, pharmaceutical, chemical Industries, agribusiness, Environment protection.
- Medical & Scientific Research Organizations.
- Universities in India & aboard.

5) Eligibility of Course:

- **Eligibility:** A Candidate possessing Bachelor Degree with Biotechnology/Biochemistry/Chemistry/ Microbiology/Botany/Zoology/B. Pharm/MBBS/B. E./B. Sc. Agri. Or life sciences as a principal subject (Biotech), and who have passed the entrance examination conducted by the PAH Solapur University shall be held eligible for admission to M. Sc. Course in Biotechnology. Students from other University with B.Sc. General Degree and who have passed the entrance examination conducted by the PAH Solapur University are also eligible.
- **Admission:** Merit list based on average of B. Sc. aggregate and entrance exam conducted by PAH Solapur University. For other university student merit list only on basis of entrance examination conducted by PAH Solapur University.

6) Duration:

- The duration for this program is of 2 years with semester pattern (04 Semesters)

7) Medium of Instruction: English

8) Structure of the Course:

- Structure of M.Sc. course in faculty of Science has total of 4 semesters for 2 years.
- M. Sc. I comprise of total two semesters and M. Sc. II comprises of total two semesters.
- Semester I includes four theory papers (3 Hard Core and 1 Soft Core) and practical course as per theory papers.
- Semester II & III includes four theory papers (2 Hard Core, 1 Soft Core and 1 Open Elective) and practical course as per theory papers.
- Semester IV includes four theory papers (3 Hard Core and 1 Soft Core) and a Major project substituting the practical course.
- Each theory paper comprising of 5 units which are distributed in total 60 lecture hours having weightage of 4 credits.
- Practical papers are to be conducted at the end of their respective semester.
- Final year Major project work should begin in III semester and the completed thesis should be submitted at the end of the IV semester.
- Student would have to present his/her project work during the project report submission which would be evaluated by the internal as well as the external examiners.
- As per the credit system, the assessment of Theory paper of 100 marks weightage will be as: 80 marks theory assessment by University examination (UA) and 20 marks internal assessment by the college (CA). The internal assessment are conducted in the formats of home assignments and written tests for each theory paper respectively with equal weightage of marks.
- As per the credit system, the assessment of practical paper of 50 marks weightage will be as: 40 marks practical assessment by University examination (UA) and 10 marks internal assessment by the college (CA).
- In each semester student has to compulsorily undergo one tutorial which has weightage of 25 marks and 1 credit. Seminar/Tutorial/ Industrial Visit/Field Tour etc. may be suitably adopted for the tutorial.
- As per the credit system, the assessment of Major project of 200 marks weightage will be as: 160 marks project assessment by University examination (UA) and 40 marks internal assessment by the college (CA) at the end of fourth semeter.

PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY, SOLAPUR

Syllabus for M. Sc. Biotechnology

M. Sc. Biotechnology Sem.-I and II (STURCTURE) w. e. f. 2020-21

Semester	Code	Title of the Paper	Semester Examination			L	T	P	Credits
			Theory UA	IA	Total				
Sem-I		**Hard Core**							
	HCT1.1	Microbiology	80	20	100	4	--	--	4
	HCT1.2	Concepts of Biochemistry	80	20	100	4	--	--	4
	HCT1.3	Inheritance biology	80	20	100	4	--	--	4
		Soft Core (Any one)							
	SCT1.1	Biostatistics and Bioinformatics	80	20	100	4	--	--	4
	SCT1.2	Nano-Materials Fabrication	80	20	100	4	--	--	4
		Seminar/Tutorial/ Industrial Visit/Field Tour	---	25	25	--	1	--	1
	HCP1.1	Practical Course HCP 1.1	40	10	50	--	--	03	2
	HCP1.2	Practical Course HCP 1.1	40	10	50	--	--	03	2
	HCP1.3	Practical Course HCP 1.3	40	10	50	--	--	03	2
	SCP 1.1/1.2	Practical Course SCP 1.1/1.2	40	10	50	--	--	03	2
	Total for Semester-I		**480**	**145**	**625**	**--**	**--**	**--**	**25**
Sem-II		**Hard Core**							
	HCT2.1	Cell Biology	80	20	100	4	--	--	4
	HCT2.2	Enzyme Technology	80	20	100	4	--	--	4
		Soft Core (Any one)							
	SCT2.1	Molecular Cell Processing	80	20	100	4	--	--	4
	SCT2.2	Molecular Medicine	80	20	100	4	--	--	4
		Open Elective(Any one)							
	OET2.1	Immunology and Immuno techniques	80	20	100	4	--	--	4
	OET2.2	Plant Breeding and Tissue Culture	80	20	100	4	--	--	4
		Seminar/Tutorial/ Industrial Visit/ Field Tour	---	25	25	--	1	--	1
	HCP2.1	Practical Course HCP 2.1	40	10	50	--	--	03	2
	HCP2.2	Practical Course HCP 2.2	40	10	50	--	--	03	2
	SCP2.1/2.2	Practical Course SCP 2.1/2.2	40	10	50	--	--	03	2
	OEP2.1/2.2	Practical Course OEP2.1/2.2	40	10	50	--	--	03	2
	Total for Semester-II		**480**	**145**	**625**	**--**	**--**	**--**	**25**

** L = Lecture T = Tutorials P = Practical
** IA=Internal Assessment
** UA= University Assessment
** 4 Credits of Theory = 4 Hours of teaching per week
** 2 Credits of Practical = 4 hours per week

** HCT = Hard core theory
** SCT = Soft core theory
** HCP = Hard core practical
** SCP = Soft core practical
** OET = Open elective theory
** OEP = Open elective practical

M. SC. BIOTECHNOLOGY (SEMESTER –I)

HCT 1.1: MICROBIOLOGY 4 Credits - (60 L)

Learning outcomes

- This paper will aid students to acquire skills and competency in microbiological laboratory practices applicable to microbiological research or clinical methods, including accurately reporting, observations and analysis.
- Students will gain awareness about the microbes present in the environment and their impact.

UNIT- I: Microbial Taxonomy [**10]**

Introduction to microbiology and microbes, history & scope of microbiology. History of Bergey's Manual, Prokaryotic Domain, Taxonomic ranks, Traditional and Modern methods of prokaryote Identification. General outline of Numerical and Polyphasic Taxonomy. Bacterial Nomenclature, Type Strain. Major bacterial culture collection units (ATCC, MTCC & NCIM).

