।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, मा. विद्याशाखेने **दिनांक ३१ मे २०२१ रोजीच्या बैठकीतील केलेल्या शिफारशीप्रमाणे व दिनांक १२ जून २०२१ रोजी संपन्न झालेल्या ५१ व्या मा. विद्या परिषद बैठकीतील विषय क्र. २६/५१–२०२१**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील तृतीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्यात येत आहेत.

1. B.Sc.-III Year-Biophysics
2. B.Sc.-III Year-Bioinformatics
3. B.Sc.-III Year-Biotechnology
4. B.Sc.-III Year-Biotechnology (Vocational)
5. B.Sc.-III Year-Botany
6. B.Sc.-III Year-Horticulture
7. B.Sc.-III Year-Agro Chemical Fertilizers
8. B.Sc.-III Year-Analytical Chemistry
9. B.Sc.-III Year-Biochemistry
10. B.Sc.-III Year-Chemistry
11. B.Sc.-III Year-Dyes & Drugs Chemistry
12. B.Sc.-III Year-Industrial Chemistry
13. B.C.A. (Bachelor of Computer Application)-III Year
14. B.I.T. (Bachelor of Information Technology)-III Year
15. B.Sc.-III Year-Computer Science
16. B.Sc.-III Year-Network Technology
17. B.Sc.-III Year-Computer Application (Optional)
18. B.Sc.-III Year-Computer Science (Optional)
19. B.Sc.-III Year-Information Technology (Optional)
20. B.Sc.-III Year-Software Engineering
21. B.Sc.-III Year-Dairy Science
22. B.Sc.-III Year-Electronics
23. B.Sc.-III Year-Environmental Science
24. B.Sc.-III Year-Fishery Science
25. B.Sc.-III Year-Geology
26. B. A./B.Sc.-III Year-Mathematics
27. B.Sc.-III Year-Microbiology
28. B.Sc.-III year Agricultural Microbiology
29. B.Sc.-III Year-Physics
30. B. A./B.Sc.-III Year Statistics
31. B.Sc.-III Year-Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदवी–सीबीसीएस अभ्यासक्रम/२०२१–२२/७५

दिनांक : १२.०७.२०२१.

स्वाक्षरित
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.
७) अधीक्षक, परिक्षा विभाग विज्ञान व तंत्रज्ञान विद्याशाखा प्रस्तुत विद्यापीठ.

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure

Faculty of Science and Technology

B.Sc. Third Year Fifth Semester Biotechnology Syllabus

Effective from June 2021

Semester	Code	Title of the Course	Hr/Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
V		Environmental Studies	4					
	CCBT-1E	r-DNA Technology	4	CC	4	75	25	100
	CCBT-2E	Developmental Biology	4	CC	4	75	25	100
	CCBT-3E	Bioprocess Technology	4	CC	4	75	25	100
	DSEBT-4E (Select any one)	I) Advanced Bioinformatics II) Medical Biotechnology	4	DSE	4	75	25	100
	Lab Course IX	Practicals based on CCBT 1E+ 2E	4	PR	4	100		100
	Lab Course X	Practicals based on CCBT3E+ DSEBT4E	4	PR	4	100		100
					24	500	100	600
Semester	**Code**	**Title of the Course**	**Hr/Week**	**Type of Course**	**Credit**	**Marks**		**Total**
						ESA	**CIA**	
VI	CCBT-1F	Pharmaceutical Biotechnology	4	CC	4	75	25	100
	CCBT-2F	Industrial Biotechnology	4	CC	4	75	25	100
	CCBT-3F	Environmental Biotechnology	4	CC	4	75	25	100
	DSEBT-4F (Select any one)	I) Agriculture Biotechnology II) Animal Biotechnology	4	DSE	4	75	25	100
	Lab Course XI	Practicals based on CCBT 1F+2F	3+3	PR	4	100		100
	Lab Course XII	Practicals based on CCBT 3F+4F	3+3	PR	4	100		100
	Lab Course XIII	Dissertation/ Project Work/Review writing	3	PR	2	50		50
					26	550	100	650

CC- Core Course, DSE- Discipline Specific Elective, AEC- Ability Enhancement Course, ESA- End Semester Assessment, CIA- Continuous Internal Assessment, PR- Practical, SEC-Skill Enhancement Course

Total credits (Sem I+ II+III+IV+V+VI) = 24+24+26+26+24+26= 150

CCBT-1E- r DNA technology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient features : This course will help to understand the concept of blotting and sequencing of biomolecules

Utility of course: This course will help to become skilled in DNA extraction, purification and quantification. Also understand the mechanism of transformation.

