Punyashlok Ahilyadevi Holkar Solapur University, Solapur

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

Name of the Faculty: Science & Technology

Syllabus: M.Sc. I - Biotechnology
(As per NEP 2020)

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

(Syllabus to be implemented from June 2023)

PUNYASHLOK AHILYADEVI HOLKARSOLAPUR UNIVERSITY, SOLAPUR

M. SC. I - BIOTECHNOLOGY

SYLLABUS (As per NEP 2020) - w.e.f. June 2023

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/BAMS/BHMS/BUMS/BDS/B. E./B. Sc. Agri. Or Concerned subject to life sciences from recognized university, and **who have passed the entrance examination conducted by the PAH Solapur University** shall be held eligible for admission to the M. Sc. Course in Biotechnology.
- **Admission:** Merit list based on average of B. Sc. aggregate and entrance exam 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 (2 Compulsory, 1 Elective and 1 Research Methodology) and 3 practical courses (2 Compulsory, 1 Elective)
- Semester II includes Three theory papers (2 Compulsory, 1 Elective), Three Practical courses (2 Compulsory, 1 Elective) and a compulsory On job Training/ Field Project/Internship/Apprenticeship.
- Each theory paper comprising of 4 units which are distributed in total 6 0 lecture hours having weightage of 4 credits.
- Practical examinations (UA/CA) are to be conducted at the end of each semester.
- A completed report of On job Training/ Field Project/Internship/Apprenticeship should be submitted at the end of 2nd Semester.
- 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).

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY,SOLAPUR

Syllabus for M. Sc. I - Biotechnology - Sem.-I and II

Semester	Code	Title of the Paper	Semester Examination			Hours Per Week	Credits	Degree
		Mandatory (Major)	**UA**	**IA**	**Total**			
Sem-I	DSC T1	Biochemistry and Enzymology	80	20	100	4	4	PG Diploma (After 3 Yr Degree)
	DSC T2	Cell and Molecular Biology	80	20	100	4	4	
		Mandatory (Minor)						
	RM	Research methodology	80	20	100	4	4	
		ELECTIVE (Any one)						
	DSE 1A	Biostatistics and Bioinformatics	80	20	100	4	4	
	DSE 1B	Nanomaterials and Fabrication						
	DSE 1C	Plant breeding and Tissue Culture						
		PRACTICALS						
	DSC P1	Practical Course Biochemistry and Enzymology	40	10	50	4	2	
	DSC P2	Practical Course Cell and Molecular Biology	40	10	50	4	2	
	DSE P1	Practical Course (Elective subject)	40	10	50	4	2	
		Total for Semester-I	**440**	**110**	**550**		**22**	

Semester	Code	Title of the Paper	Semester Examination			Hours Per Week	Credits	Degree
	Mandatory (Major)		**UA**	**IA**	**Total**			
Sem-II	DSC T3	Microbiology and Microbial Techniques	80	20	100	4	4	PG Diploma (After 3 Yr Degree)
	DSC T4	Immunology and Immunotechniques	80	20	100	4	4	
	Mandatory (Minor)							
	OJT/FP	On Job Training/ Field Project	80	20	100	4	4	
	ELECTIVE (Any one)							
	DSE 2A	Inheritance Biology	80	20	100	4	4	
	DSE 2B	Molecular Medicine						
	DSE 2C	Cancer Genetics and Animal Tissue Culture						
	PRACTICALS							
	DSC P4	Practical Course Microbiology and Microbial Techniques	40	10	50	4	2	
	DSC P5	Practical Course Immunology and Immunotechniques	40	10	50	4	2	
	DSE P2	Practical Course (Elective subject)	40	10	50	4	2	
	Total for Semester-II		**440**	**110**	**550**		**22**	

M. Sc. I - Biotechnology - Sem.-I

DSC T1 BIOCHEMISTRY AND ENZYMES

COURSE OBJECTIVES:

- Introduction to the components of biochemical basis of living system.
- Learning the structure and organization of important biomolecules.
- Understanding of biochemical processes and metabolic pathways in the living cells.
- Understanding the role and importance of enzymes in the metabolic system.

LEARNING OUTCOMES:

- Students learn about components of biochemical basis of living system.
- Students understand the structure and organization of important biomolecules.
- Sudents understand the biochemical processes and metabolic pathways and the correlation between them.
- Students learn the key role and importance of enzymes in the metabolic system.

DSC T1 BIOCHEMISTRY AND ENZYMES (4 Credits - 60L)

UNIT-I: Biomolecules and metabolism (20)

Properties of biomolecules favoring living conditions-directionality, information, 3D architecture, Structural complementarity

Structure, function biological role and important biochemical pathways of:

- Carbohydrates: Glycolysis, Gluconeogenesis, TCA, Pentose Phosphate Pathway, Glycogen metabolism
- Amino acids and Proteins: Conformation of proteins (Primary, secondary, Ramachandran plot, tertiary and quaternary structure; domains; motif and folds), Amino acid metabolism-Decarboxylation, trans amination, deamination, Urea cycle
- Lipids: biosynthesis and beta oxidation of fatty acids
- Nucleic acids: Nucleotide metabolism-De-novo and Salvage pathway
- Vitamins: Source, biochemical role and deficiency disorders
- Hormones: Classification and role of human hormones

UNIT-II: Oxidative phosphorylation and photosynthesis (10)

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-III: Enzymes (15)

Nomenclature and Classification, Characteristics, Activation energy. Transition state theory. Effect of temperature, pH and substrate concentration on reaction rate.