UNIT-II: Microbial Diversity **[14]**

Distribution of microorganisms in soil, water and air. General characters of oxygenic and anoxygenic Photosynthetic microbes, Magnetotactic bacteria, Methanogenic archaebacteria. Human micro flora (niche with one example), Extremophiles: General characters (origin, habitat, molecular adaptations) and examples of Extremophiles: Acidophiles, Alkalophiles, Thermophiles, Psychrophiles, Halophiles, Barophiles (Piezophiles), Xerophiles, Radiophiles, Metallophiles, Endoliths, and Osmophiles. Applications of Extremophiles and unculturable microbes.

UNIT-III: Microbial Techniques [**14]**

Staining techniques: Nature and types of stains. Principle & mechanism-Simple and differential, AFB staining, fluorescent, negative. Structural staining-capsule, spore, cell wall, flagella and reserve food material. Fungal staining. Wet mounting methods. Sterilization and Disinfection: Principle & technique-Physical, chemical & mechanical methods. Cultivation of microorganisms-culture media and types of culture media. Isolation of microorganism: serial dilutions, streak plate, pour plate & spread plate. Characterization & identification of colonies. Maintenance & Preservation of cultures-slant, stab, soil, glycerol & lyophilization.

UNIT-IV: Phycology, Mycology & Protozoology **[10]**

Brief introduction to- History, Classification, Characteristics, Morphology-Microscopic structure and macroscopic structures, Diversity and Reproduction of algae, fungi, slime molds and protozoans. Symbiosis-algae, fungi, slime molds and protozoans; Pathogensis and Industrial applications of algae, fungi, slime molds and protozoans.

UNIT-V: Virology **[12]**

Virus and bacteriophages, general properties of viruses, viral structures, Classification, Isolation, Cultivation and Enumeration (Bacteriophages, Plant viruses and Animal viruses). Structural study of viruses using Electron microscopy (SEM & TEM), Reproduction of Viruses: Lytic cycle (T phage and phage θ-X174), Lysogenic cycle (λ, and Mu1 phages), Replication of viruses: ssRNA + stranded (Polio), ssRNA - stranded (Influenza), dsRNA (HIV), ssDNA (Parvo), dsDNA (Hepatitis B). Sub-viral particles-viroids and prions.

REFERENCE BOOKS:

1) Bergey's Manual of Determinative Bacteriology- Gibbons, Baltimore: Williams & Wilkins, 1974.
2) Brock Biology of Microorganisms (11th edn) by Michael T. Madigan, John M. Martinko (eds).
3) General Microbiology (5th edn) – by Roger Y. Stanier et al.

4) Microbiology – Pelczar JR.
5) Prescott's microbiology (10th edn)- By Joanne Willey and Linda Sherwood and Christopher J. Woolverton
6) Microbial Genetics – David Freifelder
7) General Virology -by S. E. Luria and James E. Darnell.
8) Fungi Bacteria and viruses-by H.C Dube
9) Introduction to Plant Virology – by Bos L
10) Animal Virology – Fenner, F and White, D.O.

HCT 1.2 CONCEPTS OF BIOCHEMISTRY 4 Credits (60 L)

Learning outcomes

- It provides the knowledge of biomolecules, their synthesis and metabolism inside living cells.
- Students will be imparted complete knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and carbohydrates) found in living cells.
- It provides the knowledge of Nutrition, metabolic disorders and hormonal regulation.

UNIT-I: Chemical basis of life [12]

Composition and properties of living systems, Biomolecules hierarchy (water, carbon, nitrogen, hydrogen & oxygen). Metabolites and Macromolecules – composition, structure and role of carbohydrates, proteins,lipids, nucleic acids, vitamins. Properties of biomolecules favouring living conditions-directionality, information, 3D architechture, Structural complementarity (Garett & Grishamm). Conformation of proteins (Primary, secondary, Ramachandran plot, tertiary and quaternary structure; domains; motif and folds) Stability of protein and nucleic acid structures.

UNIT-II: Bioenergetics and Metabolism [14]

Bioenergetics, thermodynamic principles of biology, concept of free energy, biological energy transducers. Reactions, energetic and regulation of Metabolic pathways: Carbohydrate: Glycolysis and Gluconeogenesis, TCA, Pentose phosphate pathway, glycogen metabolism

Lipids – biosynthesis and beta oxidation of fatty acids. Nucleotide metabolism-De-novo and Salvage pathway. Amino acid metabolism-Decarboxylation, trans amination, deamination, Urea cycle.

UNIT-III: Oxidative phosphorylation and photosynthesis [12]

Oxidative phosphorylation - Location, components and their arrangement, mechanism of working, theories and evidences for it, inhibitors and uncouplers. Photosynthesis – Location, light harvesting in green plants, photosystem I & II, Z scheme of noncyclic photophosphorylation, Cyclic photophosphorylation, dark reactions – C3 and C4 pathway, rubisco enzyme, synthesis of sucrose and starch.

UNIT-IV: Nutrition and metabolic disorders [10]

Nutrition, calorific value of food, BMR, caloric requirements, Balancced diet Disorders of Metabolism-Introduction, Nutritional disorder-Protein Energy Malnutrition (PEM) (Kwashiorkar and Marasmus), Obesity Metabolic disorders-Diabetes. Inborn errors of metabolism- Protein-PKU, Alkaptonuria and Maple syrup & Gauchers. Carbohydrates- glycogen storage disorders, Cori's disease and Pomes disease. Lipids-Atherosclerosis. Nucleic acids- Gout, Lesch-Nyhan syndrome.

UNIT-V: Hormones [12]

General classification of hormones, Cell membrane and intracellular receptors for hormones, Secondary messengers. Synthesis, structure, secretion, transport, metabolism and mechanism of action of pancreatic, thyroid, parathyroid, hypothalamic, pituitary, adrenal and prostaglandins. Hormonal control of spermatogenesis, menstrual cycle, pregnancy and lactation. Plant growth hormones - auxins, gibberllins, abscisic acid, cytokinins, and ethylene. Pheromones.