Learning objective: To improve the knowledge of genomic structure of microbes, techniques useful in recombinant DNA technology and application of genetic engineering.

Prerequisites: Basic knowledge about molecular biology and basic techniques in molecular biology.

UNIT-I: Principles of Gene cloning

Molecular Tools of Genetic Engineering: Restriction Endonucleases- Types & Properties, DNA Ligases, Alkaline phosphatase. Vectors: Plasmids (pBR322, pUC18/19), Bacteriophages (λ Phage, M 13 Phage), Cosmids, Artificial Chromosomes-BAC.Choice of Vector. Methods of Gene Transfer- vector based and direct transfer of DNA: Gene Cloning Strategies. Markers and reporter genes in gene cloning

UNIT -II: r- DNA Techniques.

Electrophoresis: Agarose Gel Electrophoresis, Blotting techniques: Southern , Northern , Western Blotting and applications. DNA Sequencing: Sanger's and Maxam Gilbert's Method, Automated DNA sequencing.

PCR: Mechanism, Types and Application. DNA chips (Micro array) principle & application.

UNIT-III: DNA Library

Library construction, screening and applications: Genomic library, cDNA library. Nucleic Acid Probe, Chemical Synthesis of DNA, Autoradiography of DNA.

Screening of library-Probe based direct and indirect methods.

UNIT - IV: Applications of r-DNA technology

Agricultural applications i) BT-Cotton, ii) Transgenic maize, iii) Golden rice etc.

Protein engineering: to improve properties of proteins and enzymes.

Pharmaceutical Applications : i) Recombinant hormones ii) Vaccines iii) Blood Clotting factors v) Tissue Plasminogen Activator vi) Erythropoietin v) Human growth hormone. Concept of Gene Therapy

Text & References:

1. Principles of Gene Manipulation and Cloning - Old & Primrose-Black well Science
2. From Genes to Clones- Winnacker- Panima
3. Molecular Biotechnology –Glick-ASM
4. ABC of Gene cloing- Wong-Springer
5. Genomes 3 - T.A.Brown-Garland Science
6. Gene cloning and DNA Analysis- T.A. Brown- Wiley- Blackwell
7. Text book of Biotechnology – U Satyanarayan –Book & Allied
8. Jogdand S.N- Gene Biotechnology-Himalaya
9. Joshi P (2002) - Genetic Engineering and its applications, Agrobios Pub
10. MitraSandhya (2006) - Genetic Engineering, MacMillan India

Practical:

1. Isolation of Genomic DNA from Plant, Animal, Bacteria 2. Isolation of Plasmid DNA
3. Isolation of Phage DNA
4. Electrophoresis of DNA
5. Restriction digestion of DNA
6. Ligation of DNA
7. Preparation of Competent Cells & Cell Transformation
8. GFP gene cloning
9. Blotting Techniques- Southern, Western
10. Principle and study of PCR based experiments
11. Experiments based on molecular markers RAPD, RFLP and SNP etc
12. Visit to Molecular Biology & Genetic Engineering Research Laboratory/ Company

CCBT-2E – Developmental Biology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient features : This course covers the concept of embryology & development.

Utility of course : To learn & enhance skills about cloning & test tube baby.

Learning objectives : To provide an understanding of basics of gametogenesis, fertilization, stem cells, cloning & embryogenesis and developmental biology aspects in plants & animals.

Prerequisites: Basic knowledge about plant gametogenesis & fertilization, basic embryogenesis.

Unit -I: Animal Development

Development: Concept of Gametogenesis and Fertilization Types and patterns of cleavage, Blastulation, Gastrulation, Neurulation, Organogenesis and Growth in frog and chick. Concepts of competence, determination, commitment and differentiation, dedifferentiation, redifferentiation, transdifferentiation.

Unit-II: Animal Development & Stem Cell

Role of gene/s in patterning and development in drosophila Concept of Stem cells stem cell technology , Progenitor cells, cell lineages in plants and animals. Ageing and apoptosis, abnormal development and teratogenesis in plants and animals: Cancer biology

Unit -III: Plant Development

Seedling development: Photomorphogenesis, Mertistem structure and activity, Organ development: shoot and root patterning, floral patterning in Arabidopsis.

Unit –IV :Methods in Development Biology

Developmental plasticity in plant and animal development. Embryo culture and preservation, sperm bank, Cloning in mammals: Dolly and other mammals.*in vitro* fertilization, concept of test tube baby. Transgenic technology and applications in plants and animals: Conservation, Hybrids and GMOs.

