"Education for Knowledge Science and Culture"

- **Dr Bapuji Salunkhe**

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE KOLHAPUR (AN EMPOWERED AUTONOMOUS INSTITUTE),

Syllabus for

Bachelor of Science Part – III

NEP Phase – 1.0

BIOTECHNOLOGY (ENTIRE)

SEMESTER V AND VI

(Syllabus to be implemented from June, 2025 onwards)

B.Sc. - Part III Biotechnology Entire (Semester V and VI)

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-V										
1	DSC-IX	DSC07BTE51	Basics in Genetic Engineering	2	-	40	10	-	50	2
2	DSC-X	DSCO7BTE52	Industrial Biotechnology	2	-	40	10	-	50	2
3	DSC-XI	DSC07BTE53	Enzymology	2	-	40	10	-	50	2
4	DSC-XII	DSC07BTE54	Research Methodology in Biotechnology	2	-	40	10	-	50	2
5	DSE-I	DSE07BTE51	Animal Tissue Culture	2	-	40	10	-	50	2
6	VSC-PR-IV	VSC07BTE59	Techniques in Enzymology	-	4	-	-	25	25	2
7	FP	FPR07BTE51	Field Project	-	-	-	-	50	50	2
8	DSC-PR-V	DSC07BTE59	Techniques in Genetic Engineering & Industrial Biotechnology	-	16	-	-	100	100	8
Semester –V Total				**10**	**20**	**200**	**50**	**175**	**425**	**22**
Semester-VI										
1	DSC-XIII	DSC07BTE61	Advances in Genetic Engineering	2	-	40	10	-	50	2
2	DSC-XIV	DSCO7BTE62	Application of Biotechnology in Agriculture	2	-	40	10	-	50	2
3	DSC-XV	DSC07BTE63	Biosafety Bioethics, and IPR	2	-	40	10	-	50	2
4	DSC-XVI	DSC07BTE64	Bioinformatics	2	-	40	10	-	50	2
5	DSE-II	DSE07BTE61	Plant Tissue Culture	2	-	40	10	-	50	2
6	VSC-PR-V	VSC07BTE69	Techniques in Plant Tissue Culture	-	4	-	-	25	25	2
7	OJT	OJT07BTE61	OJT	-	-	-	-	50	50	2
8	DSC-PR-VI	DSC07BTE69	Techniques in Agriculture & Bioinformatics	-	16	-	-	100	100	8
Semester –VI- Total				**10**	**20**	**200**	**50**	**175**	**425**	**22**
Cumulative Total (3rd Year)				20	40	400	100	350	850	44
Three Year UG Degree in B.Sc. Biotechnology Entire									2650	132

Subject Offered Sem-V:- E Sem-VI:- F	Course outcomes paper wise for B.Sc-III Biotechnology entire for 2023- 2024
DSC07BTE51 Basics in Genetic Engineering	At the end of this course students will be able to: CO 1. Understand the concept of cloning CO2. Demonstrate the techniques of DNA fingerprinting CO 3. Perceive knowledge about sequencing technology. CO 4. Illustrate the importance of probe designing
DSC07BTE52 Industrial Biotechnology	At the end of this course students will be able to: CO 1.Construct the design required to set up industrial fermentation. CO 2. Draw a contrast between industrial & pilot fermentation CO 3. Discover various ways of media formulation for industrial scale. CO 4. Compare classical & Modern fermentation techniques.
DSC07BTE53 Enzymology	At the end of this course students will be able to: CO 1. To educate students about the fundamental concepts of enzyme CO 2. To study different types of enzyme CO 3. To enable the students to outline Enzyme kinetics CO 4. To gather knowledge of separation and purification of enzyme
DSC07BTE54 Research methodology in Biotechnology	At the end of this course students will be able to: CO 1. To understand the different types of research work CO 2. To present the research work scientifically CO 3. Illustrate the mechanism/working of Instrumentation use in Research Methodology CO 4. To perform the Application of Spectroscopy
DSE07BTE51 Animal tissue culture	At the end of this course students will be able to: CO 1. Construct the design required to set up animal tissue culture laboratory CO 2. Classify different characters and biology of cultured cells CO 3. Illustrate the importance of asepsis CO 4. Understand the importance of stem cell technology
DSC07BTE61 Advance in Genetic Engineering	At the end of this course students will be able to: CO 1. Reflect the importance of chemical synthesis of DNA. CO2. Differentiate various types of PCR & their applications. CO 3. Appreciate the importance of screening. CO 4.study impact of GM foods on human health.
DSC07BTE62 Applications of Biotechnology in Agriculture	At the end of this course students will be able to: CO 1. Outline the importance of Hybridization & mutation in crop improvement. CO2. Explain the techniques of artificial seed germination. CO 3. Discuss the strategies to develop transgenic plants CO 4. Formulate bio fertilizer.
DSC07BTE63 Biosafety, Bioethics and IPR	At the end of this course students will be able to: CO 1. Learn the concept of Bio safety CO2. Understand the mechanism of Intellectual Property Rights. CO 3. Classify different characters & functions of Bioethics.

