Shivaji University, Kolhapur

Choice Based Credit System with Multiple Entry andMultiple Exit Options as per CBCS-NEP-2020

Bachelor of Science (B. Sc. Part-III) Biotechnology (Entire) Programme Structure

Under Faculty of Science & Technology

(To be implemented from Academic Year 2024-25)

INDEX

Shivaji University, Kolhapur
Syllabus For Bachelor of Science Part–III: Biotechnology (Entire)
Choice Based Credit System with Multiple Entry and Multiple Exit Options

as per CBCS-NEP-2020

(Revised Syllabus will be implemented from June, 2024 onwards.)

1. Preamble :

This syllabus is so designed to give a sound basis to the undergraduate students of B.Sc. Biotechnology (Entire).

It is known that Biotechnology is no doubt a youngest branch of life science but it is a very important interdisciplinary subject, where in subjects of Plant science, Animal science, Microbiology, Physics, Chemistry and other sciences are blended in such a way that the students are prepared with basic knowledge of Molecular biology, Biochemistry, Biophysics, Genetic engineering, Bioinformatics, Environmental sciences, Plant and Animal cell culture etc. and their technological applications.

Such students having multidisciplinary knowledge are in tremendous demand in industries, education and fundamental research, as trainee workforce. The career opportunities of these students are very wide in different sectors dealing with life sciences.

2. Duration: Four Year Full Time Course with 8 semesters.

3. Eligibility:

- 12^{th} Science pass

4. Medium of Instruction: English

5. Programme Structure

Choice Based Credit System (CBCS) with Multiple Entry and Multiple Exit (MEME) Options as per NEP-2020
To be implemented from the Academic Year 2024-25
Third Year Bachelor of Science Biotechnology (Entire) (Level-5)
Programme Structure (NEP-2020 PATTERN)

R. B.Sc. 3:(A) (i) Structure of B.Sc. Programme (Semester V & VI)

SEMESTER–V (Duration–6Months)																	
Sr. No.	Subject Title	TEACHING SCHEME						EXAMINATION SCHEME									
		THEORY			PRACTICAL			THEORY					PRACTICAL				
								Internal		University							
		Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Max Marks	Min Marks	Hours	Max Marks	Min Marks	Hours	Max Marks	Min Marks
1	DSE-E	2	3	2.4	8	20	16	10	4	2	40	14	PRACTICAL EXAMINATION IS ANNUAL		
2	DSE-E	2	3	2.4				10	4	2	40	14			
3	DSE-E	2	3	2.4				10	4	2	40	14			
4	DSE-E	2	3	2.4				10	4	2	40	14			
5	AECC-E	4	4	3.2				10	4	2	40	14			
6	SEC-V	Any one from pool of courses			2	---	---	---	---				2	50	18
	TOTAL	12	16	12.8	10	20	16	50			200				
SEMESTER–VI (Duration–6 Months)															
1	DSE-F	2	3	2.4	8	20	16	10	4	2	40	14	As per BOS Guide-Lines	200	70
2	DSE-F	2	3	2.4				10	4	2	40	14			
3	DSE-F	2	3	2.4				10	4	2	40	14			
4	DSE-F	2	3	2.4				10	4	2	40	14			
5	AECC-E	4	4	3.2				10	4	2	40	14			
6	SEC-VI	Any one from pool of courses			2	---	---						2	50	18
	TOTAL	12		12.8	10		16	50			200				
	GRAND TOTAL	24	32	25.6	20	40	32			400	800				

6. Program Outcomes (POs)

1. **Domain Specific knowledge:** Apply the knowledge of Chemistry, Biochemistry, Microbiology, Plant science, Animal science, Cell biology, Genetics, Immunology, Molecular biology, Metabolic pathways, Enzymology, Plant and Animal Biotechnology, Ecology, Environmental Biotechnology, rDNA Technology, Industrial biotechnology, Medical Biotechnology, Bioinformatics, Nanotechnology, Biostatistics and Computer science to provide the solution to the Scientific and Technological and Social problems as well.
2. **Problem analysis:** Identification and formulation of the problems. Data analysis and Interpretation of the results with basic principles.
3. **Design/Development of solutions:** Design solutions for Scientific and Technological and Social problems of various disciplines that significantly realize domestic, agricultural, medical, pharmaceutical, industrial, societal, environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Making use of sophisticated tools, Sophisticated Instruments, Modern methodology, Microscopy, Chromatography, Spectroscopy, Electrophoresis, Thermal Cycler, Gel documentation, DNA Sequencer, Nanotechnology.
6. **The Science and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, industrial, agricultural issues.
7. **Environment and sustainability:** Application of the knowledge to ensure environmental sustainability
8. **Ethics:** Apply ethical principles in scientific Practices
9. **Individual and team work:** Function effectively as an Individual and as a Member or Leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on Scientific and Technological and problems with society at large. This includes ability to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions to realize outreach to the society.
11. **Life-long learning:** Recognize the need of study and ability to engage in independent and life-long learning in the broadest context of scientific change.
12. **Project management and finance:** Demonstrate knowledge and understanding of the Scientific, Technological and management principles and apply these to the project work, as a member or leader in a team.