Text & Reference:

1. An Introduction to Embryology - B.I. Balinsky
2. Development Biology - S.F. Gillbert- Sinauer Associates
3. Developmental Biology-Shastri and Shukla- Rastogi Publication
4. Developmental Genetics- G.S. Miglani- IK International
5. Chordate Embryology- Varma and Agarwar- S.Chand
6. Chordate Zoology- Jordan Varma- S.Chand
7. Plant Anatomy- B.P. Pande- S.Chand
8. Text book of Angiosperms- B.P. Pande- S.Chand
9. Developmental Biology - S.C. Goel
10. Developmental Biology – Wolpert
11. Embryology of Angiosperms – S.S. Bhojwani and S.P. Bhatnagar
12. An Introduction to Plant Cell Development – J. Burgess

Practicals:

1. Study of different types of animal eggs
2. Study of staging & staining of Chick embryos
3. Study of frog development, observation of frog embryo different development stages
4. Study of different types of sperms by smear preparation.
5. Frequency of genetic traits in human
6. Study of Sex-linked inheritance, Multipleallelism
7. Study of plant development and role of hormones in plant development 8. Development of male and female gametophytes
9. Developmental stages during plant Embryogenesis
10. Analysis of histochemical changes during transition of vegetative shoot to reproductive apex
11. Histochemical analysis of the activity of cambium
12. Visit to Sperm bank/ IVF centre

CCBT- 3E- Bioprocess Technology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient features : This course will help to improve the knowledge concerning the intrinsic behavior of cells and life sciences.

Utility of course : Skill enhancement in sterilization to get knowledge of upstream development.

Learning objectives :To improve the student with various designs of fermenter and related principles.

Prerequisites : basics of fermentation microbial processes knowledge and the basics of microbial growth

UNIT-I: Introduction to Concepts of Bioprocess engineering:

Definition of Bioprocesses engineering. Fermenters, Bioreactors: Construction, Design & Operation, Materials of Constructions, Welding, Surface treatment Components of the fermenters & their specifications

UNIT-II : Air & Media sterilization :

Air Sterilization Principles, Mechanisms of capture of particles in Air, Depth & Screen Filters, Sizing, Testing & validation of filters for air Principles of Media Sterilization, Decimal reduction, Design of sterilization cycle using kinetics of thermal death of microbes, Equipments used in sterilization.

Design of media: Constituents of media, their estimation & quantification, Media for large-scale processes& their optimization. Costing of media

UNIT-III : Types of Bioprocesses : Bioproducts and classification of bioproducts, Microbial Growth Kinetics: Batch, Fed-batch, continuous. Measurement & Control of Bioprocesses Parameters: Cell growth. pH, temperature, Substrate consumption, product formation, Measurement of O2/CO2 uptake. Strategies for fermentation control.

UNIT-IV : Scale up in Bioprocesses

Computer controlled fermentations, Foam & its control. Oxygen uptake rate (OUR), Viscosity & its control. Scale up in Bioprocesses fermentations, Factors used in scale up. Quality Control, Quality assurance, Standard Operating Procedures (SOP) & Good, Manufacturing Practices (GMP).

Text & References:

1. Principles of Fermentation Technology - Whittaker & Stanberry- Elsevier
2. Bioprocess Engineering Principles - Pauline Doran- Elsevier
3. Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann
4. Bioreactor Design & Product Yield, BIOTOL series - Elsevier
5. Bioprocess Engineering: Systems, Equipment & Facilities - Ed. B. Lydersen, Delia &. Nelson, John Wiley
6. Bioprocess Engineering- Shuller&Kargi -Pearson Education
7. Process Biotechnology Fundamentals-Mukopadhaya- Viva
8. Biochemical Engineering- Bailey & Bhatia- CBS
9. Biochemical Engineering Fundamentals- Bailey, Ollis- McGraHill
10. Fermentation and Biochemical Engineering Hand book-Vogel, Todaro-Strand Publisher

Practical:

1. Isolation and Screening of Industrially important Microbes-Acid, Antibiotics, Enzymes
2. Study of Strain improvement
3. Sterilization Techniques- Media, Air
4. Maintenance of pure Culture
5. Study of Growth Curve of Bacteria, Fungi
6. Growth kinetics: Effect of pH & Temp
7. Media Formulation
8. Sterilizer Design- TDP, TDT
9. Cell and Enzyme immobilization
10. Visit to Fermentation Industry

DSEBT – 4E-- I) Advanced Bioinformatics

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient features : This course covers the study of basic tools used in bioinformatics.

Utility of course : Students become expert in proteins & genes sequence databases & prediction of protein structure.

Learning objectives : To give knowledge of sequence alignment, to study the genomic & structural bioinformatics prerequisites.