Mechanism of Enzyme Catalysis: Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain,

Types of catalysis with example: acid - base and nucleophilic catalysis.

(Lysozyme, ribonuclease, trypsin, carboxypeptidase, phosphorylase, aspartate transcarbamylase and Na - K ATPase)

Ribozymes, Abzymes. Multienzyme complex.

Clinical significance of enzymes.

UNIT-IV: Enzyme Kinetics [15]

Enzyme activity, international units, specific activity, turnover number

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics.

Significance of Vmax and Km.

Graphical procedures in enzymology.

Enzyme inhibition - types of inhibitors - competitive, non- competitive and uncompetitive (with respect to Lineweaver Burk Plot),

Allosteric sites, Modulators,

Protein ligand binding, cooperativity, Hill's and Scatchard plot

ENZYME REGULATION: Product inhibition, feedback control, enzyme induction

Immobilization of enzymes, Enzymes as biosensors.

PRACTICAL COURSE

DSC P1: BIOCHEMISTRY AND ENZYMES

1. Qualitative and Quantitative analysis of carbohydrates.
2. Qualitative and Quantitative analysis of proteins.
3. Qualitative and Quantitative analysis of amino acids.
4. Quantitative analysis of nucleic acids – Diphenylamine and Orcinol Method
5. Estimation of Vitamin C.
6. Qualitative analysis of lipid detection and estimation of acid value, saponification value
7. Isolation of chloroplast and spectrophotometric assay of Hill's oxidation.
8. Isolation and quantification of activity of – amylase / invertase / alkaline phosphatase (salivary / plant source)
9. Determination of specific activity of enzyme.
10. Determination of Km and Vmax of enzyme (Amylase/ Invertase/ Alkaline Phosphatase).
11. Determination of optimum parameter of enzyme – pH and temperature/ activator and inhibitor.
12. Perform the immobilization of enzyme/Cell.

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. Fundamentals of Enzymology- Price and Stevens
7. Enzymes -Dixon and Webb
8. Isoenzymes By D. W. Moss
9. Immobilized Biocatalysts- W. Hartneir
10. Selected papers Allosteric Regulation -M. Tokushige
11. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, (2004)
12. Principles and Applications in Engineering Series: Biotechnology for Biomedical Engineers - MartinL.Yarmush, CRC Press, Boca Raton London New York Washington,D.C.
13. Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988
14. Laboratory Manual in Biochemistry J. Jayaraman
15. Experimental Biochemistry by Beedu Sashidhar Rao and Vijay Deshpande: Dreamtech Press (2020)
16. An introduction to practical biochemistry by David Plummer (3rd Ed.)
17. Biochemical Methods S.Sadasivam and A. Manickam (4th Ed.) 2022.

DSC T2: CELL AND MOLECULAR BIOLOGY

COURSE OBJECTIVES:-

- It deals with understanding the molecular aspects of the biology.
- It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse transcription.
- It also helps in understanding the concepts of cellular functionStudents will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.

LEARNING OUTCOMES:-

- Students will understand how these cellular components are used to generate and utilize energy in cells.
- Students will understand the cellular components underlying mitotic cell division.
- Students will apply their knowledge of cell biology to selected examples of changes orlosses in cell function.
- These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

DSC T2: CELL AND MOLECULAR BIOLOGY - (4 Credits - 60L)

UNIT-I: Cell Theory and Genome organization [16]

Cell Theory, Cell structure, Ultrastructure and function of Cell organelles, Cell cycle ; Gene structure of Prokaryote and eukaryote DNA as a genetic material (Avery MacLeod and McCarty; Hershey and Chase experiments), Heterochromatin and Euchromatin, Organization of prokaryotic and eukaryotic genome; Role of nuclear matrix in chromosome organization and function; Matrix binding proteins; DNA Denaturation (Tm), DNA Renaturation kinetics (Cot curve analysis): - Repetitive DNA and unique sequences; Satellite DNA; and buoyant density.

UNIT-II: Cytoskeleton and Cell Signaling [14]

Structure & function of cytoplasmic membrane, models of cell membrane, membrane permeability, Structure and function of cytoskeletal. Cell adhesion, types of cell junctions, Cell adhesion receptors. Extracellular & Intracellular Messengers, types of receptors, Signal transduction pathway- G-Protein coupled receptors, Receptor tyrosine kinase (RTK), activation of downstream signalling pathway, Light induced signal transduction, general types of Ras Pathway.

