SOLAPUR UNIVERSITY, SOLAPUR

M.Sc. Part-II Biotechnology

Revised Syllabus (New CBCS Pattern Syllabus)

w. e. f. June 2017-18

SOLAPUR UNIVERSITY, SOLAPUR
Syllabus for M.Sc. Biotechnology Part - II
(w. e. f. June, 2017-18)

COURSE STRUCTURE
SEMESTER-III

M. Sc. II- BIOTECHNOLOGY CBCS w. e. f. 2017-18 (REVISED) SEMESTER III									
SEM-III	**Code**	**Title of the Paper**	**Semester Exam.**			**L**	**T**	**P**	**Credits**
Biotech		**Hard Core**	UA	IA	Tot				
	HCT 3.1	Industrial and Environmental Biotechnology	70	30	100	4	---	---	4
	HCT 3.2	Genetic Engineering	70	30	100	4	---	---	4
		Soft Core(Any one)					---	---	
	SCT 3.1	Plant Biotechnology	70	30	100	4	---	---	4
	SCT 3.2	Cancer Genetics and Animal Cell culture	70	30	100	4	---	---	
		Open Elective (Any one)							
	OET 3.1	Computational Structure Biology and Drug Designing	7 0	30	100	4	---	---	4
	OET 3.2	Advanced Pharmaceuticals	7 0	30	100	4	---	---	
		Tutorial			25		1		1
PRACTICALS									
	HCP 3.1	**Practical Course HCP 3.1**	35	15	50	---	---	2	2
	HCP 3.2	**Practical Course HCP 3.2**	35	15	50	---	---	2	2
		Soft Core(Any one)							
	SCP 3.1	**Practical Course SCP 3.1**	35	15	50	---	---	2	2
	SCP 3.2	**Practical Course SCP 3.2**	35	15	50	---	---	2	2
		Open Elective(Anyone)							
	OEP 3.1	**Practical Course OEP 3.1**	35	15	50	---	---	2	2
	OEP 3.2	**Practical Course OEP 3.2**	35	15	50	---	---	2	
		Total for Third Semester	**420**	**180**	**625**	---	---		**25**

SOLAPUR UNIVERSITY, SOLAPUR
Syllabus for M. Sc. Biotechnology Part - II
(w. e. f. June, 2017-18)

COURSE STRUCTURE
SEMESTER-IV

M. Sc. II- BIOTECHNOLOGY CBCS w. e. f. 2017-18 (REVISED) SEMESTER-IV									
SEM-IV	**Code**	**Title of the Paper**	**Semester Exam.**			**L**	**T**	**P**	**Credits**
Biotech		**Hard Core**	UA	IA	Total				
	HCT 4.1	Animal Biotechnology and Stem Cell technology	70	30	100	4	---	---	4
	HCT 4.2	Advanced analytical Techniques	70	30	100	4	---	---	4
	HCT 4.3	Research Methodology and IPR	70	30	100	4	---	---	4
		Soft Core(Any one)					---	---	
	SCT 4.1	Medical Biotechnology and Bio-nanotechnology	70	30	100	4	---	---	4
	SCT 4.2	Advanced Pharmacognosy	7 0	30	100	4	---	---	
		Tutorial			25		1		1
PRACTICALS/PROJECT WORK									
	MP 4.1	Major Project	140	60	200	---	---	8	8
			420	**180**	**625**	---	---		**25**
M. Sc I year					**1250**				**50**
M. Sc II year					**1250**				**50**
Grand Total					**2500**				**100**

** **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**
** **MP = Major project**

M. SC BIOTECHNOLOGY SEMESTER-III

HCT 3.1: INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

4 Credits (60L)

UNIT-I: Introduction to bioprocess engineering [14]

Bioreactors, isolation, preservation and maintenance of industrial microorganisms, microbial growth kinetics, media formulation for industrial fermentation, Air and media sterilization. Designing of a fermentor/bioreactor. Types of fermentation process batch, fed batch and continuous, biotransformation, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Measurement and control of bioprocess parameters.

UNIT-II: Upstream Process [12]

Industrial production of chemicals: alcohols, acids (citric, acetic and gluconic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins, single cell oil, dairy products, wine, beer and other alcoholic Beverages.

UNIT-III: Downstream process [10]

Introduction, removal of microbial cells and solid matters, foam separation, filtration, centrifugation, cell disruption, precipitation, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment.

UNIT-IV: Scope of Biotechnology in Environmental protection [10]

Nonconventional energy sources. Environment protection Act: Environmental laws, Environmental policies, Environmental ethics. UN declaration. Environmental protection and conservation. Environmental Impact Assessment, Ecoplanning and Sustainable Development

UNIT-V: Bioremediation [14]

Biotechnology for clean environment, Biomaterials as substitutes for non-degradable materials, Metal microbe interactions: Heavy Metal Pollution and impact on environment, Microbial Systems for Heavy Metal Accumulation, Biosorption, molecular mechanisms of heavy metal tolerance. Bioindicators and biosensors for detection of pollution, Hazardous Waste Management, Xenobiotics, Biological Detoxification of PAH, Air Pollution Control, Solid Waste Management.