Prerequisites: Basic concept of molecular biology, genetic engineering, biochemistry, basic fundamental knowledge about computer.

UNIT I - History, Scope And Importance

Various definitions of Bioinformatics. Applications of Bioinformatics - challenges and opportunities. Internet basics- HTML,URLs, Role of internet and www in Bioinformatics. Advanced fields in bioinformatics (Genomics, Proteomics, Metabolomics). Human Genome Project: Aims, goals and achievements.

Unit II - Sequence Alignments And Visualization

Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm). Methods for presenting large quantities of biological data: 3D structure viewers (Rasmol, Cn3D, PyMol)

Unit III- Databases in Bioinformatics

Biological databases: Primary databases – GenBank, DDBJ, EMBL. Protein sequence databases – Swissprot, Uniprot. Structural databases – PDB, PubChem. Bibliographic databases:- Pubmed, PloS.

Unit VI - Structural Bioinformatics

Protein secondary structure classification databases. Protein secondary structure prediction methods. Motif and Domain. Protein Tertiary structure prediction methods. Molecular Docking of Protein

TEXT BOOKS

1. Baxevanis, A.D. and Francis Ouellellette, B.F. (1998) "Bioinformatics– a practical guide to the analysis of genes and proteins" John Wiley and Sons
2. Mount, D. (2004) "Bioinformatics: Sequence and Genome Analysis"; Cold Spring Harbor Laboratory Press, New York. (ISBN 0-87969-712-1)
3. Sharma, V. Munjal, A. and Shankar, A. (2008) "A text book of Bioinformatics" first edition, Rastogi Publication, Meerut – India.
4. Bergman N. H. (2007),"Comparative genomics" Volume 2, Humana Press
5. Cantor C.R., Smith C.L., (1993) "Genomics: the science and technology behind the Human Genome Project" John Wiley and Sons

REFERENCES

1. Choudhuri S., Carlson D. B. (2008), "Genomics: fundamentals and applications" Informa Healthcare
2. Clark M (2000), "Comparative genomics" Springer
3. T.A. Brown, "Genome", John Wiley & sons, 2006
4. Primrose S. B., Twyman R. M. (2004), "Genomics: applications in human biology" Wiley-Blackwell
5. Primrose S. B., Twyman R. M. (2006), "Principles of gene manipulation and genomics" Wiley- Blackwell
6. David W. Mount, "Bioinformatics: Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press, I edition, 2001.

Practical's List:

1. Knowledge of different biological database

2. Different file formats –Genbank, Genpept, FASTA, EMBL, NBRF/PIR, , PDB file format.
3. Protein and gene sequence data bases (NCBI, DDBJ, EMBL, SWISS PROT, PIR)
4. Prediction of primary, secondary and 3D structure of proteins.
5. Visualization of tertiary structure of proteins
6. Accessing existing databases on www – Artemis
7. Sequence alignment
8. Homology search tools like BLAST and modeller.
9. Genomics- Genome databases, Annotation of genome, Perdition of ORFs
10. Gene prediction GENSCAN and GeneMark.
11. Molecular Docking

DSEBT – 4E-- II) Medical Biotechnology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient features: Syllabus covers all important aspects of medical science including Immunization and antibody based diagnosis.

Outcome : Will prepare students to understand the role of different immunization techniques of diseases. It will also help students to learn the application of biotechnology in drugs discovery.

Learning Objectives : To improve the knowledge on medical techniques used to identify the diseases. To enables the students to understand the role of antigen antibody reactions and role of carcinogenic agents

Prerequisites : Technical understanding of Microbiology, immunology and basics of cancer is required to learn this subject.

Unit I

Immunization, live, killed, attenuated, Sub unit vaccines; Recombinant DNA and protein based vaccines, plant-based vaccines and reverse vaccinology; Peptide vaccines, conjugate vaccines; Passive Immunization; Antibody, Transfusion of immuno-competent cells, Stem cell therapy; Cell based vaccines.

Unit II

Antibody based diagnosis; Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis; Diagnosis of bacterial, viral and parasitic diseases by using; ELISA and Western blot.

Unit III

Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Concept of tissue engineering; Role of scaffolds; Role of growth factors; Role of adult and embryonic stem cells; Clinical applications; Ethical issues.