UNIT-III: DNA Replication & DNA Damage -Repair [14]

Unit of Replication: Enzymes involved in replication, Mechanism of DNA replication in Prokaryotic & Eukaryotic. DNA Damage**:** -Mutagens, Types of mutation; DNA Repair: - Photoreactivation, Nucleotide and base Excision, Mismatch, SOS, Recombination repair, Role of recA, recBCD pathway in E. coli, Eukaryotic repair Mechanisms Recombination: Proteins involved in Recombination, Recombination between heteroduplex, Holiday intermediate.

UNIT-IV: Transcription & Translation [16]

Regulatory regions and Regulatory proteins, Enzymes involved in Prokaryotic & eukaryotic Transcription; Mechanism of Transcription in Prokaryote & Eukaryote: - initiation, Elongation and Termination (Rho dependent, Rho independent), RNA modification, Transcription regulation in prokaryote & eukaryote, Reverse transcription. Genetic code, Components of translation,

Mechanism of Translation in Prokaryote & Eukaryote; translational proofreading, PTM (Post translation modification, Regulation of translation.

PRACTICAL COURSE
DSC P2: CELL AND MOLECULAR BIOLIGY

1. Perform the Isolation of organelle DNA Chloroplast.
2. Perform the Isolation of mitochondria and assay of a marker enzyme.
3. Study of flow cytometer (FACS).
4. Perform the Isolation of genomic DNA from bacteria.
5. Perform the Isolation plasmid DNA from bacteria.
6. Perform the Isolation of genomic DNA from Plant/Yeast
7. Perform the Isolation of RNA from Plant cell / Yeast.
8. Qantification of DNA by DPA Diphenylamine assay/Fluorescent.
9. Perform and study the photoreactivation in bacteria.

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 CollegePublishers (1995). 1. Benjamin Lewin -Gene VI, Gene VII, Gene IX, Gene X Oxford University press2 David Friefieder -Essentials of Molecular Biology, Jones &Barlett publications
7. J. Kendrew Encyclopedia of MolecularBiology Blackwell Scientific publications.4 Weaver Molecular Biology
8. J.D.Watson, N.H.Hopkins ,J.W Roberts,et alMolecular Biology of the Gene,Benjamin Cummings publ.co.inc.,California
9. 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.
10. Alberts B *et. al.*, Molecular biology of the cell. Garland Publishing Inc.9 Watson J.D., Recombinant DNA.
11. 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

RM: RESEARCH METHODOLOGY

OBJECTIVES:

- Identify an appropriate research problem in their interesting domain.
- Understand the Preparation of a research project report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

LEARNING OUTCOMES:

After completely this paper students will learn following knowledge:

- Students will get useful information about Steps in Research and Sampling Techniques
- Students will be able to learn about Thesis and Manuscript writing.
- Students will know the importance of patents and IPR in processing their innovations.

RM: RESEARCH METHODOLOGY - (4 Credits - 60L)

UNIT-I: Research [15]

Definition, Importance and Meaning of Research, Objectives, Characteristics, Types of Research. Steps in Research; Identification, Selection and Formulation of Research Problem, Research Design, Formulation of Hypothesis.

UNIT-II: Sampling Techniques & Parametric Tests [15]

Sampling theory, Types of Sampling, Steps in Sampling, Sample Size, Advantages and limitations. Collection of Data: Primary Data, Data Collection Methods, Secondary Data, Relevance, Limitations and Cautions, Testing of significance Mean, Proportion, Variance and Correlation, Testing for Significance of Difference between Means, Proportions, Variances and Correlation Co efficient. Chi-square tests, ANOVA.

UNIT-III: Thesis and Manuscript writing [15]

Report Writing : Structure and components of scientific reports, types of report, Significance, Different steps in the preparation, layout: Abstract, Introduction, Materials and Methods, Results and Discussion, Summary and Conclusion, References (IMRAD).
structure and language of typical reports, illustrations and tables, bibliography, Webliography, referencing, Appendices, plagiarism
Preparation of Manuscript; Author instructions, modes of paper communication,
Use of Audio-Visual aids in Presentation. citation index, h-index, i10-index, ISSN and ISBN. Scientific proposal writing for funding agencies (UGC, CSIR, DBT, DST, ICMR and DRDO).

UNIT-IV: Introduction to IPR and Patents [15]

Intellectual property, Protection of Intellectual property, WIPO, forms of protection- patent, copyright, trademark, geographical indications, trade secrets. Criteria and procedure of patenting, patenting biological material. Patent procedure in India and PCT-Patent cooperation treaty. Types of patenting, Patenting of biological materials with examples and case studies,IP Infringement.
Plant breeder's right, Farmer's right, advantages and disadvantages of PBR**.**

REFERENCE BOOKS:

1. Statistical Methods by S.P. Gupta.
2. Research Methodology, Method and Techniques by C.R. Kothari or by Santosh Gupta.
3. Research Methodology by Gurumani.
4. Text book of Biotechnology, P K Gupta
5. Text book of Biotechnology, B D Singh.
6. Research Methodology: Methods and Techniques ,Kothari C.R., 1990.. New Age International.
7. Research Methodology; Sinha S.C. and Dhiman, A.K., 2002. Ess Publications. 2 volumes.
8. Research Methodology ; Panneerselvam R., PHI, Learning Pvt. Ltd., New Delhi - 2009
9. Research Methods: A Process of Inquiry Anthony, M., Graziano, A.M. and Raulin, M.L., 2009.,
10. Proposal Writing ; Coley, S.M. and Scheinberg, C. A., 1990, Sage Publications.