REFERENCE BOOKS:

1. Sullia S. B & Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Glaser A.N &Nilaido. H (1995) Microbial Biotechnology,W.H Freeman & Co.
3. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers& Distributors.
4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (1997) Priciples of Fermentation Technology., Aditya Books (P) Ltd. S.N.Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House
7. Amann, R.I. Stromley, J. Stahl : Applied & Environmental Microbiology
8. Dash : Concepts of Ecology
9. Chattergy : Environmental Biotechnology
10. Varma & Agarwal : Environmental Biology
11. B.K. Sharma : Environmental Chemistry
12. Peavy & Rowe : Environmental Pollution
13. Asthana & Asthana : Environment Problems & Solution

HCT 3.2: GENETIC ENGINEERING

4 Credits (60L)

UNIT-I: Tools for Genetic Engineering [10]

DNA manipulation enzymes- Exonucleases, Restriction endonucleases, Ligase. Gene cloning Vectors- Properties and structure of natural and artificial plasmids, Bacteriophages (λand M13), Cosmids, animal and plant viruses, Phagmids.

UNIT-II: Expression strategies [12]

Various expression vectors in bacteria and eukaryotes- Yeast, Baculovirus, Mammalian and Shuttle vectors. Induced expression strategies and protocols. Expression of industrially important products.

UNIT-III: *In Vitro* construction, screening and Isolation of rDNA Molecules [14]

Isolation of vector and donor DNA and its purification, assembly of gene of interest and vector DNA, Amplification of Recombinant DNA Molecules. Definition and introduction to genomic library, Construction of Genomic & cDNA library, Preparation of primers and probes, Direct Screening, Indirect Screening, Colony hybridization, Immuno-Screening.

UNIT-IV: Analytical techniques [14]

RFLP, RAPD, Microarray, DNA chips. Blotting techniques- Southern, Northern, Western. DNA sequencing-Maxam & Gilbert method, Sanger's dideoxy chain termination method, Automated DNA sequencing. Genetic and Physical mapping techniques. Principle and applications of transformation methods- Cacl2 method, Electroporation, Microinjection, Gene-gun.

UNIT-V: Applications of rDNA technology [10]

Genetic diseases- Detection and Diagnosis, Gene therapy – ex vivo, in vivo, DNA marker technology in plants, DNA fingerprinting, Genetically engineered biotherapeutics and vaccines and their manufacturing, Transgenic animals and Bio-pharming

REFERENCE BOOKS:

1. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II ndedition,Cold spring harbor laboratory press, New York.
2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim andL.J. Cseke, CRC Press Florida 1995
4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A.R. Kimmel, Academic Press Inc, San Diego, 1996
5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990
6. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford,1994
7. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S.Reznikoff, Butterworth-Heinemann Boston 1992
8. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford,1997
9. Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, S.M. Kingsman, Blackwell Scientific Publications, Oxford, 1998.

SCT 3.1: PLANT BIOTECHNOLOGY

4 Credits (60L)

UNIT-I: Plant Physiology and Basic Techniques in Plant Tissue Culture [10]

Plant Nutrition: Microelements and micronutrients in plant metabolism, Functions & Deficiency diseases. Plant Hormones: Types & Mechanism of Action. Role of Hormones in growth ofPlants. Lab setup of Plant Tissue Culture laboratory, Tissue culture Media, Initiation and Maintenance of callus & Suspension culture, single cell clones.

UNIT-II: Micro propagation [10]

Organogenesis, Somatic Embryogenesis, Synthetic seeds. Shoot tip culture/Auxiliary bud culture, Rapid clonal propagation. Embryo Culture & Embryo Rescue. Acclimatization of Plants. Somaclonal Variations/In vitromutagenesis Selected successful examples of Plants of Diverse Origin using Tissue Culture technology, Rescue of endangered Plants.

UNIT-III: Protoplast Culture, Anther Culture and Cryopreservation [12]

Protoplast Isolation, Culture, Fusion, Selection of Hybrid Cells and Regeneration of Hybrid Plants, Symmetric and Asymmetric hybrids. Anther, Pollen and Ovary culture for production of Haploid Plants and Homozygous lines. Cryopreservation, Slow growth & DNA Banking for germ plasma Conservation.