Unit IV

Oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

Primary immunodeficiency (SCID, X-linked agammaglobulinemia, Defects in complement system), Secondary immunodeficiency (AIDS)

Reference Books

1. Kuby Immunology- Goldsby, Kindt, Osborne.-W,H Freeman
2. Cellular & Molecular Immunology- Abbas, Lichtman, Pillai.-Elsevier publications.
3. Roitt‟s Essential Immunology- Deives, Martin, Burton, Roitt-Blackwell publications.
4. Cellular interactions &Immunobiology- Butterwort & Heinemann.
5. Review of Medical Microbiology & Immunology- Warren Levinson.-McGraw Hill
6. David Sadava; Cell and Molecular biology- Jones & Bartlett Publishers
7. Cell & molecular biology - Gerald karp :John Wills
8. Developmental biology- SF Gilbert Sinauer associates.
9. T.A. Brown – Genomes – Garland Science

Practicals

1) SDS PAGE 2) 2D Gel electrophoresis capillary,
3) ELISA, Immunoblotting
4) Study of Ag-Ab reactions Widal, VDRL
5) Immuno electrophoresis and Rocket immuno electrophoresis
6) Latex agglutination
7) ELISA, Western Blotting

CCBT-1F Pharmaceutical Biotechnology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient features : syllabus course all important aspects of pharmaceutical science. Multidimention syllabus having chapters from tradition to modern pharmaceutical industry.

Outcome : Will prepare students to understand the role of different herbal and chemical pharma products in cure of diseases. It will also help students to learn the application of computational approaches in drug discovery.

Objectives: To enables the students to understand the role of various pharmaceutical product in cure and presentation of human diseases and to provide knowledge of drug discovery and designing.

Prerequisites: Technical understanding of Microbiology, Molecular Biology, Bio-informatics is required to learn this subject.

UNIT -I : Secondary Metabolites.

Introduction to Secondary Metabolites.Types and Medicinal Applications of Secondary metabolites.

Production of Secondary metabolites in Plants Through hairy Root Culture.Factors affecting Secondary metabolite production (Precursors, Growth Factors and Nutrients)

UNIT-II : Chemotherapy

Types of Antibiotics: Classification of antibiotics with example. General characteristics of an

Antimicrobial Drug. Mechanism of action of antimicrobial agent (General account).

Microbial Resistance to antibiotics and antimicrobial agents (Types and Mechanism).

Application of antibiotics in various fields.

Assaying antimicrobial activity: Principle and Methods of microbial assay (MIC and Different types of agar diffusion.)

UNIT-III: Chemotherapeutics Agents

Structure, Mechanism of Action and Applications of Antibacterial drug: Sulfonamides, Quinolones. Antiviral drug: Amantadine, Azidothymidine. Antifungal drug: Nystatin, Griseofulvin. Mechanism of action of Anticancer drugs, Antidiabetic drugs and Antihypertensive drugs

UNIT IV: Protein Engineering and Drug Discovery

Protein engineering: Principles and Application.

Discovery and Development: History, drug targeting, Molecular Biology and Combinatorial drug

discovery, Rational Drug designing. Concept of Pharmacokinetics, Pharmacodynamics. Drug delivery systems, Liposomes. Introduction to Indian and International Pharmacopoeia.Chemoinformatics

Text &References :

1. Gupta P.K. - Biotechnology and Genomics, Rastogi Publication.
2. Hugo W. B. and Russell A. D. - Pharmaceutical Microbiology -Wiley India 3. FSK Barar- Pharmaceutical- Essentials of Pharmaceuticals- S.Chand
4. S.P. Vyas, Dixit- Pharmaceutical Biotechnology-CBS
5. B.Razdan-Medicinal Chemistry-CBS
6. Satoskar, Bhandarkar- Pharmacology and Pharmacotherapeutics- Popular
7. Purohit, Saluja- Pharmaceutical Biotechnology-Student Edition
8. M. Doble- Drug Designing-McGraw Hill
9. Ed. R.H. Thomson-Chemistry of Natural Products-Springer
10. AshutoshKar-Pharmacology and Pharmacobiotechnology-New Age
11. Jogdand S.N - Biopharmaceuticals, Himalaya Publishing
12. Ramawat K.G; Merillon J.M - Biotechnology: Secondary Metabolites-Oxford

Practical:

1. Assay of antimicrobial activity of Penicillin, Chloramphenicol, streptomycin and Quinolones
2. Determination of Minimum Inhibitory Concentration (MIC) of Antibiotic
3. Determination of shelf life of antibiotics (Expired drugs)
4. Bioassay of antifungal compounds
5. Testing of antibiotic resistance
6. Sterility testing of commercial pharmaceuticals.
7. Sterility testing of injectable as per IP.
8. Effect of chemical disinfectant on growth of bacteria
9. Study of microbial spoilage of pharmaceuticals.
10. Visit to Pharmaceutical industry

CCBT-2F Industrial Biotechnology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient features : the course covers the knowledge of microbial processes and product formation

Utility of Course : To enhance production techniques and to get knowledge of downstream processing and optimization.