Program Specific Outcomes (PSOs)

- **Professional Skills:** An ability to understand the basic concepts of various branches of Biotechnology like Agricultural Biotechnology, Food Biotechnology, Industrial Biotechnology, Medical Biotechnology, Pharmaceutical Biotechnology, Environmental Biotechnology, Microbial Biotechnology, Fermentation Biotechnology, Genetic Engineering, Bioinformatics, Nanotechnology, Plant- Animal Tissue culture, Immunology and to develop skills of respective disciplines.
- **Problem-Solving Skills:** An ability to solve Scientific and Technological and Social problems using latest technology and to arrive at cost effective and appropriate solutions.
- **Successful Career and Entrepreneurship:** An understanding of social awareness along with ethical responsibility to have a successful career and to sustain zeal for real-world applications using optimal resources as an Entrepreneur.

B. Sc. Part III (Sem V and VI)

Course code	Name of Course	Course code	Name of course
Semester V		**Semester VI**	
DSC BT E-1	Basics in Genetic Engineering	**DSC BT F-1**	Advances in Genetic Engineering
DSC BT E-2	Industrial Biotechnology	**DSC BT F-2**	Food and Microbial Biotechnology
DSC BT E-3	Application of Biotechnology in Agriculture	**DSC BT F-3**	Application of Biotechnology in Health
DSC BT E-4	Nanobiotechnology	**DSC BT F-4**	Bioinformatics
AECC-E	English -III	**AECC-F**	English-IV

AECC – C:- Ability Enhancement Compulsory Course : English-III and IV

DSC BTP 11	Techniques in Genetic engineering and Bioinformatics	**DSC BTP 13**	Techniques in Agricultural and health Biotechnology
DSC BTP 12	Techniques in Industrial Biotechnology	**DSC BTP 14**	Project

7. Syllabus

DSC BT E 1 Basics in Genetic Engineering

Topic No.		Lectures 30
	Credit I	
1	**Enzymes in r-DNA technology** Introduction and Scope, Enzymes and its applications, Restriction enzymes- types (I, II, III), nomenclature, recognition sequences, cleavage patterns, modification of cut ends (linkers and adaptors), application – RFLP, Restriction mapping. Alkaline phosphatases, DNA ligases T4 and *E. coli* Ligases, Methylase , Reverse Transcriptases, Polymerases- Klenow enzymes, T4 DNA polymerases, Taq DNA polymerases, Polynucleotide kinase. **Cloning Vectors:** Introduction, Properties of good vectors , Cloning & expression vectors, Types- *E.coli* vector- plasmid – pBR 322 and pUC18 Bacteriophage vectors – λ phage vector, M 13 Vectors (λ replacement e. g. EMBL 3, EM BL 4 and λ insertional e.g λ gt 10 and λgt 11) Cosmid vector, Phagemid vector e.g pBlue script II KS/SK, Yeast vector- YAC and BAC , Animal vectors – Retroviral , Plant vector – Ti plasmid,Ri plasmid, shuttle vector- e.g pJBD 219, Ta clonig vector (introductiory) , Selection of recombinant vector.	15
	Credit II	
2.	**Nucleic Acid Hybridisation :** Nucleic Acid and plasmid purification. Probe Preparation ,Methods of labelling probes. Radio labelling – Nick translati on, End labeling, Primer extension, Non Radiolabelling – Biotin, dioxygenin, fluorescent dyes, Applications of probes. **DNA Sequencing and blotting technique** Maxam Gilbert method , Sanger Coulson method, Automated DNA sequencing, Southern Blotting, Northern Blotting, Western blotting , Dot blotting.	**15**

References :

1. Molecular Biotechnology – Principles & applications of Recombinent DNA : Glick B. R. & Padtranak
2. Gene cloning & manipulating – Christopher
3. An introduction to genetic engineering – Nicholl D. S. T.
4. Principle of gene manipulation: An introduction to genetic engineering –Old R.W. & Primrose S. B.
5. Gene VIII – Lewin
6. Fundamentals of Biotechnology – S. S. Purohit
7. Fundamentals of Biotechnology – H. S. Chawala
8. Genetic engineering – P. K. Gupta