UNIT-IV: Plant Transformation Technology [14]

Basics of Tumor formation, Hairy root, features of Ti & Ri Plasmid and their uses, Mechanism of DNA transfer role of Virulence gene, Binary vectors, Use of 35s & other promoters, genetic markers, viral vectors & their applications, Multiple gene transfers: vector less or direct DNA transfer, Use of reporter gene, Particle bombardment, electroporation, Microinjection, transformation in monocots, Transgene stability & genesilencing in Plant transformation.

UNIT-V: Applications of Plant Biotechnology [14]

Commercial micro propagation. Metabolic engineering & Industrial products, Plant secondary metabolites control mechanisms & manipulation of Phenyl Propanol pathway, Shikimate pathway, Alkaloids, Industrial enzymes, Biodegradable plastics, Therapeutic proteins: lysozomal enzymes, Antibodies and edible vaccines. Purification strategies, oleosin partitioning technology. Agriculture Diseases resistant plants, Biotic & Abiotic stress resistant plants, Enhancement of nutritional value ofcrop Plants & molecular farming, Applications in Biodiversity conservation.

REFERENCE BOOKS:

1. An introduction to Plant Tissue Culture 2nd edn. Razdan, M. K, Science Publishers, USA.
2. Textbook of plant biotechnology, Chawala P.K.2002, Oxford & IBH, New Delhi.
3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture:Theory and Practice, Elsevier Pub.
4. Chrispeels, M. J. 2002. Plant Tissue Culture: Genetical Aspects. Jones and Bortlett Publishers, International.
5. Chopra V. L. et al 1999. Applied Plant biotechnology. Science Publishers Inc.
6. Verpoorte, R. and A.W. Alfermann (Eds) 2000.Metabolic Engineering of plant secondary metabolism, lower Academic Publisher.
7. Chawla HC (2004) – Introduction to plant biotechnology (Science Publ)
8. Davies K (Ed) (2004) – Plant pigments and their manipulation – Annual plant revies, vol 14 Blackwell Publ)
9. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture. Prospects for the

21th century (Academic press).
10. Bhojwani SS. & Razdan MK (1996). - Plant Tissue Culture: Theory & Practice (Elsevier)
11. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology (CRC Press)
12. Slater A, Scott NW, Fowler MR (2008) – Plant Biotechnology: the genetic manipulation of plants (Oxford Press)
13. Vasil IK, Thorpe TA (1994) – Plant cell and tissue culture (Springer)
14. H K Das Textbook of Biotechnology 4th edition

SCT 3.2: CANCER GENETICS AND ANIMAL CELL CULTURE

4 Credits (60L)

UNIT-I: Introduction to Cancer Biology [12]

Cancer cell vs. Normal cell; Hallmarks of cancer cell; Cell cycle - Regulation of Cell cycle and pRb tumor suppressor; P53 tumor suppressor; Tumor suppressor genes; Oncogenes and Proto-Oncogenes; Factors activating proto-oncogene to oncogene; Tumor Virus; Physical and Chemical Carcinogenesis; Introduction to Epigenetics, Epigenetics in cancer.

UNIT-II: Cancer Progression [12]

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: Diagnostic and Treatment [12]

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: Introduction of Animal Tissue Culture [12]

Introduction; Infrastructure of Animal Tissue Culture Laboratory; Characteristics of cells in culture; Media - Natural & Synthetic Media; Primary culture- Cell line (Finite, Infinite, and Continuous); Disaggregation of tissue, Organ culture & its types; Cell culture – initiation, cultivation of animal cell in mass in Bioreactors; Biology of cell culture, evolution of culture dynamics and maintenance of cell lines.

UNIT-V: Viability & Micromanipulation [12]

Viability – measurement of viability and cytotoxicity; Cell cloning – cell synchronization, cell cloning, micromanipulation, Cell Transformation and applications of animal cell culture; In vitro,fertilization – embryo transplant techniques and their applications. Commonly used cell line-MCF7, HeLa, CHO & BHK.

REFERENCE 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. Animal Cell Biotechnology Ian Freshney (4th Edition) Buttler. 2nd Edition

OET 3.1: COMPUTATIONAL STRUCTURE BIOLOGY AND DRUG DESIGNING

4 Credits (60L)

UNIT- I: Introduction to Structural and Pathway Databases [14]

structural data,exploring the structural databases such as Protein Data Bank (PDB) at RCSB, Catalytic Site Atlas (CSA), Homology Derived Structures of Proteins (HSSP), Protein Data Bank Europe (PDBe), PDBeChem, PDBeFold, PDBeMotiff, PDBeNMR, PDBSum, SCOP and CATH. Introduction to biological Pathway Databases.

UNIT- II: Structure Prediction Methods [10]

Statistical methods of Chou-Fasman, Garnier-Osguthorpe- Robson method, Neural network method, Position specific scoring matrices, Motifs and domains, folds and protein folding.