	CO 4.Elaborate the process. Intellectual Property Rights
DSC07BTE64 Bioinformatics	At the end of this course students will be able to: CO 1. Outline the importance of Human Genome Project. CO2. List different types of structural database. CO 3. Explain the importance of phylogenetic analysis. CO 4. Construct drug molecules.
DSE07BTE61 Plant Tissue Culture	At the end of this course students will be able to: CO 1. Understand the importance of plant tissue culture CO 2. Technically trained with good practical exposure (different PTC techniques) to perform plant cell culture CO 3. Illustrate the importance of asepsis CO 4. Construct the design required to set up plant tissue culture laboratory

Semester - V

DSC-IX DSC07BTE51 Basics in Genetic Engineering Credit - 2

Topic No.	Credit I	Lectures 30
1	**Concept of r-DNA technology:** Introduction and Scope, Enzymes in r-DNA technology and its applications, **Restriction enzymes**- types (I, II, III), nomenclature, recognition sequences, cleavage patterns, modification of cut ends (linkers and adaptors), Alkaline phosphatase, DNA ligase T4 and E. coli Ligases, 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 – M 13 Vectors and λ phage vector, (λ replacement e. g. EMBL 3, EMBL 4 and λ insertional e.g. λ gt 10 and λ gt 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.	15
	Credit II	
2.	**Nucleic Acid Hybridization :** Probe Preparation, Methods of labeling probes. Radio labeling – Nick translation, 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.	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-X DSCO7BTE52 - Industrial Biotechnology Credit 2

Topic No.	Credit I	Lectures 30
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 Fermentor Components of Fermentor and their functions, Types of Fermentor- Stirred tank Fermentor, Airlift Fermentor, Tower Fermentor. **Fermentation Media** Concept of pure and mixed culture, 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, inducers, inhibitors. Optimization of media- Plackett and Burmann design, Factors affecting fermentation process. Microbial growth kinetics basic concept (Batch, Continuous and Fed Batch).	**15**
	Credit II	
2	**Microbial Screening, Scale up and strain improvement** Primary and secondary screening, Primary screening of antibiotics, organic acids and amines, enzymes, vitamins and amino acid producers, volatile component degraders, organisms using specific carbon and nitrogen sources. Secondary screening of antibiotic producers, Scale up of fermentations, Strain improvement- concept and methods -mutation, genetic recombination. Maintenance and preservation of industrially important cultures. Microbiological assay **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. **Industrial Production and Recovery process of**: - Vitamins (Vitamin B_{12}), Amino acids (L- Asparagine), Antibiotics (Streptomycin), Organic acids (Citric acid), Brewing (Wine), Enzyme (Amylase)	**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. and Villadeson J.**
9. **Industrial Microbology- L.E. Casida**
10. **Fermentation Biotechnology- H.A. Modi**
11. **Industrial Microbiology- A.H.Patel**
12. **Crueger, W. and Crueger, A. (2005) A Text Book of Industrial**
13. **Biotechnology, Panima, New Delhi.**