9. Principle of Biochemistry – Wilson & Walker
10. Plant genetic engineering – P. K. Gupta
11. Molecular Biotechnology of gene – S. N. Jogdan
12. Protein Biotechnology – M. Philopse
13. Molecular Biotechnology – Principle & practices by Channarayappa
14. Biotechnology – R. C. Dubey
15. Molecular cloning (Vol I, II, III) – Sambrook and Russel

DSC BT E 2 Industrial Biotechnology

Topic No.		Lectures 30
	Credit I	
1	**Introduction to Industrial Biotechnology** Concept and range of fermentation technology, Types of fermentations (Batch, continuous, dual, multiple), Concept of solid state & submerged fermentation. Microbial metabolic products-Primary & Secondary products. Basic design of fermenter Components of fermenter and their functions, Fermentation economics Types of fermenter- Stirred tank fermenter, Airlift fermenter, Tower fermenter, Tubular fermenter, Bubble cap fermenter. **Microbial Screening, Scale up and strain improvement** Primary and secondary screening, Primary screening of antibiotics,organic acids and amines, enzymes, vitamins and amino acidproducers, volatile component degraders,organisms using specific carbon and nitrogen sources. Secondary screening of antibiotic producers, Scale up of fermentations, Strain improvement- conceptand methods -mutation, genetic recombination. Maintenance and preservation of industrially important cultures. Microbiological assay.	**15**
	Credit II	
2	**Fermentation Media** Composition of typical fermentation media, Criteria for typical fermentation medium, Types of fermentation media,General role of media components- water, carbon source, nitrogen source, minerals, precursors, growth factors, buffers, antifoams, oxidation-reduction potentials, inducers, inhibitors. Optimization of media- Plackett and Burmann design , Factors affecting fermentation process . **Downstream Process and Product Recovery** Downstream Processes in fermentation and bioprocess technology Solid and liquid separation, Flocculation and Flotation, filtration and centrifugation, Cell disruption by solid and liquid shear, ultrasonication, enzyme action and mechanical disruption. Product recovery and purification- principle, Precipitation, Crystallization, Liquid-Liquid extraction, Distillation (Fractional and Steam), evaporation, Chromatographic separation (Principles), Adsorption and concentration, Membrane filtration, drying and packing.	**15**

References:

1. Text Book of Biotechnology – Dr. H. K. Das
2. Industrial Microbiology & Biotechnology – Arnold L.
3. Fermentation Technology – Jayanto Acharekar
4. Basic Biotechnology – Colin and Bjrorn
5. Frontiers in Microbial Biotechnology – Bisel P.S.

6. Industrial Microbiology – Prescot and Dunn
7. Principle of Fermentation Technology – Stanbury P.F ., Whitekar H., Hall S.
8. Bioprocess Engineering : Principles – Nielson T. an d Villadeson J.
9. Industrial Microbology- L.E. Casida
10. Fermentation Biotechnology- H.A. Modi
11. Industrial Microbiology- A.H.Patel

DSC BT E 3 Application of Biotechnology in Agriculture

Topic No.		Lectures 30
	Credit I	
1	**Methods for crop Improvement** Introduction and Acclimatization, Breeding for self and cross pollinated plants and vegetatively reproducing plants, selection (clonal pure line and mass), Hybridization and Mutation breeding. **Plant tissue culture techniques for crop improvement** -Somaclonal variations, Haploids, Micropropagation, Somatic embryogenesis. **Somatic hybridization-** Definition, protoplast, fusion technique, selection of hybrids, symmetric and asymmetric hybrids, cybrid production. **Artificial Seed-** Definition, Techniques, factors affecting, applications limitations. **Germplasm Conservation-** Introduction, *In-situ* conservation, *Ex-situ* conservation, cryopreservation, Techniques of Cryopreservation, applications, limitations.	**15**
	Credit II	
2	**Transgenic Plants** Herbicide resistant – Glyphosate resistance, Pho sphinothricin resistance, Fungal and Bacterial disease resistance approaches- PR proteins, Chitinase, Glucanase, RIPs protein, Virus resistance –Virus coat proteins, Movement proteins ,Trasmission proteins ,Satellite RNAs, Antisense RNAs, Ribozymes, Insect resistance approaches – Bt protein (Bt Cotton, Bt-Brijal) , Non Bt protein, Transgenic plant with improved nutrition - Golden Rice, Molecular farming. GM Foods, ethical & socio-economic, legal and environmental issues. Forms of protection -IPR and IPP- Patents, copyright, trademark ,trade secret and PBR **Biofertilizers –** Definition ,Principle , Mass production and field application – *Rhizobium,Azotobacter,Azospirillum,Acetobacter,Azolla*, *Cyanobacteria*, PSB, VAM. **Biopesticide –** Definition, production and applications of Bacterial, fungal, viral and Plant origin Biopesticides.	**15**