UNIT- III: Homology Modeling [12]

Introduction to homology modeling, Fold recognition and Threading, RNA structure prediction, architectures and topologies of protein and DNA using molecular visualization software, Structure validation

UNIT-IV: Molecular interaction [10]

Molecular interaction; protein-protein, protein-DNA,Protein-Lipid, Protein- Ligand, Protein-Carbohydrate, DNA-Drug interaction, Metalloproteins, Pi … Pi interactions, C-H…Pi interactions

UNIT-V: Drug Discovery and Drug designing [14]

Natural products, drugs, principles of drug development, Drug discovery, mutation in drug targets, automated drug design, structure based and ligand based drug design methods, combinatorial chemistry, high throughput screening (HTS), in silico ADMET properties, QSAR, developing lead library, DOCKING; introduction to docking method to generate new structure, tools and molecular docking programs- AUTODOCK, HEX and VLife MD suite, Virtual Screening, Drug metabolism; Cytochrome p450, pharmacodynamics and pharmacokinetics,clinical trials, FDA approval

RECOMMENDED BOOKS:

1. Wilkins, M.R., Williams, K.L., Appel, R.D., Hochstrasser, D.F. (Editors) 1997
2. Proteome Research: New Frontiers in Functional Genomics. Springer Verlag Berlin Heidelberg.
3. Baxevanis, A.D. and Francis Ouellette, B.F. 2004 Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.Second Edition, Wiley.
4. Graur, D. and Li, W-H. 2000 Fundamentals of Molecular Evolution.SinauerAss.,USA.
5. Essential Bioinformatics, Jin Xiong
6. Rastogi S. C., Mendiratta. N., Rastogi. P. 2005 Bioinformatics methods and application, Genomics, Proteomics, and Drug Discovery.

OET 3.2: ADVANCE PHARMACEUTICALS

4 Credits (60L)

UNIT-I: Physical pharmaceutics covering the following aspects [14]

Introduction to Advance Pharmaceuticals, Solids: Particle characterization by size, shape and surface of individual particle and for contacted particle. Handling of solids, pharmaceutical granulation, compression and compaction properties of binary mixtures, lubricant sensitivity, characterization of granules and compacts.

UNIT-II: Dissolution [12]

Theory of dissolution, concept of drug release. Dissolution test apparatus: different designs, factors affecting dissolution rate. Dissolution of different dosage forms: solids, suspensions, topicals, suppositories and controlled release systems. Enhancement of dissolution rate. Solid dispersions: Types, methods of preparation, selection of carrier, characterization and applications.

UNIT-III: Surfactant System [14]

Phase behavior of surfactant in binary and ternary systems. Factors affecting phase behavior; Micellization; micelle structure, shape, size factors affecting CMC and micelle size, thermodynamics and kinetics of micelle formation. Pharmaceutical aspects of Solubilization, Solubilization in non-aqueous system, interactions with polymers and oppositely charged species. Hydrotrophy in pharmaceuticals, surfactants in emulsions and suspensions. Biological implications of surfactants; Effect on: dissolution of drugs, permeability of membranes, drug absorption, antibacterial activity. Cyclodextrin inclusion complexes and co-solvents.

UNIT-IV: Polymer science [10]

Types and applications of polymers, polymerization reactions, methods of polymerization and characterization of polymers, thermodynamics of polymer solutions.

UNIT-V: Stability studies [10]

Kinetics activation energy calculations, accelerated stability studies, factors responsible for destabilization of pharmaceutical products and techniques to improve, shelf life calculations. Physical testing of solution, suspension, emulsion, aerosol, powder, tablet and sustained release products.

REFERENCE BOOKS:

1. Kitahard and A. Watanabe; Electrical Phenomena at Interfaces; Marcel Dekker.
2. Martin, P. Bustamante and A. H. Chun; Physical Pharmacy; Waverly.
3. D. M. Parikh; Handbook of Pharmaceutical Granulation Technology; Marcel Dekker.
4. G. Alderborn and C. Nystrom; Pharmaceutical Powder Compaction Technology; Marcel Dekker.
5. H. G. Brittain; Physical Characterization of Pharmaceutical solids; Marcel Dekker.
6. J. T. Cartensen; Drug Stability; Marcel Dekker.
7. James J. Wells; Pharmaceutical Preformulation, Ellis Harwood Ltd.
8. Lieberman, Rieser and Banker; Pharmaceutical Dosage Forms; Disperse system; Marcel Dekker.