Learning objectives : To provide knowledge of many procedures in industries, role of microorganisms in industries and techniques used to improve product formation in industries.

Prerequisites : Should known basic design of fermenter, knowledge about quality control and quality assurance.

UNIT- I : Strain Improvement

Selection of Mutants producing improved level of Primary Metabolites with suitable Example. Isolation of mutants which do not produce feedback inhibitors or repressors. Mutants that do not recognize presence of inhibitors or repressors. Modification of Permeability.

UNIT - II : Down Stream Processing.

Removal and Recovery of cell mass (Precipitation, Filtration and Centrifugation)

Cell disruption- Physical and Chemical methods. Purification of Product Liquid-liquid extraction : Solvent Recovery.Chromatography : Adsorption, Ion-exchange, HPLC

Membrane processes: Ultrafiltration and Reverse Osmosis. Drying and Crystallization.

UNIT -III : Fermentation Processes.

Fermentation processes: Microorganisms involved, Inoculum preparation, Medium used and product Recovery. Enzyme: Protease, pectinase. Organic acid: Citric acid. Antibiotic: Penicillin, erythromycin. Vitamin: Vitamin B12, vitamin B2.

UNIT- IV : Quality Control, Process Economics and GLP.

Sterility testing.Pyrogen testing.Carcinogenicity testing.Toxicity testing.

Fermentation Economics: Cost Estimates ,Process Design ,Capital Cost Estimates, Operating Cost Estimates.Concept of QC, QA, Good Laboratory Practices, GMP.

Text &References :

1. Casida L.E - Industrial Microbiology- New Age
2. Crueger W and Crueger A - Biotechnology: A Textbook of Industrial Microbiology-Panima Publishing
3. Patel A.H. - Industrial Microbiology, Macmillan India
4. Peppler H.J and Perlman D - Microbial Technology, Vol I and II-Elsevier
5. Stanbury P.F., Whitaker A. and Hall S.J - Principles of Fermentation Technology-Elsevier
6. Prescott and Dunn‟s- Industrial Microbiology-CBS
7. Ed. G. Subramaniam- Bioseparation& Bioprocessing - Wiley –VCH
8. Product Recovery in Bioprocess Technology, „BIOTOL series, Butter worth Heinemann 1992
9. Paul A. Belter, Cussler- Bioseparation :Downstraem Processing for Biotechnology - Academic Press
10. LarlSchuger-Solvent Extraction in Biotechnology - Spinger
11. Roger Harrison-Bioseparation Science & Engineering-Oxford
12. N.K. Prasad-Downstream Process Technology-PHI

Practical:

1. Isolation and Screening of Industrially important Microbes-Acid, Antibiotics, Enzymes
2. Isolation & identification of bacteria from different milk & water samples.
3. Fermentative production purification and estimation of antibiotics/ vitamins
4. Fermentative production purification and estimation of Citric Acid
5. Fermentative production purification and Estimation of alcohol. Using *Sacharomycescerevisiae*
6. Estimation of fermentative product (Acetic acid from vinegar).
7. Qualitative estimations of fermentation products by analytical instruments
8. Wine production & estimation of alcohol
9. Production of cheese using different substrate fro microorganism.
10. Study of fermentation economics with any one example
11. Visit to Fermentation Industry

CCBT-3F Environmental Biotechnology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient Features: Syllabus focus on current needs of environmental sector. Details of important commercial agro products are nicely illustrated in syllabus. Provides information of important microbes for cleaning the environment.

Outcome: Will prepare students to understand the problems of environments and they can tackle environmental problems using recent Biotechnological advances.

Objectives: To understand aspects of environmental science and techniques implemented to solve environmental problems.

Prerequisites: Technical understanding of environment and its components is prerequisite to student to learn this syllabus.

UNIT- I : Waste Water Treatment.

Domestic (Municipal) and Industrial Waste Water Treatments: Primary, Secondary and Tertiary. Important microorganisms in waste water treatment, Principles of their growth and Plasmid Borne Metabolic Activities. Aerobic Biological Treatments: Activated sludge process Rotating Biological Contactors. Anaerobic Biological Treatments: Air Lift Membrane Bioreactors Packed Bed (Column Reactor.)

UNIT- II : Biodegradation techniques

Biodegradation: Definition and Concept, Aerobic and Anaerobic degradation pathways in Microbes. Biodegradation of Hydrocarbon with Suitable Example. Concept of Municipal Solid Waste management

UNIT -III : Bioremediation

Introduction, Definition and Concept, Methods of Bioremediation (*in situ* and *ex situ* Methods) Bioremediation of Soil (Saline Soil and Alkaline Soil) Phytoremedation: Concept and Types. Applications of Bioremediation.