REFERENCE BOOKS:

1. Biochemistry by Stryer Lubert. (1988). New York: Freeman
2. Biochemistry by Mathew VanHolde
3. Lehninger A. L. (1982), Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
4. Voet, D., & Voet, J. G. (2004). Biochemistry (4th ed.). Hoboken, NJ: J. Wiley & Sons.
5. Hormones by Norman Litwack

6. Basic and Clinical Endocrinology- Greenspan and Baster
7. Biochemistry and Physiology of Plant Hormones- Thomas Moore.
8. Annual Review of Biochemistry 1977
9. Thermodynamics for Biological Systems -Baine
10. Textbook of medical physiology by Arthur C. Guyton 11th Edition
11. Plant Physiology by Taiz & Zeiger, 3rd Edition
12. Life: The Science of Biology, by David Sadava, 9th Edition
13. Biochemical Methods.1st , (1995), S.Sadashivam, A.Manickam, New Age International Publishers, India
14. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA
15. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.
16. An Introduction to Practical Biochemistry.3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu.Pvt.Ltd. India

HCT 1.3: INHERITANCE BIOLOGY 4 Credits (60 L)

Learning outcomes

- Gain knowledge as how genes are transmitted in organisms from one generation to another.
- Along with this, Inheritance pattern will highlight the role of genetics in gene mapping.
- The role of genes in evolution and effect of genes on variation among the population.

UNIT-I: Mendelian Genetics [12]

Concept of Gene: Allele and its types, Mendelian laws- Law of Dominance, Co-Dominance, Incomplete Dominance, Segregation, Independent assortment. Test cross, Back cross, Allelic interactions, gene interactions, Linkage and crossing over.

UNIT- II: Drosophila genetics [10]

Drosophila as an eukaryotic model, analyses of autosomal and sex linkages, screening of mutations based on phenotypes and mapping the same, hypomorphy, genetic mosaics, genetic epistasis in the context of developmental mechanisms.

UNIT- III: Cytogenetics [14]

Chromosomes-Morphology, Heterochromatin & Euchromatin, Lampbrush chromosome, Polytene chromosome. Numerical changes- Aneuploidy, Euploidy, polyploidy with examples. Chromosomal aberrations: Deletion, duplication, inversion, translocation. Structure of sex chromosomes, Sex linked inheritance, extra chromosomal inheritance- chloroplast, mitochondria, and plasmid.

UNIT- IV: Bacterial and Yeast Genetics [10]

Methods of genetic transfers –Transformation, Disovery, competency, artificial methods of transformation- $CaCl_2$ method, electroporation, gene gun and microinjection. Conjugation-discovery, nature of donor strain and compatibility, Hfr, F, map of F plasmid. Transduction- discovey, structure of bacteriophages lambda and T4, generalized and specialized. Yeast Genetics life cycle of *saccharomyces cerevisiae*, matting type switching.

UNIT- V: Evolutionary genetics and Population genetics [14]

Theories of evolution- Lamarckism, Darwinism, mutation theory and Neo-Darwinism , genetic basis of evolution, Genetic polymorphism, Hardy-Weinberg genetic equilibrium, causes of changes in allele frequency, gene frequency, factors affecting gene frequency. Significance of population genetics. Gene mapping in Prokaryotes and Eukaryotes, QTL mapping strategies, Genome mapping (Physical maps), C-value paradox, Functional genomics.

REFERENCE BOOKS:

1. Principles of Genetics 8th edition, Eldon J. Gardner, Michael J. Simmons, and D. Peter Snustad,
2. Wiley India Edition (Indian edition).
3. Molecular Genetics: An introductory Narrative (2nd Edition) Gunther S. Stent and Richard
4. Calendar, CBS Publishers and Distributors (Indian Edition) –Reprint 2004.
5. Principles of Genetics, 7th Edition, Robert H Tamarin, Tata McGraw Hill Edition (Indian Edition) Reprint 2004
6. Genetics 5th edition –Strickberger, Pearsons publisher –Low Price Edition (Indian Edition).
7. Modern Microbial Genetics –Editors Uldis N Streips and Ronald E. Yasbin Wiley –Liss publications, 1991.

SCT 1.1: BIOSTATISTICS AND BIOINFORMATICS 4 Credits (60 L)

Learning outcomes

- The primary goal of this is to uncover how various tools and techniques of bioinformatics can be utilized in studies pertaining to macromolecules (DNA, RNA, protein).
- After completing this students will be able to analyze, interpret and study biological data (sequence, structure, etc) stored in various databases available on internet.
- Gain the knowledge of statistics in biology.

UNIT-I: Introduction to Biostatistics and Measures of central tendency [14]

Population, Sample, sampling methods, variable, parameter, classification of data, Frequency Distribution, tabulation, graphic and diagrammatic representation. Mean, mode & median (with merits and demerits), measures of dispersion: range, variance, standard deviation, coefficient of variation, symmetry: measures of skewness and kurtosis, Probability and distributions: Definition of probability (frequency approach), independent events. Conditional probability, Examples of Bernoulli, Binomial, Poisson and Normal distributions. Coefficient of distribution, Use of these distributions to describe in biological models.

UNIT-II: Correlation, regression and Test of significance [12]

Scatter plot, correlation coefficient (r), properties (without proof), Interpretation of r, linear regression. Fitting of lines of regression, regression coefficient, coefficient of determination. Hypothesis testing: Hypothesis, critical region, and error probabilities. Z-test,'t'-test, Chi-square test for independence. P-value of the statistic. Confidence limits, Introduction to analysis of variance.

UNIT-III: Introduction to Bioinformatics [12]

Virtual library: Searching Medine, PubMed, current content, science citation index and current awareness services, electronic journals, grants and funding information. Introduction to bioinformatics, genomics and proteomics; introduction to NCBI and search engine; Biological Databases: Nucleic acid sequence databases:- GenBank, EMBL & DDBJ, Sequence submission using BanKit & Sequin; Primary Protein sequence databases:- PIR, MIPS, Swiss-PROT, TrEMBL, NRL–3D; Composite Protein sequence databases: - NRDB, OWL, MIPSx, SWISS- PROT+ TrEMBL; Secondary Protein databases: - PROSITE, PRINTS, BLOCKS, PROFILES, Pfam, IDENTIFY. Introduction to genome databases (Bacteria, Human, Viral and Plant)

UNIT-IV: Sequence analysis methods [12]

Methods, Algorithms, Pairwise sequence analysis using BLAST and FASTA; Multiple sequence analysis ClustalW or T-coffee. Phylogenetic analysis: Elements of molecular phylogeny, methods of phylogenetic analysis, types of phylogenetic trees (Rooted, Unrooted, Bifurcating versus multifurcating Special tree- Dendrogram, Cladogram & Phylogram), phylogenetic analysis tools- Phylip and MEGA.