DSC-XI-DSC07BTE53 **Enzymology** Credit 2

Topic No.	Credit I	Lectures 30
1	**Introduction to enzymes :** Nature of enzymes - protein and non-protein. Cofactor and prosthetic group, apoenzyme, holoenzyme. IUB classification of enzymes. **Unit of enzyme activity** – definition of IU, nature of non-enzymatic and enzymatic catalysis, Concept of Active site, ES complex, Activation energy and transition state hypothesis, Specific activity, Enzyme specificity, Turn over number. **Enzyme kinetics:** Hyperbolic curve, Michaelis – Menten equation. Lineweaver – Burk (L-B) plot, Significance of Km and Vmax. **Allosteric Enzymes:** Characteristics, Symmetric model, and Sequential model, **Example** – Aspartate transcarbomylase	15
	Credit II	
2	**Features of enzyme activity :** Factors affecting enzyme activity like Temperature, pH, Activator, inhibitor and substrate concentration Fischer's lock and key hypothesis, Koshland's induced fit hypothesis. **Mechanism of enzyme catalysis**: General features – proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes. **Isoenzymes:** Nature, importance. Lactate dehydrogenase as an example. **Immobilization of Enzyme:** Concept, Methods- Physical adsorption, covalent bonding, cross linking, Encapsulation and entrapment, Applications of Immobilization enzyme. **Biosensor :** Introduction, Mechanism and working of Glucometer	15

Reference

1) Enzyme technology – S. Satishkumar.
2) Enzymes – Trevor Palmer, Philip Bonner
3) Biotechnology – U. Satyanarayan
4) Biochemistry - Stryer

DSC-XII-DSCEBTE51 Research and Methodology Credit-2

Topic No.	Credit I	Lectures 30
1	**Introduction to Research** – Definition, The concept of research, characteristics of good research, Approach of research, Application of research, Research hypothesis, Review of Literature. **Sampling, data collection** – Concept of Sampling, Primary and Secondary Data. **Web search** – Introduction to Internet, Use of Internet and WWW, Using Search engines and advanced search tools. **Report writing**- Types of Report, Different steps in report writing **Writing tools** – Grammerly, Chat Gpt, Quill boat. **Result analysis tools** - Graphpad prism, Origin **Plagirism**- Introduction, Ourcuit, Turnitin and Scribbr	15
	Credit II	
2	**Spectroscopic method** – Principle, Instrumentation and Applications of: a) NMR spectroscopy b) Infra- red spectroscopy c) ESR spectroscopy d) Atomic absorption spectroscopy e) Mass spectroscopy **Tracer technique** – Introduction, Radioactivity, radioisotopes Types of radiation (α, β, γ), half-life period of the radioisotope **Methods of measurement of radioactivity**- Gas ionization (Geiger-Muller Counters), solvent excitation (Liquid scintillation counter), Autoradiography **Application** of radioisotopes in biological system.	15

References:-

1] **Kumar R., Research Methodology- A Step-By-Step Guide for Beginners, Pearson Education, Delhi (2006)**