UNIT –IV: Xenobiotics

Xenobiotics and Recalcitrancy.Xenobiotics Degradation: Pesticide Degradation (Principle with suitable example) Herbicide Degradation (Principle with suitable example) Metabolism of Xenobiotics: Cytochrome P450 System, Phase I, Phase II, Metabolic reactions

Text &References :

1. Asthana D.K. and Asthana M.,-Environment : Problems and Solutions- S. Chand
2. Chatterji A.K., Introduction to Environmental Biotechnology, Prentice Hall of India Pvt. Ltd
3. Jogdand S.N.- Environmental Biotechnology- Himalaya Publishing House
4. Kalaichelvan P.T., I Arul Pandi- Bioprocess Technology, MJP Publishers
5. Murugesan A. G.andRajakumari C-Environmental Science and Biotechnology: Theory &Techniques, MJP
6. Rajendran, Gunashekaran- Microbial Bioremediation-MJP
7. Hammer & Hammer-Water & Waste water Technology-PHI
8. Metcaf& Eddy-Waste water Engineering-TMH
9. Indushekhar Thakur- Environmental Biotechnology-I K International
10. P. Mohapatra-Text book of Environmental Biotechnology-I K International 11. Rittmann B. E. And McCarty P. L.- Environmental Biotechnology Principles & Applications, McGraw Hill

Practicals

1. Determination of Dissolved Oxygen and Biological Oxygen Demand of polluted water.
2. Determination of Chemical Oxygen Demand of polluted water.
3. Bacterial Examination of Water by MPN Test: Presumptive and Confirmed Coliform test.
4. Determination of soil pH and Total organic carbon.
5. Determination of Total Carbohydrates and Phosphorus of soil.
6. NPK determination of soil samples
7. Determination of Alkalinity and Hardness of water.
8. Demonstration of Total Nitrogen estimation by Kjeldahl‟s Method.
9. Biodegradation of polymer compounds
10. Biodegradation of textile dyes
11. Visit to STP, MSW treatment/ Industrial effluent treatment plants

DSEBT-4F I) Agriculture Biotechnology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient Features: Syllabus focus on current needs of agriculture sector. Details of important commercial agro products are nicely illustrated in syllabus. Provides information of important crop diseases of India.

Utility of course : Will prepare students to understand the problems of farmers and them to tackle them with recent Biotechnological advances.

Learning bjectives : To enables students to understand the role of Biotechnology in the field of agriculture and allied industry.

Prerequisites : Technical understanding of microbial culturing plant tissue culture is prerequisite to student to learn this syllabus.

UNIT- I: Nitrogen Fixation and Phytoharmones.

Symbiotic N2 fixation - Legume, Rhizobium symbiosis, Host specificity, Infection, Nodule Development, Mechanism of N2 Fixation.Non Symbiotic N2 Fixation - Diazotrophy, Sites of N2 Fixation, Nitrogenase Complex, Cyanobacteria, Azotobacter, Azospirillum.Phytoharmones- Definition, Classification, Physiological Effects, Functions of Auxin, Cytokinin,Gibberellins.Assimilation of Sulphur and Phosphorus in Plants.

UNIT- II :Biofertilizers

Concept and Types of Biofertilizer. Microbial Inoculums - Rhizobium Inoculant, Blue-Green algae, Azotobacter, Sulphur and Phosphate Solubilizing Biofertilizer.Applications of Biofertilizer.

UNIT- III:Plant Pathology

Concept of Plant Pathology. Host Pathogen Relationship. Pathogenesis mechanism- Enzymes, Toxins, Nutrition etc.Mechanism of Plant defense, resistance to disease.Classification of Plant Diseases based on Symptoms. Plant Diseases: Causative agent, Symptoms,Mechanism of Action and Control Measures (Chemical and Biological).i) Bacterial Blight of Cotton ii)Whip Smut of Sugar Cane, iii) Powdery Mildew of Wheat.iv) Citrus Canker of Lemon.

UNIT- IV :Agro-Biotechnology

Bio-pesticides- Definition and Types (Microbial and Botanical) Advantages of Biopesticides over chemical pesticides. Biomass : Composition , Types, Biomass as a energy Source, Biomass conversion and Utilization.Single Cell Protein and its Nutritive Value eg.Spirulina. Mushroom production.