References :

1) Biotechnology – U. Satyanarayana
2) A textbook of plant breeding – B.D . Singh
3) Medical biotechnology – S. N. Jogd and
4) Advances in Biotechnology- S.N.Jogadand
5) Introduction to plant breeding – R . C. Chaudhary
6) A textbook of Biotechnology - R. C. Dubey
7) Pharmaceutical Biotechnology – S. P . Vyas ,V. K. Dixit
8) Biotchnology – B. D. Singh
9) Fundamentals of agriculture biotechnology – S . S. Purohit
10) Animal & cell biotechnology – Ian, Freshney
11) Animal cell biotechnology – Buttler

12) Methods in cell biology – Volume 5 7
13) Cell and Developmental Biotechnology.-Raj narian Desikar
14) Agricultutre application of Microbiology- Neeelima Rajvaidya.

DSC BT E 4 Nanobiotechnology

Topic No.		Lectures 30
	Credit I	
1	**Introduction and Fundamentals of nanobiotechnology** Concepts, historical perspective; Nanoscale materials: Definition and properties, Basic concept of Carbon dots and Quantum dots. **Concepts of Nanoparticles**: Basic structure of Nanoparticles- Kinetics in nano-structured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two-dimensional nanostructures; clusters of metals and semiconductors, bionano-particles. **Synthesis and characterization of different nanomaterials**: Synthesis of nanomaterials from plant, microbial and animal cell sources. Characterization of nanomaterials using Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunneling Microscopy, Optical Absorption and Emission Spectroscopy, Differential Scanning Calorimetry, X-Ray and NMR. **Bionancomposites:** Nano-particles and Microorganisms; Microbial Synthesis of Nano- materials; Biological methods for synthesis of nano-emulsions using bacteria, fungi and Actinomycetes; Plant-based nanoparticle synthesis.	**15**
	Credit II	
2	**Applications of Nanobiotechnology** **Applications of Nanomedicine:** Nanotechnology in diagnostic applications, materials used in Diagnostics and Therapeutics. Nanomaterials for catalysis, development and characterization of nanobiocatalysts, application of nano-scaffolds in synthesis, applications of nano-biocatalysis in the production of drugs and drug intermediates. **Nano-films:** Thin films; Colloidal nanostructures; Self-assembly, Nanovesicles; Nanospheres; nanocapsules and their characterization. **Nanoparticles for drug delivery**: Strategies for cellular internalization and long circulation, strategies for enhanced permeation through various anatomical barriers. **Nanoparticles for diagnostics and imaging:** Concepts of smart stimuli responsive nanoparticles, implications in cancer therapy, nanodevices for biosensor development. **Applications in Agriculture:** Biogenic nanomaterials and their role in soil, water quality and plant protection; Smart nanoscale systems for targeted delivery of fertilizers, pesticides (nanocides); Nanoremediation.	**15**

References:-

1. Bharat Bhushan: .Handbook of Nanotechnology, Springer
2. Jurgen Schulte: Nanotechnology: Global Strategies, Industry Trends and Applications
3. Luisa Filipponi and Duncan Sutherland: Nanotechnologies: principles, applications, implications and hands on activities
4. Nanomaterials – An introduction to synthesis, properties and applications, D. Vollath, WileyVCH, Second Edition 2013
5. Nanostructured materials: Processing, Properties and Potential Applications, Edited by Carl. C. Koch, Noyes Publications, 2002

DSC BT F 1 Advances in Genetic Engineering

Topic No.		Lectures 30
	Credit I	
1	**Isolation of Gene** Chemical synthesis, Phosphotriester approach ,Phosphitetriester approach, Isolation desired gene from DNA, Isolation of specific gene with PCR, cDNA and genomic library . Screening of libraries- immunological screening and colony or plaque hybridization. **PCR and its application** Primer designing **,** Fidelity of thermostable enzymes. Steps in PCR reaction, Types of PCR – RT-PCR,real time PCR, to uchdown PCR, hot start PCR, colony PCR, Applications- site directed mutagenesis, Molecular diagnostics, viral and bacterial detection Introduction to molecular identification --16 s r RNA18 s r RNA, and Bar code	**15**
	Credit II	
2	**Cloning methodologies** Construction of plasmid – e. g. Somatostatin, Inse rtion of foreign DNA into host cells , Agrobacterium mediated gene transfer, Transformation, Transfection . Chemical methods- $CaCl_2$ coprecipitation, polycation mediated gene transfer. Physical methods- Liposomes, microingection, electroporation, biolistics. screening of recombinants, Direct selection , Insertional inactivation selection , Blue white selection, Expression based screening (HART) Fluorescent Activated Cell Sorter, South –Western S creening. **Application of r-DNA technology** Production of transgenics- knock out mice, In medicines –Insulin and Somatostatin, Gene Silencing- Introduction, Principle of Si-RNA and Si- RNA technology **Molecular Markers** Introduction – Morphological , Biochemical, Molecu lar Markers- RFLP, RAPD, AFLP, STRS, QTL, SSR.	**15**