9. M. N. Rubinstein; Pharmaceutical Technology, Drug stability, John Wiley and sons.
10. Martin Rhodes; Principles of Powder Technology, John Wiley and sons.
11. N. G. Stanley – Wooed; Enlargement and compaction of particle solids; Butterworths.
12. P. H. List and P. C. Schmidt; Pharmaceutical Technology, CRS Press.
13. P. J. Tarcha; Polymer for Controlled Drug Delivery, CRC Press.
14. Robinson; Novel Drug Delivery Systems, Marcel Dekker.
15. Kitahard and A. Watanabe; Electrical Phenomena at Interfaces; Marcel Dekker.
16. Martin, P. Bustamante and A. H. Chun; Physical Pharmacy; Waverly.
17. D. M. Parikh; Handbook of Pharmaceutical Granulation Technology; Marcel Dekker.
18. G. Alderborn and C. Nystrom; Pharmaceutical Powder Compaction Technology; Marcel Dekker.
19. H. G. Brittain; Physical Characterization of Pharmaceutical solids; Marcel Dekker.
20. J. T. Cartensen; Drug Stability; Marcel Dekker.
21. James J. Wells; Pharmaceutical Preformulation, Ellis Harwood Ltd.
22. Rieser and Banker; Pharmaceutical Dosage Forms; Disperse system; Marcel Dekker.
23. M. N. Rubinstein; Pharmaceutical Technology, Drug stability, John Wiley and sons.
24. Martin Rhodes; Principles of Powder Technology, John Wiley and sons.
25. N. G. Stanley – Wooed; Enlargement and compaction of particle solids; Butterworths.
26. P. H. List and P. C. Schmidt; Pharmaceutical Technology, CRS Press.
27. P. J. Tarcha; Polymer for Controlled Drug Delivery, CRC Press.
28. Robinson; Novel Drug Delivery Systems, Marcel Dekker.

PRATICALS

PRACTICAL COURSE HCP 3.1: INDUSTRIAL & ENVIRONMENTAL BIOTECHNOLOGY

2- Credits

1. Fermentative production of Organic solvents: - Ethanol/Acetone/ Butanol.
2. Alcoholic beverages: Beer/ Wine
3. Fermentative production of Amino Acid: L-glutamic acid/Phenylalanine/ L-lysine &Vitamins: Vitamin B12.
4. To study the BOD & COD levels of different water systems.
5. Bacteriological analysis of water by presumptive, confirmatory and completed tests
6. Isolation of xenobiotic degrading microorganisms

PRACTICAL COURSE HCP 3.2: GENETIC ENGINEERING

2-Credits

1. Isolation of Genomic DNA from bacteria
2. Isolation of plasmid DNA.
3. *In vitro* DNA ligation
4. Transformation of *E. coli*
5. Southern blotting and hybridization
6. Restriction Fragment Length Polymorphism (RFLP)
7. DNA amplification by PCR
8. Isolation of Bacteriophage and purification of phage lysate

PRACTICAL COURSE SCP 3.1: PLANT BIOTECHNOLOGY

2-Credits

1. Preparation of Media.
2. Ex-plant Surface Sterilization
3. Callus Culture and Organ Culture
4. *In vitro* rooting and acclimatization.
5. Protoplast isolation and culture.
6. Anther Culture/ Production of haploids.
7. Synthetic seed preparation

PRACTICAL COURSE SCP 3.2: CANCER GENETICS AND ANIMAL CELL CULTURE

2 Credits

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 -
7. A.Warm Trypsinization B.Cold Trypsinization
8. Chick Embryo Culture / Lymphocyte Culture.

PRACTICAL COURSE OEP 3.1: COMPUTATIONAL STRUCTURE BIOLOGY AND DRUG DESIGNING

2 Credits

1. Accessing to Structural Databases and Data retrieval using RCSB PDB, CSA PDBe, PDBeChem, PDBeFold, PDBeMotif, PdbSum.
2. Structural classification using CATH, SCOP resources.
3. Secondary structure prediction using SOPMA and GOR.
4. Homology modeling by SWISSMODEL, and Modeller 9V2 and Model Validation using RAMPAGE or PROCHECK,
5. Prediction of protein-protein, protein-DNA, protein-ligand interactions and
6. Drugbank database and Chembank database
7. Design of ligands using ACD lab and Chemsketch and Development of lead library and high throughput screening using *In silico* ADMET Properties.
8. Docking studies using AUTODOCK and HEX.

PRACTICAL COURSE OEP 3.2 ADVANCED PHARMACEUTICALS 2-Credits

1. Powder characterization: Microscopy – Particle size analysis, calculation of shape factors. Powder Characterization: Compression and compaction – Huckel plot studies, tensile strength.
2. Solubilization :
    - Effect of dielectric constant on solubility
    - Complexation
    - Ternary phase diagram.
    - Solid dispersion
3. Stability of multiple emulsions
4. Polymer science: Rheological and thermal characterization of polymers. Stability study
5. Degradation kinetic study of a drug in a solution.
6. Accelerated stability studies of a formulation.
7. Dissolution studies of various dosage forms

M.SC BIOTECHNOLOGY (SEMESTER-IV)

HCT 4.1: ANIMAL BIOTECHNOLOGY AND STEM CELL TECHNOLOGY

4 Credits (60L)

UNIT-I: Introduction, history of animal cell culture and cell culture media [14]

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture, hybridoma technology, culture of lymphocyte, oviductal, epithelial cell culture, stem cell and Induced pluripotent stem (iPS) cells. Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application. Bioreactor Design, Mechanochemical Regulation of Cell Behaviour, *In vitro* and *In vivo* Synthesis of Tissues and Organs, MicroScale Patterning of Cells and their Environment, Three-Dimensional Scaffolds.