UNIT-V: Structure prediction [10]

Nucleic acid structure prediction; Protein structure prediction-primary (ExPasy server), secondary (GOR & SOPMA) and tertiary (Homology based modeling), Validation of 3-D structure (Ramchandran plot), molecular mechanics, force field, molecular dynamics & simulations. 3D structure visualization tools (RasMol, Jmol, PyMol and Cn3D).

REFERENCE BOOKS:

1. Biostatistics: A foundation for Analysis in the Health Sciences 7/E /Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Introductory Statistics. Fifth Edition. (2004) Prem S. Mann John Wiley and Sons (ASIA) Pte Ltd.
3. Basic Statistics-Aprimer for Biomedical Sciences-(Olive Jean Dunn).
4. Biostatistics-An introductory text – (Auram Gold Stein).
5. Statistics : An Introductory Analysis (Taro Yamane) Harper and Row Publisher 1964,67,73
6. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
7. An introduction to Computational Biochemistry. (C. Stain Tsai, A JohnWiley and Sons, Inc., publications).
8. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).
9. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery. (Rastogi S. C. Mendiratta, and Rastogi P.)
10. NCBI Web site: http://www.ncbi.nlm.nih.gov

SCT 1.2: NANO-MATERIALS FABRICATION 4 Credit (60 L)

Learning outcomes

- Understand the principles and methods of fabrications.
- Understand the classification nano-structured materials.

Unit-I: Physical Methods of Synthesis of Nanomaterials (10)

Synthesis of Nano-structured materials : Principle and relative merits of each techniques for production of Nano-structures including ultra-thin films and multilayer by: (a) Laser Ablation technique, (b) Arc Discharge technique and (c) Mechanical Milling.

Unit-II: Physico-Chemical Methods of Synthesis of Nanomaterials (15)

Fundamentals and need of identification of pertinent parameters amenable to synthesis of nanoparticles by chemical methods such as (a) CVD (Chemical Vapor Deposition)/MOCVD technique, (b) Plasma/Sputtering / Hot-Wire Plasma Enhanced CVD method, (c) Molecular Bean Epitaxy (d) Atomic Layer Epitaxy and (f) Self assembly technique.

Unit-III: Chemical Methods of Synthesis of Nanomaterials (15)

Chemical methods of synthesis and applicability of the methods: (a) Solution growth techniques of 1D-2D nano structures:- Synthesis of metallic, semiconducting and oxide nanoparticles homo- and hetero-nucleation growth methods, (b) Template-based synthesis (*electrochemical, electrophoretic, Melt and solution, CVD, ALD*) , (c) Gas Phase Synthesis of Nanopowders: – Vapor (or solution) – liquid – solid (VLS or SLS) growth – the Need for Gas/vapor State Processing – Main Stages of Gas Phase Synthesis (d) Evaporation, (e) Self assembly technique (f) Sol-gel method and (g) Spray pyrolysis. Special features of nanoscale growth.

Unit-IV: Thermodynamics (10)

Thermodynamics of Phase Transitions – triggering the Phase Transition – fundamentals of nucleation growth – Controlling Nucleation & Growth – Size Control of the Nanometric State Aggregation – Stability of Colloidal Dispersions – Spontaneous Condensation of Nanoparticles: Homogeneous Nucleation – Spinodal decomposition – Other undesirable Post-Condensation Effects Nanoparticles' morphology.

Unit-V: Biogenic Methods of Synthesis of Nanomaterials (10)

Properties of living organisms such as to combat deleterious effect of heavy metals in highconcentrations; resistance against metals by Modulation of their transport, Active efflux, Redox changes and Sequestration and intracellular compartmentation into detoxified complexes; Biogenic synthesis by (i) bacteria, (ii) fungi, (iii) algae and (iv) plants.

References:

1. Edelestein A.S and Cammarata RC, Nano materials synthesis, properties and applications:
2. Michael Kohler, Wolfgang Fritzsche, Michael Kohler, Wolfgang Fritzsche, Nanotechnology-An Introduction to Nano structuring Techniques Wiley (Practical)
3. Brian Robinson, Self-Assembly,IOS Press
4. Tai Ran – Hsu, MEMS and Microsystems, Design, Manufacture and Nanoscale Engineering, John Wiley & Sons, 2008.
5. M. Gentili, C. Giovannella, S. Selci, Nanolithography: A Borderland between STM, EB, IB and X-Ray Lithographies (NATO ASI Series), Kluwer Academic Publishers, 1994.
6. Nicholas A. Kotov, Nanoparticle Assemblies and Superstructures , CRC, (2006).
7. Guozhong Cao, Nanostructures & Nanomaterials Synthesis, Properties G; Z, Applications, World Scientific Publishing Pvy. Ltd., Singapore 2004

M. SC. - I - BIOTECHNOLOGY (SEMESTER –I)

PRACTICALS

PRACTICAL COURSE HCP 1.1: MICROBIOLOGY **2 Credit**

1. Studies of aseptic techniques-Disinfection, cotton plug making, cleaning and sterilization of used and new glassware's, Good laboratory practices.
2. Perform the isolation of bacteria from different sources (Soil, water and air) by spread, pour and streak plate method.
3. Perform & study of colony characters of *E. coli*, *P. aeruginosa*, *B. subtilis* & *Klebsiella neumoniae* on Nutrient agar and specific media.
4. Perform the Microscopic examination-Simple, Gram's staining, Motility, Acid-fast stain and Lactophenol cotton blue staining (Fungi). Algae and Protozoa
5. Perform the structural staining: capsule, endospore, cell wall, flagella and reserve food material.
6. Perform & study of growth curve of *E. coli.*
7. Perform & study biochemical characters *E. coli* and *Bacillus sp.*
8. Perform & study the morphological and biochemical characters of Acidophilic/Alkalophilic/ Thermophilic/Halophilic bacteria.
9. Perform antimicrobial susceptibility test by disc diffusion method.
10. Perform the isolation of Bacteriophages (Plaque formation).

PRACTICAL COURSE HCP 1.2: CONCEPTS OF BIOCHEMISTRY **2 Credits**

1. Perform the Qualitative and Quantitative analysis of carbohydrates.
2. Perform the Qualitative and Quantitative analysis of proteins.
3. Perform the Qualitative and Quantitative analysis of amino acids.
4. Perform the Quantitative analysis of nucleic acids
5. Perform the Estimation of Vitamin C and Riboflavin.
6. Perform the Lipid isolation, detection and estimations
7. Perform the Fractionation of egg proteins
8. Perform & Study of Kranz anatomy
9. Production and estimation of indol acetic acid.
10. Isolation of chloroplast and spectrophotometric assay of Hill's oxidation.
11. Estimation of transaminase activity.