References :

1. Molecular Biotechnology – Principles & applications of Recombinent DNA : Glick B. R. & Padtranak
2. Gene cloning & manipulating – Christopher
3. An introduction to genetic engineering – Nicholl D. S. T.
4. Principle of gene manipulation : An introduction to genetic engineering – Old R.W. & Primrose S. B.
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6. Fundamentals of Biotechnology – S. S. Purohit
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12. Protein Biotechnology – M. Philopse
13. Molecular Biotechnology – Principle & practices by Channarayappa
14. Biotechnology – R. C. Dubey
15. Molecular cloning (Vol I, II, III) – Sambrook and Russel

DSC BT F 2 Food and Microbial Biotechnology

Topic No.		Lectures 30
	Credit I	
1	**Microbial Cultures and Production** Concept of pure and mixed culture., Microbial growth kinetics basic concept (Batch, Continuous and Fed Batch). Microbial Production of - Enzymes (amylase –koji fermentat ion), Antibiotics (Penicillin), Vitamins (B_{12}), Amino acids (Lysine), Organic acid (Citric acid). Edible mushroom, Single Cell Protein-(Spirulina). **Fermented Foods and Beverages** Dairy Products – Cheese, Dahi, Yoghurt, Indian Foods – I dli, Bakery Products – Bread , Fermented Pickles – Sau erkraut, Beverages – Beer, Wine (Red table and white table) .	**15**
	Credit II	
2	**Food Spoilage, preservation & toxicity** Types of spoilage- Physical, Chemical and Biological (auto and microbial), Preservation methods- High and Low temperatures, Controlled atmosphere and Anerobiosis, Radiations and Asepsis. Chemical preservatives (Salt, sugar, organic acids,SO_2, NO_2). Food Toxicity – Mycotoxin (Aflatoxin), Exotoxin (*Staphylococcal*), Neurotoxin (Botulinum), Food borne illness-Shigellosis, Amoebiosis, Aspergillosis. **Impact of GM food on human health** Principle, Risk analysis and Regulations, Multidisciplina perspectives of GM foods and impact, Public health principles Characteristics of food supply for public health, Food Safety, Capacity to supply nutritional adequacy, Sustainability, Capacity for Consumer choice, Accessibly and affordability to all.	**15**

References :

1. Text Book of Biotechnology – Dr. H. K. Das
2. Industrial Microbiology & Biotechnology – Arnold L.
3. Fermentation Technology – Jayanto Acharekar
4. Basic Biotechnology – Colin and Bjrorn
5. Frontiers in Microbial Biotechnology – Bisel P.S.
6. Industrial Microbiology – Prescot and Dunn
7. Principle of Fermentation Technology – Stanbury P.F ., Whitekar H., Hall S. J.
8. Bioprocess Engineering : Principles – Nielson T. an d Villadeson J.
9. Industrial Microbology- L.E. Casida
10. Fermentation Biotechnology- H.A. Modi
11. Industrial Microbiology- A.H.Patel
12. Food Biotechnology- Varun Mehta

DSC BT F 3 Application of Biotechnology in Health

Topic No.		Lectures 30
	Credit I	
1	**Stem cells and Transgenic Technology** Characteristics of stem cells , Concept of stem cell progenitors, concept of stem cell technology and its application, Transgenic technology & cloning in mammals, Transgenic mice and their applications, Transgenic cattle. **Vaccines- Principle and Practices** Concept and types of vaccine, Subunit vaccines- Hepatitis B vaccine, Foot and Mouth disease Vaccine, AIDS Vaccine, DNA Vaccines, Edible Vaccines, Recombinant vaccines- Cholera Vaccine, Vaccinia Virus Vaccine.	**15**
	Credit II	
2	**Monoclonal Antibodies-** Introduction, Hybridoma Technology, Applications- Diagnostics , Therapeutics , Protein purification andAbzymes. **Biosensors-** Introduction, Principle, Types (Amperometric, Thermometric, Optical biosensor, Immuno biosensor), Applications**Gene Therapy –** Introduction , Approaches-*ex vivo* (Therapy for Adenosine deaminase deficiency) *and in vivo* gene therapy (Gene therapy strategy for cancer), Antigene and antisense therapy , antisense therapy for cancer **Public health** Introduction, DNA sample preparation, Methods of Diagnosis – Nucleic acid hybridization (Radioactive and Non radio detection). Detection of infectious disease (Tuberculosis, Malaria, AIDS, Chaga's) Detection of genetic diseases (cystic fibrosis, Sickle cell Anemia, Huntington's, DMD).	**15**