DSE 1A- BIOSTATISTICS AND BIOINFORMATICS

COURSE OBJECTIVES:

- The course covers basic methods used in measures of central tendency, Correlation, regression and test of significance.
- The course includes biology databases, sequence analysis such as pairwise and multiple alignment, searching databases for sequence similarity, profiles, pattern matching, gene prediction methods and principles for molecular phylogeny.
- The course considers theoretical principles as well as how existing programs are being used by bioinformaticians.

LEARNING OUTCOMES:

After successfully completing the course, the students will be able to

- Gain the knowledge of statistics in biology.
- Understand the concept of hypothesis testing.
- 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 and protein).
- Able to analyze, interpret and study biological data (sequence, structure, etc) stored in various databases available on internet.
- Describe how bioinformatics methods can be used to relate sequence, structure and function.
- Know the in-silico tools and techniques used in molecular biology.

DSE 1A- BIOSTATISTICS AND BIOINFORMATICS (4 CREDITS - 60L)

UNIT-I: Measures of central tendency: [15]

- Population, Sample, sampling methods, 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, Probability, Conditional probability. Correlation, Scatter plot, correlation coefficient, regression- linear,
- Hypothesis testing: Hypothesis, critical region, and error probabilities.
- Z-test,'t'-test, Chi-square test for independence, P- value of the statistic.
- Confidence limits.

UNIT-II: Introduction to Bioinformatics [15]

- Search engines, searching Medline, PubMed, Introduction to bioinformatics, genomics and proteomics; introduction to NCBI,
- Biological Databases: Nucleic acid sequence databases- Gen Bank, EMBL & DDBJ,
- Sequence submission using Ban Kit & Sequin; Primary Protein sequence databases. genome databases
- (Bacteria, Human, Viral and Plant).

UNIT-III: Sequence analysis methods [15]

- Methods, Algorithms, pairwise sequence analysis using BLAST and FASTA;
- Multiple sequence analysis Clustal W, Muscle. Phylogenetic analysis: Elements of molecular phylogeny, methods of phylogenetic analysis,
- Types of phylogenetic trees, phylogenetic analysis tools- Phylip and MEGA.

UNIT-IV: Structure prediction [15]

- Nucleic acid structure prediction, Protein structure prediction-primary (ExPasy
- server), secondary (GOR & SOPMA) and tertiary (Homology based modeling),
- Validation of 3-D structure (Ramachandran plot), 3D structure visualization tools
- (RasMol and PyMol). Applications of Bioinformatics- Introduction, ORF
- Prediction, gene prediction methods and tools, Analyzing Genomes
- and Genome Annotation. In silico restriction digestion, In silico primer designing.

PRACTICAL COURSE DSE P1 (A)

BIOSTATISTICSAND BIOINFORMATICS

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.

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

DSE 1B - NANOMATERIALS AND FABRICATION

COURSE OBJECTIVES:

- This course describes the foundational knowledge of the Nanoscience and related fields.
- Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment.
- The course should give a basic introduction to chemical and physical principles in the synthesis of inorganic nanostructured materials. In addition, basic principles of finite size effects will be covered. The course will also cover different methods for synthesis and characterization of different nanostructures and nanostructured bulk materials. Prerequisites include general knowledge in chemistry, physics and material science

LEARNING OUTCOMES:

- After successfully completing the course, the students will be able to:
- Understand the principles and methods of fabrications.
- Understand the classification nano-structured materials.
- Qualitatively describe how the nanoparticle size can affect the morphology, crystal structure, reactivity, and electrical properties.
- Describe several synthesis methods for fabrication of inorganic nanoparticles, one-dimensional nanostructures (nanotubes, nanorods, nanowires), thin films, nanoporous materials, and nanostructured bulk materials.
- And also could describe how different lithography methods can be used for making nanostructures.
- The student should have a theoretical background within synthesis/fabrication of nanomaterials
- which makes he/she prepared for later literature studies and laboratory work within the field.

DSE 1B - NANOMATERIALS AND FABRICATION (4 CREDITS - 60L)

Unit-I: Physical Methods of Synthesis of Nanomaterials (15)

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: 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 CVD (Chemical Vapor Deposition), Plasma/Sputtering method, Self assembly technique. Synthesis of metallic, semiconducting and oxide nanoparticles homo- and hetero- nucleation growth methods, Gas hase Synthesis of Nano powders, Sol-gel method and Spray pyrolysis.