UNIT-II: Characters of cells and behavior [10]

Behavior of cells in culture, division, their growth pattern, metabolism of estimation of cell number. Scaling up the cell culture to large scale/industrial level production.

UNIT-III: Concept of cell line and transgenic animal [10]

Development of cell lines, characterization and maintenance of cell lines, cryopreservation, common cell culture contaminants. Culture of cells for production of various biological, Concepts of transgenic animal technology; strategies for the production of transgenic and knock out animals– significance in biotechnology - stem cell cultures in production of transgenic animals.

UNIT-IV: Stem Cells – Basics, Properties and Classification [12]

Types of Stem cells – Hematopoietic Stem Cells, Mesenchymal Stem Cells, Embryonic Stem Cells, Fetal Stem Cells, Stem cells from adult organs- Characteristics, Isolation, Culture and Characterization protocols Three-Dimensional Cell Culture, Organ Culture, Organotypic Culture. Extra Cellular Matrices Morphogenesis and Tissue Engineering.

UNIT-V: Tissue Engineering and Transplantation Techniques [14]

Immunoisolation Techniques, Modes of Cell and Tissue Delivery, Regeneration of Bone and Cartilage Islet Cell transplantation and Bioartificial Pancreas Bioprinting of Organs and Tissues ,Stem Cells in Gastrointestinal , Liver, Pancreas, Kidney, Heart, Spinal Cord and Lung Regeneration Stem Cells in Eye Diseases and Disorders

REFERENCE BOOKS:

1. I.M. Butley.Anaimal Cell Culture and Technology. Second edition, Taylor and Francis
2. Freshney RI. 2005. Culture of Animal Cells. Wiley Liss.
3. Portner R. 2007. Animal Cell Biotechnology. Humana Press.
4. R. Lanza, J. Gearhart et al (Eds), Essential of Stem Cell Biology. (2009), Elsevier Academic press.

5. R. Lanza and I. Klimanskaya, Essential Stem Cells Methods. (2009), Academic Press
6. J. J. Mao, G. Vunjak-Novakovic et al (Ed): Translational Approaches in Tissue Engineering & Regenerative Medicine 2008, Artech House, INC Publications.
7. Robert Lanza et al. Principles of Tissue Engineering, 3rd Edition. Academic Press; 3 edition (August 21, 2007)
8. Stein et al. Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual.Wiley-Blackwell; 1 edition (January 4, 2011)
9. Lanza et al. Handbook of Stem Cells, Two-Volume Set: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells (v. 1).Academic Press (September 28, 2004).

HCT 4.2: ADVANCED ANALYTICAL TECHNIQUES 4 Credits (60 L)

UNIT-I: Microscopy & Centrifugation [12]

Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope, confocal microscopy. Centrifugation: Small bench top centrifuges, large capacity refrigerated, centrifuges, High speed refrigerated centrifuges, preparative and analytical ultracentrifuge, Molecular weight determination.

UNIT-II: Chromatographic techniques [10]

Principles of chromatography, size exclusion, ion exchange and affinity chromatography. High performance liquid chromatography (HPLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography, GC-MS, LC-MS, Chromatofocussing.

UNIT-III: Electrophoresis [14]

General principles, factors affecting migrating rates, factors affecting migration of ions, support media, Techniques of electrophoresis: low and high voltage, capillary electrophoresis, electro osmotic flow techniques, instrumentation, zone electrophoresis and applications. Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose acetate electrophoresis, continuous flow electrophoresis; Detection, estimation and recovery of proteins, Western blotting. Electrophoresis of nucleic acids: agarose gel electrophoresis of DNA, DNA sequencing gels, Pulse field gel electrophoresis, electrophoresis of RNA, Capillary electrophoresis.

UNIT-IV: Electrochemical technique and Spectroscopy [14]

Principles of electrochemical techniques, redox reactions, pH electrode, ion-sensitive and gas sensitive electrodes, The Clark oxygen electrode, Biosensors. Spectroscopic techniques: Properties of electromagnetic radiation, interaction with matter. Gamma ray spectroscopy, X-ray spectroscopy, UV and Visible spectroscopy, Infrared and Raman spectroscopy, Electron spin resonance spectroscopy, Nuclear magnetic resonance spectroscopy, Circular dichorism spectroscopy, Atomic spectroscopy, MALDI Tof, Lasers, Spectro-fluorimetry, turbidometry and nephelometry, X-ray crystallography.