2] **Research Methodology : Methods and Techniques- C. R. Kothari**

3] **Practical Biochemistry- Keith Wilson and walker**

4] **Biophysics –Daniel**

5] **Biophysics- Nath Upadhye**

DSE-I-DSE07BTE-51 Animal Tissue Culture Credit -2

Topic No	Credit - I	Lectures 30
1.	**History and Introduction of Animal Tissue culture**- History of animal cell culture. **Laboratory design and layout-**Construction and services, layout of aseptic room (sterile handling area, laminar air flow, service bench), incubation (incubators, hot room), preparation area (media preparation, washing area, storage). **Requirements of Animal Tissue culture-** Characteristics of animal cell in culture, substrate for cell growth, Equipment's required for animal cell culture (Laminar air flow, CO_2 incubator, Centrifuge, Inverted microscope) **Culture media-** Natural media, synthetic media (serum containing media, serum free media, balanced salt solution, media constituent, complete culture media, physicochemical properties of media). **Cultured cells- Biology and Characterization-** Characteristics of cultured cells, cell adhesion, cell proliferation, cell differentiation, and metabolism of cultured cells, Initiation of cell culture, Evolution and development of cell lines. **Measurement of growth parameters of cultured cells-** Growth cycle of cultured cells, plating efficiency of cultured cells **Cell synchronization-** Cell separation by physical means, cell separation by chemical blockade	**15**
	Credit II	
2.	**Basic technique of mammalian cell culture-** Isolation of tissue, disaggregation of tissue, measurement of viability, primary cell culture, Cell lines, Maintenance of cell culture, Subculture, Stem cell cultures **Scale up of Animal Tissue culture-**Scale up in suspension-stirrer culture, continuous flow culture, Airlift fermenter culture, Scale up in monolayer- Roller bottle culture, multisurface culture, multiarray disks and tubes, Micro carrier culture, Perfused monolayer culture. **Contamination-** Concept and Sources of contamination, types of microbial contamination, eradication of contamination. **Applications of cell culture-**In transplantation, and tissue engineering, monoclonal antibodies, culture based vaccine, valuable recombinant product, cloning, ethics and morality. **Stem Cell technology:** General introduction and applications.	**15**

References:-

1] **Culture of animal cell 3rd edition-R Ian Freshney**
2] **Animal cell culture- R.W.Masters**
3] **Animal biotechnology-M.M.Ranga**

4] **Animal tissue culture- Paul**

Semester - VI

DSC-XIII DSC07BTE61- Advances in Genetic Engineering Credit-2

Topic No.	Credit I	Lectures 30
1	**Isolation of Gene:** Isolation of 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, touchdown 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. **DNA Bar-coding Principle and Application**	**15**
	Credit II	
2	**Cloning methodologies:** **Construction of plasmid:** e.g. Somatostatin, Insertion of foreign DNA into host cells, Agrobacterium mediated gene transfer, Transformation, Transfection. **Chemical methods**: $CaCl_2$ precipitation, polycation mediated gene transfer. **Physical methods**: Liposome, microinjection, electroporation, and biolistics transfer. **Screening of recombinants**: Direct selection, Insertional inactivation selection, Blue white selection, Expression based screening (HART) Fluorescent Activated Cell Sorter. Human Recombinant Proteins- Erythropoietin and HGH. **Application of r-DNA technology:** Production of transgenic- knockout mice, In medicines –Insulin and Somatostatin, Introduction to Gene Silencing, Principle of Si-RNA and Si- RNA technology **Molecular Markers:** Introduction – Morphological, Biochemical, Molecular Markers- RFLP, RAPD, AFLP.	**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. **Priciple 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-XIV DSC07BTE62 Applications of Biotechnology in Agriculture Credit 2

Topic No.	Credit I	Lectures 30
1	**Methods for crop Improvement** Introduction and Acclimatization, Breeding for self- and cross-pollinated plants and vegetative reproducing plants, selection (clonal pure line and mass), Hybridization and Mutation breeding. **Plant breeding markers**- RAPD, RFLP, AFLP **Somatic hybridization-** Definition, protoplast, fusion technique, selection of hybrids, symmetric and asymmetric hybrids, cybrid production. **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, Phosphinothric resistance, Fungal and Bacterial disease resistance approaches- PR proteins, Chitinase, Glucanase, RIPs protein, Virus resistance –Virus coat proteins, Movement proteins, Transmission proteins, Satellite RNAs, Antisense RNAs, Ribozyme, Insect resistance approaches – Bt protein (Bt Cotton, Bt-Brinjal), 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 **Biofertilizer –** Definition, Principle, Mass production and field application – *Rhizobium, Azotobacter, Azospirullum, Acetobacter, Azolla, Cyanobacteria,* PSB, VAM. Carrier Based Inoculum types **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. Jogdand
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 57
13) Cell and Developmental Biotechnology. -Raj narian Desikar
14) Agricultutre application of Microbiology- Neeelima Rajvaidya.