PRACTICAL COURSE HCP 1.3: INHERITANCE BIOLOGY **2 Credit**

1. Demonstration of Mendelian principles using Drosophila / plant system.
2. Numerical exercises related to Mendelian principles, gene interactions, linkage and gene mapping.
3. Studies on induction and detection of sex linked recessive lethals (Drosophila).
4. Studies on mutagenic treatment to seeds, pollen grains and its mitotic and meiotic analysis.
5. Study of mutation analysis in bacteria (antibiotic resistance).
6. Study of Karyotype.
7. Study and calculate gene frequency in population by Hardy-Weinberg equilibrium.
8. Study of transformation, conjugation and transduction.
9. Study of construction of restriction map of plasmid DNA.
10. Preparation of salivary gland chromosome from Drosophila/chironomous larvae.

PRACTICAL COURSE SCP 1.1: BIOSTATISTICS AND BIOINFORMATICS 2 Credits

1. Measures of Central Tendency and Dispersion on Excel
2. Statistical Analysis using EXCEL (Diagrammatic and graphical presentation)
3. Problems on Z test, t-test & chi square test
4. Accessing virtual library- current content, science citation index and current awareness services, electronic journals, grants and funding information.
5. Retrieval of literatures using PubMed and PMC.
6. Retrieval of an amino acid sequence, nucleotide sequence and performing FASTA and BLAST.
7. Multiple sequence alignment by CLUSTAL X/ CLUSTAL W.
8. Predication of secondary structure of proteins.
9. Homology modeling for prediction of 3D structure & its visualization.
10. Structure analysis: secondary, tertiary and quaternary structure, bond angle, bond length, different interactions by RasMol.
11. Phylogenetic tree construction & analysis.

PRACTICAL COURSE SCP 1.2: NANO-MATERIALS FABRICATION 2 Credits

1. Synthesis of micelles and inverse micelles.
2. Synthesis of dendrimers.
3. Preparation of thiolated silver nanoparticles
4. Synthesis of Gold Nanoparticles by chemical and biogenic methods
5. Zinc selenide quantum dot preparation.
6. Synthesis of Iron Oxide Nanoparticle
7. Thin film preparation by spin coating technique.
8. Synthesis of Nickel metal nanoparticle by urea decomposition method
9. Synthesis of Zinc Oxide nanoparticle
10. Preparation of nanoparticles by using Ball milling

M. SC. BIOTECHNOLOGY (SEMESTER –II)

HCT 2.1: CELL BIOLOGY 4 Credit (60 L)

- In particular, this course will focus on different attributes of living cells, how cells are formed, how cells interact along with the cell adhesion and cellular signaling.
- Specific knowledge will be imparted about role of cell division and its regulation on diseases like cancer.

UNIT- I: Cell theory and Cell Dynamics [12]

Cell Theory, Cell Structure and organization of prokaryotic and eukaryotic (plant and animal) cells. Cell motility, Cell dynamics, Extracellular matrix. Cell differentiation, hormones and growth factors. Ultrastructure & function of Cell organelles – mitochondria, chloroplast, endoplasmic reticulum, ribosomes, golgi apparatus, lysosomes, peroxisomes and nucleus.

UNIT-II: Cytoskeleton and Cell Organelles [12]

Cytoplasmic Membrane: Chemical Composition of Membrane, Structure and function of Membrane. Models of cell membrane. Membrane permeability: Active and passive transport. Structure and functions of microtubules, microfilaments and intermediate filaments. Working of actin, kinesin, dynein and ATPase as motor protein. Actin and myosin in heart.

UNIT-III: Cell cycle and Cell adhesion [10]

Cell Cycle: Cell Cycle Phases-mitosis and meiosis, Role of cyclins and Cdks, Cell cycle check points. Cell senescence and programmed cell death mechanisms. Biology of oncogenes and anti-oncogenes-Rb gene and P53. Cell Adhesion- Cell-cell interactions and cell-matrix interaction. Desmosomes, Hemidesmosomes, Integrins, Selectins, Cadherins, Tight Junction, Gap Junction.

UNIT-IV: Cell signaling [14]

Extracellular Messengers, & their receptors, G -protein- Coupled receptors their second messengers and signal transduction pathway- Regulation of Glucose levels, Protein Tyrosine Kinases-RTK Dimerization, Protein Kinase activation, RTKs activates downstream signaling pathway, signaling by the insulin receptors (RTKs) , Calcium as an intracellular messenger: IP3 and Voltage-Gated Ca2+ Channels, Calcium binding Protein (calmodulin) & its role in signaling; Neurotransmitters. Light induced signal transduction (Plant transduction). General Pathways of Ras- MAP Kinase pathway, Hedgehog pathway, WNT signalling pathway, Notch Pathway, Nf-κB Pathway. Bacterial chemotaxis and quorum sensing.

UNIT-V: **Embryonic development [12]**

Structure of gametes, cellular and biochemical processes during early fertilization, strategies for monospermy and conservation of species specificity, cascade of events (acrosome reaction and egg activation cleavage blastulation, gastrulation) embryonic development in frog, morphogenetic movements origin of embryonic endoblasts (ecto, meso and endoderm) regeneration in animals with reference to hydra, planaria and salamander limb.

REFERENCE BOOKS:

1. Molecular Cell Biology, Lodish et al.Scientific American Books (1995)
2. The World of the Cell Becker, W.M. et al.Benjamin Cummings (2004)
3. Cell and Molecular Biology, Karp G,John Wiley and Sons. (1999).
4. Molecular Biology of Cell, Alberts B et al.Garland Publishers, (2001)
5. Lehninger Principle of Biochemistry, Nelson DL and Cox MM, Worth Publishers, (2000)
6. Principles of cell and Molecular Biology, Kleinsmith LJ & Kish VM,Harper Collins College Publishers (1995).

HCT 2.2: ENZYME TECHNOLOGY 4 Credit (60 L)

- Upon successful completion of this course, the student will learn the major classes of enzyme and their functions in the cell.
- The course also provides information pertaining to role of co-enzyme cofactor in enzyme catalyzed reaction, properties of enzymes and regulation of biochemical pathways.
- Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic data and estimate important parameter (Km. Vmax, Kcat etc).