UNIT-V: Radio isotope techniques [10]

The nature of radioactivity, detection and measurement of radioactivity: detection based on gas ionization- Geiger Muller counter- principles and applications. Detection based on excitation Liquid Scintillation counter-principle and applications. Supply, storage and purity of radiolabelled compounds, specific activity, inherent advantages and restrictions of radio tracer experiments, safety aspects, applications- of radio isotopes in biological sciences.

REFERENCE BOOKS:

1. Keith Wilson and John Walker. Practical Biochemistry- principles and techniques; Cambridge University press, London, UK.
2. David T Plummer, Tata McGraw- Hill publishing company limited; McGrqw office, New Delhi.
3. C.R. Kothari, 2nd Edition, 2004. Research methodology- methods and techniques. New Age International (P) limited publishers, New Delhi.
4. Instrumental methods of chemical analysis - P.K. Sharma
5. Biophysical chemistry - Upadhyay. Upadhyay and Nath
6. A Biologist's guide to principle and techniques of practical biochemistry - Brigan L. Williams.
7. Handbook of Biomedical Instrumentation - R.S. Khandpur, Tata McGraw Hill.

HCT 4.3: RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHT (IPR)

4 Credits (60L)

UNIT-I: Research **[10]**

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

UNIT-II: Sampling Techniques & Parametric Tests **[14]**

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. Chisquare tests, ANOVA.

UNIT-III: Thesis and Manuscript writing **[14]**

Abstract, Introduction, Materials and Methods, Results and Discussion, Summary and Conclusion, References (IMRAD). Preparation of Manuscript; Author instructions, modes of paper communication, criteria for publication. Computer and internet application in Research. Presentation of a scientific Paper, Preparation of Oral Presentation and Poster Presentation for conferences. Use of Audio-Visual aids in Presentation.

UNIT-IV: Introduction to IPR and Patents **[12]**

Intellectual property, Protection of Intellectual property, World organizations, forms of protection-patent, copyright, trademark, geographical indications, trade secrets. Criteria and procedure of patenting, patenting biological material. Patent procedure in India. Types of patenting, Patenting of biological materials with examples and case studies.

UNIT-V: Plant breeder's right **[10]**

UPOV, Breeders exemption, Plant variety protection in India. Farmer's right, advantages and disadvantages of PBR**.** Technology transfer- Introduction, types of technology transfer and Indian scenario.

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.

SCT 4.1: MEDICAL BIOTECHNOLOGY AND BIO-NANOTECHNOLOGY

4 Credits (60L)

UNIT-I: Medical biotechnology [14]

Microbial Diseases: Normal microbial flora of human body, host-microbe interactions. Infection and infectious process, routes of transmission of microbes in the body. Epidemiology, description and pathology of human diseases caused by bacteria; *Staphylococcus, E.coli, Salmonella, Pseudomonas, Klebsiella, Vibrio cholera*, *Clostridium*, *Mycobacteria,* syphilis, Fungi: description and pathology of diseases Caused by *Aspergillus, Candida,.Micrococcosis,* Protozoa: Malaria and Ameobiosis. Viruses: pathogenesis of HSV, HIV.

UNIT-II: Laboratory diagnosis [10]

Laboratory diagnosis of common infective syndromes and parasitic, Molecular diagnosis of various diseases. Biosensors: Concept and development of biosensors- Historical perceptive. Market potential and limitations, new generations of biosensors, Biosensors in medical diagnostics. Industrial applications of biosensors.

UNIT-III: Chemotherapy [12]

Principles of chemotherapy, Mode of antibiotics: Penicillin, Streptomycin, Sulfonamides, and Polymyxins Antifungal drugs (Nystatin), Antiviral agents. Problems of drug resistance and drug sensitivity, Drug resistance in bacteria (MDR bacteria). InterferonInduction of interferon, types of inducers. Inactivation of viruses - Photodynamic inactivation. Vaccination for prevention of diseases, Application of phages in therapeutics.

UNIT IV: Bio-Nanotechnology [10]

Introduction to Nanoworld, Nanoscience and Nanotechnology - nanoparticles, Nanowires, Nanorods, Nanotubes, thin films and multilayer. Applications in nanotechnology viz. Biosensors, separation of cells and cell Organelles, environmental cleaning, drug delivery, gene therapy etc.

UNIT-V: Synthesis of nanostructures [14]

Natural in inorganic, Natural in organism, chemical and physical methods–Sol Process, Micelle, Chemical Precipitation, Hydrothermal Method, Pyrolysis, Bio-based Protocol, Chemical Vapor Deposition, Sputtering etc. Functionalization of nanoparticles for biological applications. Recent trends in Nanobiotechnology.