References:

1) Biotechnology – U. Satyanarayana
2) A textbook of plant breeding – B.D . Singh3
3) Medical biotechnology – S. N. Jogd and
4)Advances in Biotechnology- S.N.Jogadand
5) Introduction to plant breeding – R . C. Chaudhary6) 6)
A textbook of Biotechnology - R. C. Dubey
7) Pharmaceutical Biotechnology – S. P . Vyas ,V. K. Dixit8 8)
Biotchnology – B. D. Singh
9) Fundamentals of agriculture biotechnology – S. S. Purohit
10) Animal & cell biotechnology – Ian, Freshney
11) Animal cell biotechnology – Buttler
12) Methods in cell biology – Volume 5 7
13) Cell and Developmental Biotechnology.-Raj narian Desikar
14) Text Book of Bryophytes, Pteridophytes, Gymnosperms, and Paleobotany- Subramurti.
15) Agricultutre application of Microbiology- Neeelima Rajvaidya .

DSC BT F 4 Bioinformatics

Topic No.		Lectures 30
	Credit I	
1	**Introduction to Bioinformatics** **History of bioinformatics:** Multidisciplinary approach of bioinformatics, Computers in Biology and Medicines, Internet, and related programs; Networking HTTP, HTML, WAN, LAN, MAN, applications in communication. **Information Resources**: Introduction, aim and objectives, National Centre for Biotechnology Information(NCBI), National Library of Medicine (NLM), and National Institute of Health (NIH), EBI, Sequence retrieval system(SRS): Entrez, DBGet. **Introduction to Genomics and Genome databases**: Introduction, Databases, Data, Nucleic acid sequence database, Gene Bank, EMBL, DDBJ. **Genomics:** Human Genome Project (HGP), Goal and applications,final draft of HGP (complete information resources covered).	**15**
	Credit II	
2	**Sequence Alignment and Phylogenetic analysis** **Sequence Alignment**: Introduction, Protein sequence, Nucleic acid sequence, Pair wise sequence alignment, Multiple sequence alignment, Local and Global sequence alignment. **Algorithm used in sequence alignment**: Matrices- Dot matrix, PAM, BLOSSOM. **Phylogenetic analysis**: Introduction: Evolution, definition of phylogenetic tree, nodes, internodes, root, tree, styles; cladogram, phenogram, curvogram, Steps involved in construction of phylogenetic tree **Phylogenetic analysis tools:** Phylip, ClustalW. **Drug designing** **Structure-based drug designing:** Introduction; Structure-based drug designing approaches, Target Identification and Validation, homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps. **Ligand-based drug designing and Docking:**Introduction; Ligand-based drug designing approaches, Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), QSAR, Database generation and Chemical libraries, ADME property.	**15**

References

1. Bioinformatics methods and applications. S. C. Rastogi, N. Mendiratta, P.Rastogi.
2. Principle of bioinformatics. P. Shanmughavel.
3. Computational Drug Designing. David C. Young
4. Computational Drug Design: A Guide for Computational and Medicinal Chemists.David

C. Young

5. An introduction to Bioinformatics. T. K. Attwood, Parry-Smith D. J.

6. A textbook of bioinformatics. Sharma, Munjal, Shankar.

DSC BT P 11 Techniques in Genetic Engineering and Bioinformatics

Sr. No.	Practical	15 P	
	Techniques in Genetic engineering		
1.	Calculation of molecular size of digested DNA	01	Minor
2.	Construction of restriction map of plasmid DNA	01	Minor
3.	Western blotting technique	01	Major
4.	Southern blotting technique	01	Major
5.	DNA Amplification by PCR	01	Minor
6	cDNA cloning by Reverse Transcription PCR	01	Major
7.	Ligation of DNA	01	Minor
8.	Expression of gene in *E. Coli* (GST)	01	Major
	Techniques in Bioinformatics		
9.	Introduction to PUBMED Central database using the ENTREZ search engine.	01	Minor
10.	Getting the amino acid and gene sequences by exploring and querying the protein and nucleic acid Sequence database.		Minor
11.	Similarity search for nucleotide and protein using the BLASTn, BLASTp and interpretation of the results.	01	Major
12.	Protein and nucleic acid pair-wise sequence alignment by using ClustalW and Construction of Phylogenetic Tree using ClustalW.	01	Major
13.	Analysis of Secondary and tertiary structure of protein using visualizing software like Pymol or Rasmol.	01	Minor
14.	Calculation of PI/MW of protein and Prediction of the secondary structure of protein using ExPasy web tool (GOR method).		Major
15.	Molecular Docking of protein and ligand by Argus lab.	01	Major
16	Energy calculation of the biomolecules using molecular mechanics and quantum mechanics. (Argus lab)	01	Minor
	Compulsory visit to molecular biology laboratory		