DSC-XV DSC07BTE63 Bio safety, Bioethics and Intellectual Property Rights Credit 2

Topic No.	Credit I	Lectures 30
1	**Bioethics** **Basic Principles of Bioethics:** Overview of National Regulations of Bioethics (ICMR, CDSCO) and International considerations. **Regulatory bodies for Bioethics in India** Role of Institutional Ethical Committee Bioethics in Plants, Animals and Microbial Genetic engineering **Biosafety** Introduction to Biosafety Concepts, symbols and significance in experimental biological sciences. International laws on Biosafety Levels of Biosafety (BSL-1 to 4) for Specific microorganisms. Introduction to Biological Safety Cabinets. Introduction to the concept of containment level and Good Laboratory Practices (GLP).	**15**
	Credit II	
2	**Intellectual Property Rights:** Introduction to Intellectual Property Rights (IPR) and Indian Patent Law. World Trade Organization and its related intellectual Property provisions. Intellectual property and its legal protection in research **Significance of IPR in Biotechnology:** Budapest Treaty, Protection of GMOs Tools of IPR and terminologies in IPR-Patent, Copyright, Trademarks and Trade secrets, Industrial designs and Geographical Indications (with examples)	**15**

References:-

Reference:

1. **IPR, Biosafety and Bioethics, DeepaGoel and ShominiParashar, Pearson; 1 edition (1 January 2013)**
2. **Diane O. Fleming; Debra A. Long; Biological Safety: Principles and Practices, ASM Press; 4th edition, 20062.**
3. **Nancy Ann SilbergeldJecker; Albert R. Jonsen; Robert A. Pearlman; Bioethics: Introduction to History, Methods, and Practice; Jones & Bartlett Publishers; II edition, 2007**
4. **Lim Li Ching; TerjeTraavik; Biosafety First: Holistic Approaches to Risk and Uncertainty in Genetic Engineering and Genetically Modified Organisms; Tapir Academic Press, 2007**
5. **21st Century Complete Guide to Biosafety and Biosecurity (CD-ROM): by U.S. Government, Publisher: Progressive Management, 2004**
6. **Wadehra, B.L. Law Relating To Intellectual Property, (2011), Fifth Edition, Universal Law Publishing Co.Pvt. Ltd.**
7. **GanguliPrabuddh, Intellectual Property Rights , (2001), Tata McGraw-Hill Publishing**
8. **Matthew Rimmer, Intellectual Property and Biotechnology: Biological Inventions (2008)**
9. **Kshitij Kumar Singh, Biotechnology and Intellectual Property Rights: Legal and Social Implications Springer (India) (2014)**
10. **Bioethics: the basics, Alastair V. Campbell, Routledge; 2 edition**
11. **Burgess J. (1985) An Introduction to Plant Cell Development (Cambridge Univ Press, UK)**
12. **Taiz L, Zeiger E (2010) – Plant physiology (Sinauer Associates, USA).**
13. **Sharma HP (2009) – Plant embryology: Classical and experimental (alpha sci)**
14. **Steeves TA & Sussex IM (2004) – Patterns in plant development. (Cambridge Univ Press, Cambridge, New York)**

DSC-XVI DSC07BTE64 Bioinformatics Credit 2

Topic No.	Credit I	Lectures 30
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, LMS) applications in communication. **Introduction to Genomics**: Introduction, Databases, Data, Nucleic acid sequence database, Gene Bank, EMBL, and DDBJ. Sequence retrieval system (SRS): Entrez, DB Get. **Human Genome Project (HGP),** Goal and applications, final draft of HGP (complete information resources covered). **Literature Database:** Pub Med and Pub Med central **Introduction to Proteomics:** Primary Protein sequences databases, Secondary sequences Databases, Structural Databases related to proteins (PDB, MMDB, CATH, SCOP)	**15**
	Credit II	
2	**Sequence Alignment and Phylogenetic analysis** **Sequence Alignment**: Pair wise sequence alignment, Multiple sequence alignment, Local and Global sequence alignment. **Phylogenetic analysis**: Introduction: Definition of phylogenetic tree, nodes, internodes, root. Styles of phylogenetic tree. Steps involved in construction of phylogenetic tree **Phylogenetic analysis tools:** ClustalW. **Drug designing** **Structure-based drug designing:** Introduction; Structure-based drug designing approaches, Target Identification and Validation, homology modeling, active site analysis and pharmacophore mapping, and Molecular Docking. **Ligand-based drug designing:** Introduction; Ligand-based drug designing approaches, Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), 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.**