REFERENCE BOOKS:

1. Nanomedicine books series by Robert A. Freitas Jr. NanomedicineVolumeI: basic capabilities, Landes, Austin, Tx, 1999
2. Robert A. Freitas Jr., Nanomedicine, volume IIA: Biocompatibility Lands, Austin, Tx 2003.
3. C.Wei, Nanomedicine, An issue of medical Clinics, 91-5, Elsevier Saunders, 2007
4. D.E. Reisner, bionanotechnology: Global Prospects, CRC Press, Boca Raton, FL 2008.
5. William F.Ganong. Review of medical Physiology Text Book Volume-I Springer
6. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.

SCT 4.2: ADVANCED PHARMACOGNOSY

4 Credits (60 L)

UNIT-I: General Research Methodology **[10]**

Definition of research, meaning of research objective of research, types of research, Review of literature and sampling techniques.

UNIT-II: Herbal drug Industry **[12]**

Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Entrepreneurship Development. Project selection, project report, technical knowledge, plant design, layout and construction. Pilot plant scale–up techniques, case studies of herbal extracts. Formulation production management.

UNIT-III: Herbal drug regulatory affairs **[14]**

Basic principles of clinical studies, Stability, Safety and toxicology of herbal drugs. Adverse drug reaction in herbal drugs. Effect of herbal medicines on clinical laboratory testing. Regulation and dispensing of herbal drugs.

UNIT-IV: Information Retrieval systems of Herbal Drugs & Literature survey of following therapeutic groups **[10]**

Immunomodulators: Withaniasomnifera, Centellaasiatica, Embelicaofficinalis, Ocimum sanctum
Antipeptic ulcer: Glyceriza root, Azadirachtaindica,Gingiberofficinalis
Hepatoprotectives: Silibummarianum,Phyllanthusniruri,Picrorrhizakurroa, Andrographispaniculata
Anticancer :Taxus species, Camptotheca acuminate
Antifertility : Embelicaribes, Azadirachtaindica, Gossypium species
Nervine Tonic: Centellaasiatica, Acoruscalamus, Valerianawallichi
Anti-AIDS : Areca catechu, Theasinensis

UNIT-V:Volatile oils and Dyes **[10]**

Volatile oil of commercial significance. Review of Natural sweeteners: Dyes and Pigments, Preservatives.

REFERENCE BOOKS

1. Ayurvedic formulary of India, Govt.of India, 1962.
2. British Herbal Pharmacopoia, (vol. I, II & III) Her majestys Services, U.K.
3. Cultivation and Utilization of aromatic plants: Atal & Kapoor, RRL, Jammu
4. Cultivation and Utilization of medicinal plants: Atal & Kapoor, RRL, Jammu.
5. Drug and Cosmatic act, (with latest amendments including Ayurvedic GMP), Govt. of India.
6. Herbal Drug industry: R.D. Chudhary, Eastern Publishers, New Delhi 1996.
7. Introduction to spices, plantation crops, medicinal and aromatic plants: N.Kumar et al , Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi,1997.
8. Pharmacognosy: Trease W.C., Evans G.E. Bailliere and Tindall, Londan, 14th edtn.
9. Research in Education : John w. Best & James V. Kahn, Practice Hall of India Pvt. Ltd., New Delhi,1996.
10. Various journals related to medicinal plants.
11. Various journals related to spices, perfumes, food and nutrition.
12. Various Research Journals on Medicinal natural products.Wealth of India , CSIR, New Delhi (Related Volumes).

MP 4.1: PRACTICAL PAPER: PROJECT DISSERTATION AND VIVA VOCE
(200 Marks, Credits-8)

Students have to begin their projects in 3rd Semester and submit the report in 4th Semester.

Solapur University, Solapur

Nature of Theory Question Paper for CBCS Pattern
(CHOICE BASED CREDIT SYSTEM-CBCS)
Faculty of Science
M.Sc. Biotechnology

Time:- 3 hrs **Total Marks-70**

Note: 1) Section - I Compulsory
2) Answer any four questions from Section – II

SECTION - I

Q. 1 A) Multiple choice questions **(07)**

i) ----------

a) b) c) d)

ii)

iii)

iv)

v)

vi)

vii)

B) Define the following terms **(07)**

i)

ii)

iii)

iv)

v)

vi)

vii)

SECTION - II

Q. 2) Long answer type question **(14)**

Q. 3) Long answer type question **(14)**

Q. 4) Long answer type question **(14)**

Q. 5) Answer any *TWO* of the following **(14)**

i) Short answer type question

ii) Short answer type question

iii) Short answer type question

Q. 6) Write Short notes on any *TWO* of the following **(14)**

i) Short note

ii) Short note

iii) Short note

N. B. In Q.5 and 6 the sub-questions (i, ii, and iii) in a given question should be from different topics of the syllabus.