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

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.

Unit-IV: Fabrication of Nanocomposite Materials (15)

Introduction to nanocomposites, recent advances in nanocomposites, different types of nanocomposites fabrication, different property of nanocomposites, Fabrication and Evaluation of Bio-Based Nanocomposite, Applications of Nanocomposite.

PRACTICAL COURSE DSE P1 (B)
NANO-MATERIALS FABRICATION

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

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

DSE 1C - PLANT BREEDING AND TISSUE CULTURE

COURSE OBJECTIVES:

- 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.

LEARNING OUTCOMES:

- Students gain knowledge of plant breeding and apprise students with its relevance to production of quality plant varieties.
- Students learn about basic principles methods of plant breeding and tissue culture.

DSE 1C - PLANT BREEDING AND TISSUE CULTURE - (4 Credits - 60L)

UNIT I: [15]

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: [15]

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.

Transgenic crops for resistance against biotic and abiotic stresses

PRACTICAL COURSE DSE P1 (C)
PLANT BREEDING AND TISSUE CULTURE

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.

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. I - Biotechnology - Sem.-II

DSC-T3: MICROBIOLOGY AND MICROBIAL TECHNIQUES

COURSE OBJECTIVES

- To understand concepts in Microbiology.
- To complement the students with basic knowledge of microorganisms and microbial techniques
- To enrich the students with knowledge related to basic concepts in Microbial Systematics

LEARNING OUTCOMES

- Students will gain the deep knowledge and awareness about microorganisms
- Students will able to learn different microbial techniques.
- Students will be able to identify and classify the microorganisms based on morphological and biochemical characteristics.

DSC-T3: MICROBIOLOGY AND MICROBIAL TECHNIQUES - 4CREDITS- (60L)

UNIT-I: Microbial Taxonomy [**15]**

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

UNIT-II: Microbial Diversity [15]

- Distribution of microorganisms in soil, water and air.
- General characters of oxygenic and anoxygenic, Photosynthetic microbes, Magnetotactic bacteria, Methanogenicarchaebacteria.Human micro flora (nichewithoneexample)
- Extremophiles:Generalcharacters(origin,habitat, molecularadaptations) and examples of Extremophiles:Acidophiles, Alkalophiles, Thermophiles, Psychrophiles, Halophiles,Barophiles (Piezophiles), Xerophiles, Radiophiles, Metallophiles, Endoliths, and Osmophiles. Applicationsof Extremophiles and unculturable microbes.

UNIT-III: Phycology, Mycology, Protozoology & Virology [15]

- 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; Pathogenesisand Industrial applications of algae, fungi, slimemolds and protozoans.
- Virus and bacteriophages, general properties of viruses, viral structures, Classification,
- Isolation, Cultivation and Enumeration (Bacteriophages, Plant viruses and Animal viruses). Reproduction of Viruses: Lytic cycle (T phage and phage θ-X174), Lysogenic cycle (λ, and Mu1 phages)

UNIT – IV: Microbial Techniques [**15]**

- Staining techniques: Nature and types of stains.
- Principle & mechanism-Simple and differential, AFB staining, fluorescent, negative. Structuralstaining- 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.
- Isolationofmicroorganism:serialdilutions, streak plate, pour plate & spread plate.Characterization & identification of colonies.
- Maintenance & Preservation of cultures-slant, stab, soil, glycerol & lyophilization.

PRACTICALCOURSE
DSC P3: MICROBIOLOGY AND MICROBIAL TECHNIQUES

1. Studies of aseptic techniques-Disinfection, cotton plug making, cleaning and sterilization of usedandnewglassware's, Good laboratorypractices.
2. Perform the isolation of bacteria from different sources (Soil, water and air) by spread, pour andstreakplatemethod.
3. Perform & study of colony characters of *E. coli*, *P. aeruginosa*, *B. subtilis*&*Klebsiellaneumoniae*onNutrientagarandspecificmedia.
4. Perform the Microscopic examination-Simple, Gram's staining, Motility, Acid-fast stain andLactophenolcotton bluestaining(Fungi).Algaeand Protozoa
5. Performthestructuralstaining:capsule, endospore,cellwall,flagella andreservefoodmaterial.
6. Perform &studyofgrowthcurveof*E.coli.*
7. Perform &studybiochemicalcharacters*E. coli*and*Bacillussp.*
8. Perform & study the morphological and biochemical characters of Acidophilic/Alkalophilic/Thermophilic/Halophilicbacteria.
9. Performtheisolationof Bacteriophages(Plaqueformation).