Text &References :

1. Bilgrami K.S and Dube H.G.- Textbook of Modern Plant Pathology, Vikas
2.Gupta P.K. - Genetics and Biotechnology in Crop Improvement, Rastogi Publications
3.Pathak V.N, Khatri N.K.,Pathak M. - Fundamentals of Plant Pathology, Agrobotanical Publications,
4. R.C. Dubey – Text book of Biotechnology-S.Chand publications.
5. SubbaRao- Soil Microbiology- Oxford IBH
6. Melhotra and Agarwal- Plant Pathology- TataMcGraw Hill
7.VyasS..,and Modi H.A.(1998) - Biofertilizer and Organic Farming, AktaPrakashan
8. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, New age
9. Lehninger-Biochemistry- Kalyani
10. Schmauder Hans Peter (1997) - Methods in Biotechnology, Taylor and Francis, London.

Practical:

1. Isolation of *Rhizobium* sp.from root nodule of leguminous plant.
2. Isolation & Study of non symbiotic nitrogen fixing organims
3. Isolation and study of PSBs.
4. Estimation of leg haemoglobin from root nodule of leguminous plant.
5. Determination of IAA Oxidase activity.
6. Cultivation and study of Spirulina algae, Mushrooms
7. Isolation & identification of plant pathogen (*Xanthomonas)* from infected citrus fruit /leaf.
8. Study of Bio pesticides: *Trichoderma*
9. Study of community by quadrate method (Frequency, Density and Abundance of Species)
10. Visit to Cell Culture Facilities /Production /Biofertilizer Industry.

DSEBT-4F II) Animal Biotechnology

Maximum Marks : 75 **Hours : 45** **Credits: 4**

Salient Features: Syllabus focus on current needs of Animal biotechnology sector
Outcome of course: To enhance production techniques and to get knowledge of animal cell handling, culturing of advanced techniques in animal biotechnology
Learning objectives: The objective of this course is to apply fundamental principles and concepts of animal cell and its culture systems
Prerequisites: Technical understanding of animal cell and animal cell culturing is prerequisite to student to learn this syllabus

UNIT- I Animal Cell Culture

Equipments and Materials for animal Cell Culture Technology, Design of Tissue Culture Laboratory Equipments: Laminar Flow Hoods, CO2 incubator, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous small items of Equipments, Materials, filters, Miscellaneous Items. Basic Aseptic Techniques .Cells and tissue types: Behavior of cells in culture: Primary cell lines permanent/Established cell lines/Transformed cell lines.

UNIT- II Animal Cell Culture

Physical requirements and Nutritional Requirements of Cells and growth media. Natural media: Basal salt solution (BSS)-Various types, Minimum Essential Medium(MEM), Serum dependent and Serum independent defined media – Cell specific media, pH, CO2, O2 tension Ascorbic acid, sugars etc.
Basic Techniques of mammalian cell culture: Primary Cell culture – Isolation and separation of cells, viable cell count, maintenance of cell culture, maintenance of stock culture, Types of cell cultures – Monolayer, Suspension and Embryonic

UNIT- III Animal Cell Culture

Cell synchronization. Cryopreservation. Biology and characterization of cultured cells: tissue typing; cell-cell interaction; Scale up, measuring parameters of growth; measurement of cell death; Apoptosis and its determination; cytotoxicity assays

UNIT- IV Molecular techniques in cell culture
Cell transformation; physical, chemical and biological methods; Viral gene delivery systems: hybridoma technology and its applications; cell fusion methods; vaccine production; gene therapy. Application of animal cell culture - Engineered cell culture as source of valuable products and protein production

Text & References

1. Animal cell culture; A practical approach, - Freshney. R.I.- John Wiley publication.
2. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford
3. Exploring genetic mechanism; Ed. Maxine Singer and Paul Berg.
4. Principles of genetic manipulation; - Old and Primrose- Blackwell science
5. Biotechnological innovations in Animal productivity- BIOTOL – Elsevier
6. An introduction to embryology. WB Sounders company, Philadelphia, Balinsky. BI,
7. Arora M.P.- Biotechnology-Himalaya Publishing.
8. Gangal Sudha- Principles and Practice of Animal Tissue Culture-Universities

9. Animal Cell Culture – John Masters- Oxford University Press
10. In Vitro Cultivation of Animal cells- Butterworth- Heinemann, BIOTOL, Elsevier
11. Developmental biology- SF Gilbert -Sinauer associates.

Practicals

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of reagents and media for cell culture.
3. Primary culture technique for chicken embryo fibroblast.
4. Secondary culture of chicken embryo fibroblast.
5. Cultivation of continuous cell lines.
6. Quantification of cells by trypan blue exclusion dye.
7. Isolation of lymphocytes and cultivation of lymphocytes
8. Study of effect of toxic chemicals on cultured mammalian cells