UNIT-I: Enzymes [14]

Historical aspect, Nomenclature and Classification - IUB system, rationale, overview and specific examples. Characteristics of enzymes, enzym. Concept of active centre, binding sites, stereospecificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme Catalysis: Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain, acid - base and nucleophilic catalysis. Methods for studying fast reactions. Isoenzymes, Ribozymes, Abzymes. Multienzyme complex: Properties, pyruvate dehydrogenase system (*E. coli* and mammalian), Tryptophan synthetase, multienzyme complex from *E. coli*, fatty acid synthetase.

UNIT-II: Enzyme Kinetics [12]

Michaelis - Menten Equation - form and deriveation, steady state enzyme kinetics. Significance of Vmax and Km. Bisubstrate reactions. Graphical procedures in enzymology - advantages and disadvantages of alternate plotting. Enzyme inhibition - types of inhibitors - competitive, non- competitive and uncompetitive, their mode of action and experimental determination. Enzyme activity, international units, specific activity, turnover number, end point kinetic assay.

UNIT-III: Structure Function Relations [10]

Lysozyme, ribonuclease, trypsin, carboxypeptidase, phosphorylase, aspartate transcarbamylase and Na - K ATPase. Clinical aspects of enzymology: LDH isozymes, SGOT, SGPT, creatine kinase, alpha amylase, phosphatase.

UNIT-IV: Allosteric Interactions [10]

Allosteric sites, Modulators, Protein ligand binding including measurements, analysis of binding isotherms, cooperativity, Hill and Scatchard plots and kinetics of allosteric enzymes. ENZYME REGULATION: Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation.

UNIT-V: Engineering Techniques [14]

Metabolic engineering, enzyme engineering. Immobilized Enzymes: Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and Km). Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Immobilized multienzyme systems. Biosensors -glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors.

REFERENCE BOOKS:

1) Fundamentals of Enzymology- Price and Stevens
2) Enzymes -Dixon and Webb
3) Isoenzymes By D. W. Moss
4) Immobilized Biocatalysts- W. Hartneir
5) Selected papers Allosteric Regulation -M. Tokushige
6) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, (2004)
7) Principles and Applications in Engineering Series: Biotechnology for Biomedical Engineers - Martin L.Yarmush, CRC Press, Boca Raton London New York Washington,D.C.
8)Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988

SCT 2.1: MOLECULAR CELL PROCESSING 4 Credits (60 L)

- Course on molecular cell processing will enhance the knowledge base about functional and structural organization of nucleic acid.
- The course particularly aims at understanding structure, synthesis and replication of nucleic acids.
- Imparts the knowledge regarding molecular process occurs in the cell such replication, transcription, translation, mutations, gene regulation etc..

UNIT-I: Genome organization [14]

Organization of prokaryotic and eukaryotic genome; Role of nuclear matrix in chromosome organization and function; Matrix binding proteins; Heterochromatin and Euchromatin; DNA reassociation kinetics (Cot curve analysis); Repetitive DNA and unique sequences; Satellite DNA; DNA melting and buoyant density. Forms of nucleic acids, DNA as a genetic material (Avery MacLeod and McCarty; Hershey and Chase experiments). Prokaryotic and eukaryotic gene structure.

UNIT-II: DNA Replication [12]

Unit of Replication (Replicon: Bacterial, Eukaryotic and Extra chromosomal). Enzymes, proteins and mechanism of DNA replication in prokaryotes and eukaryotes. DNA proof reading, DNA methylation. DNA replication inhibition.

UNIT-III: **Transcription [14]**

Prokaryotic transcription: RNA Polymerases, Promoters and their consensus sequences, Transcription initiation, Elongation and Termination (Rho dependent, Rho independent), Eukaryotic transcription: RNA Polymerases (I, II & III) & subunits, Promoter elements for three polymerases, GTFs, Activators, Enhancers, Repressors. Initiation, Elongation and Termination of transcription. mRNA processing, RNA editing, alternative splicing. Transcriptional regulation-Positive and negative; Operon concept-lac, trp, ara, his, and gal operons, Reverse transcription.

UNIT-IV: Translation [10]

Prokaryotic and eukaryotic ribosomes, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post translational modification of proteins. Regulation of translation.

UNIT-V: DNA damage, Repair and Recombination [10]

DNA damage-types of mutations, mutagens; DNA Repair-Photoreactivation, Nucleotide and base Excision, Mismatch, SOS, Recombination repair, Eukaryotic repair Mechanisms Recombination: Recombination between heteroduplex, Holiday intermediate, Proteins involved in Recombination, Role of recA, recBCD pathway in *E. coli*, single strand assimilation in Bacteria.

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REFERENCE BOOKS:

1. Benjamin Lewin -Gene VI, Gene VII, Gene IX, Gene X Oxford University press
2 David Friefieder -Essentials of Molecular Biology, Jones &Barlett publications
3 J. Kendrew Encyclopedia of MolecularBiology Blackwell Scientific publications.
4 Weaver Molecular Biology
5 J.D.Watson, N.H.Hopkins ,J.W Roberts,et alMolecular Biology of theGene,Benjamin Cummings publ. co.inc.,California
6 J.Darnell. *et. al.*, molecular biology of the cell (2nd edition) Garland Publishing Inc.
7 Meyers R.A (ed)., Molecular biology and biotechnology.VCH publishers NY Inc.

8 Alberts B *et. al.*, Molecular biology of the cell. Garland Publishing Inc.
9 Watson J.D., Recombinant DNA.
10 Malacimski; Essentials of Molecular Biology.
11 Stansfield; Molecular and cell biology.
12 Walker Molecular biology and Biotechnology.
13 Brown T.A Essential of Molecular biology Vol 1 and 2 each. 14 Dale Molecular Genetics of Bacteria

SCT 2.2: MOLECULAR MEDICINE 4 Credits (60 L)

- After having completed this course the students shall have obtained a basic understanding of molecular mechanisms in development of disease.
- How molecular/cellular biology may be used to characterize cellular processes.

UNIT-I: Human Molecular Genetics [14]

Human genome project; Sequence Architecture of human genome; Blood and Blood group Antigens; MHC Antigen – HLA; Identification and isolation of disease genes – Positional cloning, Functional cloning, Microarray technology; Pre-natal diagnosis - Chorionic villus sampling, Amniocentesis; Forensic testing - DNA fingerprinting, DNA footprinting, Paternity testing

UNIT-II: Genetic Diseases in Human [10]

Cystic fibrosis, Duchenne muscular dystrophy, Haemoglobinopathies, Agammaglobulinemia, Marfan syndrome, Huntington's disease, Phenylketonuria, Down syndrome, Parkinson's Disease, Alzhesimer's Disease.