REFERENCEBOOKS:

1) Bergey's Manual of DeterminativeBacteriology-Gibbons,Baltimore:Williams&Wilkins,1974.
2) Brock Biology of Microorganisms (11thedn) by MichaelT.Madigan,JohnM.Martinko(eds).
3) General Microbiology (5thedn)–by RogerY.Stanieretal.
4) Microbiology –PelczarJR.
5) Prescott'smicrobiology(10th edn)-ByJoanneWilleyandLindaSherwood andChristopherJ.Woolverton
6) MicrobialGenetics–DavidFreifelder
7) GeneralVirology-byS.E.Luria andJamesE.Darnell.
8) Fungi Bacteriaand viruses-byH.CDube
9) IntroductiontoPlantVirology–byBosL
10) AnimalVirology –Fenner,FandWhite,D.O.
11) Laboratory Manual in Microbiology by P. Gunasekaran
12)Practical Microbiology by Vinita Kale, Kishor Bhusari
13)Practical Microbiology by R. Vasanthakumari

DSC T4: IMMUNOLOGY AND IMMUNOTECHNIQUES

COURSE OBJECTIVES

- To promote critical thinking among students
- To provide students with a foundation in immunological processes;
- To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology
- Be able to clearly state the role of the immune system
- Be able to compare and contrast the innate versus adaptive immune systems

LEARNING OUTCOMES

After completion of this course, students will

- Understand Immune system and its components.
- Get the knowledge and understanding of various defense mechanisms for combating foreign particles.
- Come to know various disorders / abnormalities of immune system.

DSC T4: IMMUNOLOGY AND IMMUNOTECHNIQUES - (4 Credits - 60L)

- **Unit I: Immunity and Components of Immune System [20]**
  Native or Innate immunity: Introduction, First line of Defense – Physical and Chemical barriers atthe 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 immunesystem. Third line of Defense: Humoral Immunity and cell mediated Immunity.
- Primary and secondary immune response.
- Antigen: immunogenicity, antigenicity, properties of immunogen, Major Histocompatibility Complex: Introduction, classes – structure and function.
- Processing andpresentation of exogenous and endogenous antigens.
- Cytokines: Introduction, properties, function, Cytokine receptors.
- Complement system: Introduction, functions, components, general account on complementactivation – classical and alternative pathways.
- Cell-mediated effector functions: Cytotoxic T cells, Natural Killer Cells, ADCC, NK cell receptors,inverse correlation with target MHC expression, missing self hypothesis, cytotoxicity reaction

Unit II: Antibody [10]

- Antibody: Antibody structure and function (classification of immunoglobulins, immunoglobulin domains, concept of variability, isotypes, allotypes and idiotypic markers).
- Immunoglobulin genes, VJ/VDJ rearrangements and genetic mechanisms responsible for antibody diversity, affinity maturation, allelic exclusion.
- Class switching, receptor and soluble forms of immunoglobulin

Unit III: Antigen – antibody interactions [15]

- Antigen antibody interactions: Principles of interaction, strength of interactions, cross reactivity, features of interactions.
- In vivo reactions of antigen-antibody complex – precipitation, flocculation,agglutination, complement fixation, neutralization.
- Principles and applications of techniques based on antigen-antibody interactions– Immunodiffussion, Immunoelectrophoresis, ComplementFixation Test, Immunofluorescence Test, Radioimmunoassay, ELISA, Western blot.

Unit IV: Applications of immunological principles (vaccines, and diagnostics) [15]

- Tumor and transplantation Immunology: Immune tolerance to allograft, mechanism of allograft rejection, Immunosuppressive Therapy, Tumor antigens and tumor evasion of immune system. Autoimmunity: Introduction, general mechanism, classification of autoimmune diseases Hemolytic, organ specific (Type I diabetes) and non-organ specific (SLE and RA).
- Immunodeficiency: Primary immuno-deficiencies (SCID), Secondary immune-deficiencies (AIDS) Hypersensitivity: Introduction, classification, general mechanisms in Hypersensitivity Monoclonal antibodies: Hybridoma Technology for monoclonal antibody production and applications of monoclonal antibodies.
- Vaccines: Introduction active and passive immunization, Traditional vaccines Live-attenuated, killed, New Trend vaccines: subunit, conjugate, DNA, recombinant vector vaccines.

PRACTICAL COURSE

DSC P4 - IMMUNOLOGY AND IMMUNOTECHNIQUES

1. Study of Immunodiffusion (Ouchterlony method, Mancini method)
2. Study of Immunoelectrophoresis (CCIEP, Rocket Immunoelectrophoresis)
3. Study of slide agglutination test by colony emulsion method for the diagnosis of *Salmonella typhi*.
4. Preparation of *Salmonella typhi* antigens.
5. Diagnosis of *Salmonella typhi* by Widal test (Qualitative and Quantitative test)
6. To study the Dot-blot ELISA.
7. Demonstration of carcinoma slides of different organs of human.
8. Live and Dead cell counting by Trypan blue
9. Demonstration of Immunohistochemistry (IHC) slides.
10. Case study of organ transplantation in India

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. Medical Microbiology- Fritz H. Kayse
11. Laboratory Manual on Biotechnology by Dr. P.M. Swamy; Rastogi Publications
12. Practical Microbiology by R.C. Dubey and D.K. Maheshwari; S. Chand & Company Ltd.
13. Textbook of Practical Microbiology by Dr. Subhash Chandra Parija; Ahuja Publishing House
14. Practical Immunology by Lesle Hudson and Frank C. Hay; Blackwell Scientific Publications
15. LIFE SCIENCES PROTOCOL MANUAL (DBT Star College Scheme) 2018 Compiled by
16. Dr. P. Hemalatha Reddy and Dr. Suman Govil

On Job Training (OJT)/ Internship/ Field Project (FP)

COURSE OUTCOMES:

By the end of this course students will able to

1. Perform and design individual research/ laboratory/ practical/ project work.
2. Get hands on skills essential for the practical work in concerned subject.