DSC BT P 12 Techniques in Industrial Biotechnology

Sr. No.	Practicals	15 P	
1	Primary screening of amylase producers by Replica Plate technique	01	Major
2	Screening and isolation of antibiotic producing organism from soil (Crowded plate/ Giant colony method).	01	Major
3	Production and partial purification of enzyme (Amylase/ Invertase)	01	Major
4	Study of Immobilization of enzyme (Amylase/ Invertase).	01	Minor
5	Production of alcohol/ wine and estimation by colorimetric method	01	Minor
6	Production of sauerkraut.	01	Minor
7	Mushroom Cultivation.	01	Minor
8	Production, Recovery and estimation of Citric Acid	01	Minor
9	Production, Recovery and estimation (Bioassay) a of Primary metabolite (Growth factor)	01	Major
10	Production, Recovery (Filtration, Solvent extraction) and estimation (Bioassay) a of Secondary metabolite (Antibiotic)	01	Major
11	Isolation and identification (Genus level) of spoilage causing microorganisms from spoiled foods.	01	Major
12	Isolation and identification of starter organisms from Idli batter/ Dahi	01	Major
13	Analysis of Milk - a) Estimation of lactic acid. b) Estimation of total fat. c) MBRT	02	Major
14	Preparation of fermented food (Bread/ Idli)	01	Minor

DSC BT P 13 Techniques in Agricultural and Health Biotechnology

r. No.	Practicals	15 P	
1	Isolation of *Azotobacter*	01	Major
2	Isolation of *Rhizobium* from root nodules	01	Major
3	Isolation of PSB from soil.	01	Major
4	Production of Biofertilizer- *Azotobacter* /PSB	01	Major
5	Isolation of *Trichoderma*	01	Minor
6	Isolation of *Bacillus thuringenisis*	01	Minor
7	Production of Biopesticide – *Trichoderma*	01	Minor
8	Production of Biopesticide – *Bacillus thuringenisis*	01	Minor
9	Production of Artificial seed	01	Minor
8	Antibiotic sensitivity test using paper disc method	01	Minor
9	Determination of Minimum inhibitory Concentration (MIC) of antibacterial compound.	01	Minor
10	*Agrobacterium* mediated transformation in plants	01	Minor
11	Isolation of Blood genomic DNA	01	Minor
12	RAPD analysis demonstration experiment.	01	Major
12	RFLP analysis demonstration experiment.	01	Major
13	Immunoglobulin G Purication.	01	Minor
14	Study of Protoplast fusion and regeneration	01	Minor
15	DPPH assay for antioxidant plant extract.	01	Minor
	Industrial Visit- Wine Industry/ Food Processing Industry/Fermentation unit.		

DSC BT P 14 Project

Guidelines –

1. Projects can be performed in pair or individually.
2. Selection of the Project topic and allotment of project supervisor.
3. Preparation of Project Execution Plan : Time and Resource Allocation
4. Separate practical session should be organized for preparation of following topics—
   a) Selection of problem, preparation of synopsis. b) Introduction. c) Review of literature d) Materials and Methodology e) Result and discussion f) Bibliography.
5. Guidance by the Project Supervisor, for the self-study of relevant course topics andconcepts by the student.
6. Self-study and reference work of relevant topics and concepts by the student.
7. The Project Work must involve practical work(wet lab.) related to selected discipline
8. Students are expected to work on "Project Work" for about 10 periods per week.
9. The project work must be allotted individually.
10. The student invests his energy, time and resources in a project. The project therefore should, if possible, have important bearing on some practical aspect. This will help student to justify his efforts on project.
11. It is the joint responsibility of student and project supervisor to maintain daily register book of his/her project work and has to be produced at the time of examination if asked.
12. Submission Process: Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Supervisor must approve both copies positively before university examination. Then respective Head or Coordinator approves both copies of the Project Report.
13. The student has to submit one of these approved copies of project report, duly signed by the project Supervisor and Principal, before practical examination. The report will be assessed by both Internal examiner (The project supervisor), who will assign the marks out 20 and the external examiner (appointed by university), who will assign marks out of 30, Thus the total will be out of 50 marks.
14. Theory, practical and project report shall form separate heads of passing.

8. Examination Pattern

Practical Examination:

A) The practical examination will be scheduled as given below; practical exanimation should be conducted for minimum 5 hours on each day. For practical examination of DSC BT P11 Techniques in Genetic Engineering and Bioinformatics and DSC BT P14 Project separate examiners should be appointed and conducted in 2 consecutive days for each, while for DSC BT P12 Techniques in Industrial Biotechnology and DSC BT P13 Techniques in Agricultural and Health Biotechnology examination will be conducted in 3 consecutive days.