UNIT-III: Stem Cell as Regenerative medicine [14]

Introduction; Stem cell sources; Unique properties of stem cells; Classification - Embryonic stem cells, Adult stem cells; Similarities and differences between adult and embryonic stem cells; Applications of Embryonic stem cells and ethical issues associated with it; Adult stem cell Differentiation, plasticity, types of adult stem cells; Stem cell specific transcription factors - Induced pluripotent stem cells (iPSC); Therapeutic applications as regenerative medicine.

UNIT-IV: Gene Therapies [10]

Introduction; Types of Gene therapy: Somatic and Germ line gene therapy, *in-vivo* and *ex-vivo* gene therapy; Virus based vehicle for gene therapy, Non Viral Methods of Gene transfer.

UNIT-V: Pharmacogenetics [12]

Steps involved in Drug Discovery/Design- *In silico* method, Structure based method, Nature and Sources of drugs; Route of drug administration; Absorption and Bioavailability of drugs in system; Excretion of drugs from system; Pharmacogenetics study of drug.

REFERENCE BOOKS:

1. Peter Sudbery, Ian Sudbery, 2009, Human Molecular Genetics, 3rd edition, Pearson education limited.
2. Leaf Huang, Mien-Chie Hung, Ernst Wagner, 1999, Non viral vectors for gene therapy, Academic press.
3. Max Levitan, Ashley Montagu, 1977, text book of Human Genetics, 2nd Ed. Oxford University press, N.Y.
4. Tom Strachan & Andrew P. Read. 2004, Human Molecular Genetics, 2ndEd. John Wiley & Sons. (Asia) PTE Ltd.
5. Ricki Lewis. Human Genetics- Concepts and Applications, 3rd Ed.WCB, McGraw-Hill.
6. Amita Sarkar.2001, Human Genetics, Dominant Publishers, VOL No-1 & 2 New Delhi.
7. Nagy A, Gertenstein M, Vintersten K, Behringer R (2003). Manipulating the MouseEmbryo ,New York:Cold Spring Harbor Press.
8. Gilbert SF.(2000) Developmental biology, 6th edition Sunderland,MA: SinauerAssociates, Inc.

OET 2.1: IMMUNOLOGY AND IMMUNE TECHNIQUES 4 Credit (60 L)

- At The course will provide sound knowledge of how immune system deals with various pathogens, different processes and cell types involved in prevention of disease.
- At The course will provide sound knowledge of how immune system deals with various pathogens, different processes and cell types involved in prevention of disease.
- Along with this the students will become aware about concept, synthesis and action mechanism of vaccines.

Unit I: Immunity [**14]**

Native or Innate immunity: Introduction, First line of Defense – Physical and Chemical barriers at the portal of entry. Second line of Defense – Cellular Processes in nonspecific defense mechanism Structure and functions of primary lymphoid organs, secondary lymphoid organ Cells of immune system. Third line of Defense: Humoral Immunity and cell mediated Immunity. Primary and secondary immune response Antibody:, basic structure and biological function of antibody classes.Monoclonal antibodies: Hybridoma Technology for monoclonal antibody production and applications of monoclonal antibodies.

Unit II: Antigen, Major Histocompatibility Complex, Cytokines, Complement [14]

Antigen: Introduction, immunogenicity, antigenicity, types of antigens, Haptens, properties of immunogen, role of biological system in immunogenicity, route of Administration. Processing and presentation of exogenous and endogenous antigens. Major Histocompatibility Complex: Introduction, classes – structure and function. Cytokines: Introduction, properties, function, Cytokine receptors. Complement system: Introduction, functions, components, general account on complement activation – classical and alternative pathways.

Unit III: Immunopathology [10]

Hypersensitivity: Introduction, classification, general mechanisms in Hypersensitivity Autoimmunity: Introduction, general mechanism, classification of autoimmune diseases Hemolytic, organ specific (Type I diabetes,Psoriasis Pernicious anemia) and non-organ specific (SLE and RA). Transplantation: Immune tolerance to allograft mechanism o allograft rejection, Immunosuppressive Therapy,Tumour Immunology

Unit IV: Antigen and antibody interactions [10]

Antigen antibody interactions: Principles and applications of interaction, strength of interactions, crossreactivity, features of interactions. Reactions of antigen-antibody complex – precipitation, flocculation, agglutination, complement fixation. Immunodiffussion, Immunoelectrophoresis, Electroimmunodiffussion, Complement Fixation Test, Immunofluorescence Test, Radioimmunoassay, ELISA.

Unit V: Vaccines and Immnunohematology [12]

Vaccines: Introduction active and passive immunization, Traditional vaccines Live-attenuated, killed, New Trend vaccines: subunit, conjugate, DNA, recombinant vector vaccines, Vaccination Schedule and traveler vaccines. Immuno hematology: ABO and Rh blood group system, applications of blood group, Hemolytic diseases of new born, detection of Rh antibodies, ABO hemolytic diseases

REFERENCE BOOKS:

1. Immunology - Kuby
2. Essential Immunology- Roitt
3. Cellular and Molecular Immunology- Abbas
4. Immunology and Serology- Philip Carpenter
5. Textbook of Immunology- Barrette J.T.
6. Basic and Clinical Immunology- Fundenberg H.

7. Biology of Immune response- Abramoff and Lavice
8. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul
9. Immunology an Introduction- Tizard
10. Molecular Biotechnology-Principles and applicatons of rDNA- 4th Edition, Bernard R. Glich et al.
11. Textbook of Microbiology- Ananthanarayan and Paniker
12. Microbiology 5th Edition- Prescott
13. Microbiology – Pelczar JR.
14. Microbial Genetics - Freifelder
15. Brock Biology of Microorganisms – MF Madigan
16. General Microbiology – Stanier et al.
17. General Virology - Luria
18. Animal Virology – Fenner, F and White, D.O.
19. Virology – Dulbecco R. and Ginsberg H.S.
20. Medical Microbiology- Fritz H. Kayse

OET 2.2 PLANT BREEDING AND TISSUE CULTURE 4 Credit (60 L)

- To refresh the basic knowledge of plant breeding and apprise students with its relevance to production of quality plant varieties.
- To introduce the basic principles methods of plant breeding and tissue culture.

UNIT I: **[10]**

History; Genetic resources- centers of diversity and origin of crop plants, Law of Homologous variation, genetic resources. Breeding methods for self-pollinated, crosspollinated and clonally propagated crops. Component, recombinational and transgressive breeding. Single seed descent. Populations, their improvement methods and maintenance, Hybrid breeding and genetic basis of heterosis.Ideotype breeding.Mutation breeding.