Under the One-year PG Diploma program/two-year Master's Degree program, the students must complete on-the-job training/internship of 04 credits **during the second semester of the first year in the respective Major Subject.**

An internal assessment of the OJT/Internship/ Field Project will be of **20 Marks**.
A progress report showing the proof of ongoing OJT/Internship/FP, certified by respective Major Subject Teacher must be presented for the internal assessment.

A university assessment of the OJT/internship/ field project will be of **80 Marks**.
A completion report certified by Major Subject Teacher and Concerned Trainer/Authority must be presented for the University assessment.

DSE 2A INHERITANCE BIOLOGY

COURSE OBJECTIVES:

- To learn the mechanism of gene transfer in organisms from one generation to another.
- To understand the concept of inheritance and its pattern.
- To learn the role of genes in evolution and effect of genes on variation among the population.

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 ingene mapping.
- The role of genes in evolution and effect of genes on variation among the population.

DSE 2A INHERITANCE BIOLOGY (4 Credits - 60L)

UNIT-I: Mendelian Genetics and Cytogenetics (15)
Test cross, Back cross, Allelic interactions, gene interactions, Linkage and crossing over. , extra chromosomal inheritance- chloroplast, mitochondria, and plasmid.Concept of Chromosomes, Numerical changes- Aneuploidy, Euploidy, polyploidy with examples. Chromosomal aberrations: Deletion, duplication, inversion, translocation. Structure of sex chromosomes, Sex linked inheritance,

UNIT- II: Drosophila genetics: (15)
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: Bacterial and Yeast Genetics: (15)
Methods of genetic transfers –Transformation, Disovery, competency, artificial methods of transformationCaCl2 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.

UNIT- IV: Evolutionary genetics and Population genetics: (15)
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), Cvalue paradox

PRACTICAL COURSE DSE P2 (A)

INHERITANCE BIOLOGY

1. Demonstration of Mendelian principles using Drosophila / plant system.
2. Numerical exercises related to Mendelian principles, gene interactions, linkage and gene mapping.
3. Study and calculate gene frequency in population by Hardy-Weinberg equilibrium.
4. Study of Karyotype
5. Preparation of salivary gland chromosome from Drosophila/Chironomus larvae.
6. Studies on mutagenic treatment to root, seeds, pollen grains and its mitotic and meiotic analysis.
7. Study of mutation analysis by Replica plate Technique.
8. Study of genetic transfer-Conjugation and transduction
9. Cloning- 1. Preparation of competent cell; 2. Transformation of competent cell
10. Study of genetic transfer- Transduction.

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

DSE 2B - MOLECULAR MEDICINE

COURSE OBJECTIVES:

- To study the molecular and cellular phenomena in biological systems,
- To learn molecular aspects of human diseases, the human body's response to diseases, heterogeneity of response and personalized medicine, stem cells, immune response and genetic determinants.
- To learn molecular techniques to address issues pertaining to biotechnology development.

LEARNING OUTCOMES:

- Students will be able to:- Develop a sound molecular understanding about the different diseases we encounter and how at molecular level
- Student can one could tackle the issues to develop diagnostics and therapeutics for the betterment of healthcare.
- The course covers the use of molecular understanding in discovery research in disease prevention, drug development, diagnosis and therapy.

DSE 2B - MOLECULAR MEDICINE (4 Credits - 60L)

UNIT I: **(15)**

Human Molecular Genetics: 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: **(15)**

Genetic Diseases in Human: Classification of genetic disorder: single gene disorder and examples: Cystic fibrosis, Duchenne muscular dystrophy, Haemoglobinopathies, Agammaglobulinemia, Marfan syndrome, Huntington's disease and Phenylketonuria. Chromosomal disorders and examples: Trisomy 18, Trisomy 13, Klinefelter syndrome, XYY syndrome, Turner syndrome and Down syndrome. Multifactor/ Polygene disorders and examples: Parkinson's disease, Alzheimer's disease.

UNIT III: **(15)**

Stem Cell as Regenerative medicine: 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. Stem cell preservation. Organoid Culture and its Applications in Medicine.

UNIT IV: **(15)**

Gene Therapies: 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. **Pharmacogenetics:** Steps involved in Drug Discovery/Design - Insilco 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; Pharmacogenetic study of drug.