DSE-II DSE07BTE61 Plant Tissue Culture Credit 2

Topics No	Credit- I	Lectures 30
1.	**Introduction to plant tissue culture**- Definition, History ,Cellular totipotency, techniques in plant tissue culture **Infrastructure & Organization Of Plant Tissue Culture Laboratory- General and aseptic laboratory-** different work areas, equipment's and instruments required and other requirements **Aseptic Techniques-** Washing and preparation of glasswares, packing and sterilization, media sterilization, surface sterilization, aseptic workstation and precautions to maintain aseptic conditions. **Culture Medium-** Composition of basal M.S. medium and preparation of media, Hormones used- Natural and synthetic- Chemical structure and their role, stock preparation **Micropropagation-** Introduction, stages of Micropropagation, factors affecting, advantages and applications, **Example-** Banana, Sugarcane, Pomegranate **Different Pathways of Micropropagation**- Auxiliary bud proliferation, somatic embryogenesis, organogenesis and meristem culture. **Organ Culture**- Ovary, Ovule, Endosperm, Embryo, Anther and Pollen culture (Introduction, principle, protocol, factors affecting and applications)	**15**
	Credit-II	
2.	**Callus Culture Techniques-** Introduction, principle, protocol, morphology and internal structure, genetic variations and applications **Somatic Embryogenesis-** Introduction, principle, protocol, factors affecting, applications and limitations **Organogenesis-** Introduction, principle, protocol, applications. **Suspension Culture Technique**- Introduction, principle, protocol, types, growth measurement, synchronization and applications **Somaclonal Variation-** Introduction, terminology, origin, selection at plant level, selection at cell level, mechanism, assessment, applications and limitations **Plant Protoplast Culture:-** History, Principle, protocol for isolation- Mechanical and Enzymatic, protoplast culture and importance **Commercial applications of PTC –** Secondary metabolite production using turbidostat and chemostat	**15**

References:-

1. Introduction to plant tissue culture- M.K. Razdan
2. Plant tissue culture-Theory & practice-S.S.Bhojwani & M.K. Razdan
3. Plant tissue culture-Kalyankumar Dey
4. Biotechnology- B.D. Singh
5. A text book of Biotechnology- R.C. Dubey
6. Plant tissue culture-U.Kumar
7. Fundamentals of Biotechnology S.S. Purohit
8. Biotechnology- H.S. Chawla
9. Crop Improvement In biotechnology- H.S.Chawla

DSE-PR-V DSC07BTE59 -Techniques in Genetic Engineering & Industrial Biotechnology

Sr. No.	Section I (Techniques in Genetic Engineering)		
1	Western blotting technique	01	Major
2	Southern blotting technique	01	Major
3	Calculation of molecular size of digested DNA	01	Major
4	C-DNA cloning by Reverse Transcription RT- PCR	01	Major
5	Purification of DNA from Agarose gel by Silica Column based method	01	Major
6	Ligation of DNA	01	Minor
7	Construction of restriction map of plasmid DNA	01	Minor
8	DNA Amplification by PCR	01	Minor
9	Transformation in Bacteria (Blue White Screening)	01	Minor
10	Qualitative detection of DNA by DPA method	01	Minor
	Section II (Techniques in Industrial Biotechnology)		
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)	01	Major
4	Fermentation of sugar industrial waste (molasses) for production of alcohol	01	Major
5	Bioassay) a of Primary metabolite (Growth factor)	01	Major
6	(Bioassay) a of Secondary metabolite (Antibiotic)	01	Major
7	Production of sauerkraut.	01	Minor
8	Demonstration of Mushroom Cultivation.	01	Minor
9	Production, Recovery and estimation of Citric Acid	01	Minor
10	Study of Immobilization of enzyme (Amylase).	01	Minor
11	Estimation of alcohol by colorimetric Method (Potassium Dichromate).	01	Minor
12	Analysis of milk: i) MBRT ii) Estimation of lactic acid from milk by titration method.	02	Minor