B) Each candidate must produce a certificate from the Head of the Department in his/her college stating that he/she has completed in a satisfactory manner the practical course on the guidelines laid down from time to time by Academic Council on the recommendation of Board of studies and has been recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit the Biotechnological institutes and satisfactorily complete project work and entrepreneurship as per the syllabus. The report of the same should be duly certified by the Head of the Department and submit the respective reports at the time of examination.

DSC BT P 11 Techniques in Genetic Engineering and Bioinformatics

A) Major Experiment (DSC BT P8 Techniques in Genetic Engineering) - 20 Marks
B) Minor Experiment (DSC BT P8 Techniques in Bioinformatics) - 10 MarksOR
A) Major Experiment (DSC BT P8 Techniques in Bioinformatics) -20 Marks
B) Minor Experiment (DSC BT P8 Techniques in Genetic Engineering) - 10 Marks
Spotting - 05 Marks (5 spots- each carry one mark)
Journal -10 Marks Major Experiment 20 Marks
Tour Report -05 Marks

DSC BT P 12 Techniques in Industrial Biotechnology and DSC BTP 13 Techniques in Agricultural and Health Biotechnology

Major Experiment 20 Marks
Minor Experiment 10 Marks
Spotting 10 Marks (5 spots- each carry two marks)
(Q.1 to 3 Based on DSC BT P9 Techniques in Industrial Biotechnology)
Major Experiment 20 Marks
Minor Experiment 10 Marks
Spotting 10 Marks (5 spots- each carry two marks)
(Q.4 to 6 Based on DSC BT P10 Techniques in Agricultural and Health Biotechnology)

Tour Report 10 Marks
Journal 10 Marks

DSC BT P 14 Project

Q.1 Internal Examination 20 Marks
A) Regularity 10 Marks
B) Research aptitude 10 Marks
Q.2 **External Examination 30 Marks**
A) Project report 05 Marks
B) Review of Literature 05 Marks
C) Material & Methods 05 Marks
D) Result & Discussion 05 Marks
E) Presentation 05 Marks
F) Viva-Voce 05 Marks

9. Scheme of Teaching- As per University/BOS guidelines

Nature of Theory Question Paper

Nature of Question Paper for B.Sc. Biotechnology (Entire) Part – III (40 + 10 Pattern) according to Revised Structureas Per NEP – 2020 to be implemented from academic year 2024-25

Maximum Marks: 40
Duration: 2 hrs

Q. 1 Select the most correct alternate from the following [8]

i) to viii) MCQ one mark each with four options

A)
B)
C)
D)

Q.2 Attempt any TWO of the following [16]

A)
B)
C)

Q. 3 Attempt any FOUR of the following [16]

a)
b)
c)
d)
e)
f)

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Equivalence of the CBCS-NEP with course CBCS

CBCS-NEP		CBCS	
Course code	**Name of Course**	**Course code**	**Name of Course**
Sem V		**Sem V**	
DSC BT E-1	Basics in Genetic Engineering	**DSC BT 29**	Basics in Genetic Engineering
DSC BT E-2	Industrial Biotechnology	**DSC BT 30**	Industrial Biotechnology
DSC BT E-3	Application of Biotechnology in Agriculture	**DSC BT 31**	Application of Biotechnology in Agriculture
DSC BT E-4	Nanobiotechnology	**DSC BT 32**	Developmental Biology (Plant and Animal)
AECC-E	English -III	**AECC-E**	English -III
Sem VI		**Sem VI**	
DSC BT F-1	Advances in Genetic Engineering	**DSC BT 29**	Advances in Genetic Engineering
DSC BT F-2	Food and Microbial Biotechnology	**DSC BT 30**	Food and Microbial Biotechnology
DSC BT F-3	Application of Biotechnologyin Health	**DSC BT 31**	Application of Biotechnologyin Health
DSC BT F-4	Bioinformatics	**DSC BT 32**	Bioinformatics
AECC-F	English – II	**AECC-F**	English-IV
Practicals (Annual practical examination)			
DSC BTP 11	Techniques in Genetic engineering and Bioinformatics	**DSC BTP 8**	Techniques in Genetic engineering and Bioinformatics
DSC BTP 12	Techniques in Industrial Biotechnology	**DSC BTP 9**	Techniques in Industrial Biotechnology
DSC BTP 13	Techniques in Agricultural and health Biotechnology	**DSC BTP 10**	Techniques in Agricultural and health Biotechnology
DSC BTP 14	Project	**DSC BTP 11**	Project