Practical Course : DSE P2 (B)

Molecular medicine

1. Study of Sickled RBCs.
2. Demonstration of Flow cytometer.
3. Estimation of hemoglobin from blood
4. Separation of serum and plasma.
5. Estimation of alkaline phosphatase activity in blood serum
6. Estimation of acid phosphatase activity in blood serum
7. Serum Protein Electrophoresis and its clinical significance
8. Study of Gene therapy for SCID by ICT
9. Study of Stem cell in Bone marrow Regeneration by ICT
10. Study of 3D Bioprinting by ICT.

References:

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.Max Levitan, Ashley Montagu, 1977, text book of Human Genetics, 2nd Ed. Oxford University press, N.Y.
3. Tom Strachan & Andrew P. Read. 2004, Human Molecular Genetics, 2nd Ed. John Wiley & Sons. (Asia) PTE Ltd.
4. Ricki Lewis. Human Genetics- Concepts and Applications, 3rd Ed.WCB, McGraw-Hill.
5. Amita Sarkar.2001, Human Genetics, Dominant Publishers, VOL No-1&2 New Delhi.
6. Nagy A, GertensteinM,VinterstenK,Behringer R(2003).Manipulating the MouseEmbryo ,NewYork:Cold Spring Harbor Press.
7. Gilbert SF (2000) Developmental biology, 6th edition Sunderland,MA:SinauerAssociates,Inc.
8. Jamie Davies and Melanie Lawrence, Organoids and Mini Organs, Academic Press, 2018

DSE 2C - CANCER GENETICS AND ANIMAL TISSUE CULTURE

COURSE OBJECTIVE:

- To study the stem cell and its use as regenerative medicine.
- To study the molecular level of cancer development and progression.To study the diagnosis and treatment for cancer.

LEARNING OUTCOMES:

- After completion of this course students understand basic aspects of Cancer pathology, epigenetic and somaticgenetic changes in tumors. Students become familiar with basic principles and applications of cell culture.
- Students will also learn about the different types of stem cells.

DSE 2C - CANCER GENETICS AND ANIMAL TISSUE CULTURE (4 Credits - 60L)

UNIT I: [15]
Introduction to Cancer Biology: Cancer cell vs. Normal cell; Hallmarks of cancer cell; Cell cycle - Regulation of Cell cycle and Tumor suppressor genes (pRb, P53, BRCA, Gene encoding CDK inhibitors); Oncogenes and Proto- Oncogenes; Factors activating proto-oncogene to oncogene (Tumor Virus; Physical and Chemical Carcinogene); Introduction to Epigenetics, Epigenetics in cancer

UNIT II: [15]
Cancer Progressions: Apoptosis mechanism, Apoptotic Pathways; Metastasis (Clinical significances of invasion, Metastatic cascade, Basement membrane disruption); Theory of invasion (Proteinases and tumour cell invasion; Angiogenesis and its sequence of events in detail

UNIT III: [15]
Diagnostic and Treatment: Methods of diagnosis - Chemotherapy, Radiation Therapy, Immunotherapy use of immunotoxins in cancer therapy, retroviral drugs, Anti- angiogenic Drug; Drugs based on Epigenetics (Acetylation of Histones and Methylation of DNA)

UNIT IV: [15]
Animal Cell culture: Introduction to animal cell and tissue culture, its advantages and limitations, Applications of animal cell and tissue culture. Basic techniques in animal cell culture: Disaggregation of tissue and setting up of primary culture, established cell line cultures, maintenance of cell culture, culture media and role of serum in cell culture, organ culture.

PRACTICAL COURSE: DSE P2 (C)
CANCER GENETICS AND ANIMAL CELL CULTURE

1. DNA amplification by PCR
2. Reporter gene assay (b- Gal)
3. DNA Fingerprinting: Using RAPD techniques
4. Aseptic Transfer technique in animal Cell Culture
5. Preparation of Balanced Salt Solution and pH standards for animal cell culture.
6. Trypsinization methods in animal cell culture -

A. Warm Trypsinization

B. Cold Trypsinization

7. Chick Embryo Culture/Lymphocyte Culture.
8. Any suitable practicals conducted by the department with respect to the concerned course. (maximum two practicals)

Recommended Text Books:

1. The Biology of Cancer, Robert Weinberg, Garland Science; 2 edition;2010
2. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
3. Ruddon.R.W., Cancer Biology, Oxford University Press, Oxford, 1995.
4. Bishob J. A. 1982, Retrovirus, Cancer genes, Advances in Cancer Research.
5. Vogel F. Chemical mutagenesis Spinger and Verlag.
6. Sanberg A. A. 1980, The Chromosome in Human Cancer And Leukemia
7. Stich H. F. Carcinogens and Mutagens in EnvironmentCRC press.
8. R. Lanza, J. Gearhartet al (Eds), Essential of StemCell Biology. (2009), Elsevier Academic press.
9. R. Lanza and I. Klimanskaya, Essential Stem Cells Methods. (2009)
10. J. J. Mao, G. Vunjak-Novakovic et al (Ed): Translational Approaches in Tissue
11. Engineering & Regenerative Medicine 2008, Artech House, INC Publications.