UNIT II: **[15]**

Plant Breeding for Stress Resistance and Nutitional Quality: Genetic basis and breeding for resistance to diseases and insect-pests. Breeding for vertical and horizontal resistance to diseases. Genetic and physiological basis of abiotic stress tolerance. Breeding for resistance to heat, frost, flood, drought and soil stresses. Important quality parameters in various crops, their genetic basis and breeding for these traits. Role of molecular markers in stress resistance breeding: MAS, MARS and MABB.

UNIT III: **[15]**

Plant regeneration pathways - Organogenesis and Somatic embryogenesis; Endosperm culture and triploid production; Anther and pollen culture, and production of haploid and doubled haploid plants; Protoplast culture and fusion, Somatic hybrids; Organelle transfer and cybrids; Micropropagation, artificial seed and bioreactor technology, Virus-free plants by meristem culture; Use of somaclonal and gametoclonal variation for crop improvement; In vitro mutagenesis and mutant selection; Preservation of plant germ plasm *in-vitro*.

UNIT IV: **[10]**

Cryopreservation -Principle and types. Biosynthesis- batch, continuous cultures, immobilized plant cell, Biotransformation of precursors by cell culturing, metabolic engineering for production of secondary metabolites, Hairy root culture, elicitation.

UNIT V: **[10]**

Transgenic crops for resistance against biotic and abiotic stresses; Transgenic plants-Edible vaccine, Golden rice; Engineering crops for male sterility and modification of flower colour, flowering, fruit ripening and senescence; GM crops for nutritional quality and quantity; RNAi-mediated crop improvement; Molecular pharming; Other applications; Global status and biosafety of transgenic plants.

Recommended Text Books:

1. Principles of Plant Breeding, Allard RW – Wiley
2. Plant Breeding Theory and Practice, Stoskopf NC, Tomes DT and Christie BR –Westview Press
3. Quantitative Genetics, Genomics and Plant Breeding, Kang MS – CABI Publishing
4. Plant Molecular Breeding, Newbury HJ – CRC Press
5. Plant Cells in liquid culture (1991), Payne Shuler Hanser Publishers.
6. Introduction to plant tissue culture- M.K. Razdan
7. Plant tissue culture-Theory & practice-S.S.Bhojwani& M.K. Razdan
8. Plant tissue culture-KalyankumarDey
9. Biotechnology- H.S. Chawla

M. SC. BIOTECHNOLOGY (SEMESTER –II)

PRACTICALS

PRACTICAL COURSE HCP 2.1: CELL BIOLOGY 2 Credit

1. To isolate and study Animal cell (human), Plant cell, Bacteria, and Fungi under a microscope and prepare a comparative table.
2. To study all the phases of Mitosis and Meiosis in a cell.
3. To study Permeable and Semi-permeable membrane of cell using the concept of Osmosis.
4. To investigate the effect of Heat/Enzymes/Chemicals on the permeability of plant cell membranes.
5. Isolation and Observe chloroplast under microscope.
6. Isolation and Observe mitochondria under microscope.
7. To study red blood cells and white blood cells.
8. Study of flow cytometer (FACS).
9. Study of Micrometry and Measurement of given biological sample.
10. Developmental stages of chick embryo by ICT.

PRACTICAL COURSE HCP 2.2: ENZYME TECHNOLOGY 2 Credits

1. Isolation and quantification of activity of – amylase / invertase / alkaline phosphatase (salivary / plant source)
2. Determination of specific activity of enzyme.
3. Determination of activity of enzyme in presence of activator and inhibitor.
4. Determination of Km and Vmax of Invertase.
5. Determination of optimum parameter of enzyme – pH and temperature.
6. Induction and estimation of beta- galactosidase.
7. Perform the immobilization of enzyme/Cell.
8. Perform the estimation of creatinine.

PRACTICAL COURSE SCP 2.1: MOLECULAR CELL PROCESSING 2 Credits

1. Perform the Isolation of genomic DNA from bacteria.
2. Perform the Isolation plasmid DNA from bacteria.
3. Perform the Isolation of genomic DNA from Plant/Yeast.
4. Perform the Isolation of RNA from Plant cell / Yeast.
5. Perform the Isolation of organelle DNA (Chloroplast / mitochondria)
6. Perform the Silver nitrate staining of DNA.
7. Determine the Effect of protein synthesis inhibitors on the induction of beta galactosidase.
8. Perform & study the photoreactivaton in bacteria

PRACTICAL COURSE SCP 2.2: MOLECULAR MEDICINE 2 Credits

1. Isolation of Genomic DNA from different sources (dried blood & hair).
2. Study of Sickled RBCs.
3. Demonstration of Study of Flow cytometer
4. Isolation and quantification of hemoglobin from blood
5. Separation of serum from plasma
6. Estimation of alkaline & acid phosphatase activity in blood plasmas
7. Study of Genetic Diseases.
8. Isolation and cultivation of lymphocytes

PRACTICAL COURSE OEP 2.1: IMMUNOLOGY AND IMMUNE TECHNIQUES

2 Credits

1. Study of Immunodiffusion. (Ouchterlony Technique.)
2. Study of Immunoelectrophoresis. (CCIEP, Rocket Immunoelectrophoresis)
3. Preparation of *Salmonella typhi* antigens.
4. Study of slide agglutination test by colony emulsion method for the diagnosis of *Salmonella typhi.*
5. Diagnosis of Salmonella typhi by Widal test (Qualitative and Quantitative test)
6. Isolation of Candida species and study its morphological characters (Budding, Mycelia, Spores).
7. To study the Dot-blot ELISA.
8. Demonstration of ELISA for HIV diagnosis.

PRACTICAL COURSE OEP 2.2: PLANT BREEDING AND TISSUE CULTURE

2 Credit

1. Induction of polyploidy using colchicines. (Root Tip)
2. Cytological analysis of polyploidy plants. (Root Tip)
3. Study of Pollen fertility.
4. Isolation of genomic DNA from Plants.
5. Isolation of Ti Plasmid from Agrobacterium.
6. Media preparation, sterilization and callus culture.
7. Somatic embryogenesis and somaclonal variation, micro-propagation.
8. Cell suspension culture.
9. Isolation of protoplast by chemical and mechanical methods.
10. Synthetic seeds preparation.
11. Visit to commercial R & D green houses, agro based industries.