VSC-PR-V: VSC07BTE69 Techniques in Plant Tissue Culture	
Sr. No.	**Name of the Practical**
1	Laboratory Organizations & general techniques
Major Experiments	
1	Preparation of M.S. stock solutions & medium
2	Protoplast culture
3	Callus culture technique
4	Embryo culture technique
5	Anther Culture technique
Minor Experiments	
1	Suspension culture technique-Initiation of embryogenesis
2	Aseptic *in vitro* seed germination
3	Artificial seed production
4	Micro propagation demonstration
	Visit to commercial Plant Tissue Culture Laboratory

DSC-PR-VI-DSC07BTE69-Techniques in Agricultural Biotechnology & Bioinformatics

Sr. No.	Section I(Techniques in Agricultural Biotechnology)		
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* /*Rhizobium*	01	Major
5	Isolation of *Agrobacterium* Spp	01	Minor
6.	*Agrobacterium* mediated transformation in (dicot) plants	01	Minor
7.	Study of parameters of biofertilizers – temperature, pH, moisture.	01	Minor
8.	Determination of growth curve of isolated *Azotobacter*	01	Minor
9	Determination of cell count of isolated *Azotobacter*	01	Minor
	Section II (Techniques in Agricultural Bioinformatics)		
1.	Protein analysis by RASMOL	01	Major
2.	Phylogenetic Tree using Clustal W.	01	Major
3	Pair wise and Multiple sequence alignment.	01	Major
4	Measurement of bond length in an protein	01	Major
5	Sequence Retrieval from Biological data bases	01	Minor
6	PUBMED and PUBMED Central database	01	Minor
7	Getting the gene sequences from primary DNA Sequence.	01	Minor
8	Getting the Protein sequences from Protein Database.	01	Minor
9	Calculation of PI/MW of protein.	01	Minor

VSC07BTE59 Techniques in Enzymology

Sr. No.	Name of the Practical		
1	Isolation and study of Phosphatase enzyme activity from Moog and Urad	01	Major
2	Isolation and study of β-amylase from sweet potato	01	Major
3	Study of Invertase enzyme activity by using Sucrose as a substrate	01	Major
4	Study the effect of substrate concentration on α-amylase	01	Major
5	To study the effect of Temperature on α-amylase	01	Minor
6	To study the effect of pH on α-amylase	01	Minor
7	Study of catalase / Hydrogen peroxidase activity	01	Minor
8	Immobilization of α-amylase	01	Minor

Practical Examination:

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 :- Semester- V

VSC-PR-IV- VSC07BTE59- Techniques in Enzymology

DSE-PR-V DSC07BTE59-Techniques in Genetic Engineering and Industrial Biotechnology

VSC-PR-V- VSC07BTE69-Techniques in Plant Tissue Culture

DSC-PR-VI- DSC07BTE69- Techniques in Agriculture Biotechnology and Bioinformatics.

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.

Nature of Practical Exam Question Paper- 50 Marks

DSC07BTE-59- Techniques in Genetic Engineering and Industrial Biotechnology

Q.1 Major Experiment - 20 Marks
Q.2 Minor Experiment - 10 Marks
Q.3 Viva Voice- 05marks
Q.4 Spotting- 05 Marks (5 spots- each carry one mark)
Q.5 Journal and Practical Note book- 05 and 05 marks total = 10 marks
Total = 50

DSC07BTE69- Techniques in Agricultural biotechnology and Bioinformatics

Q.1 Major Experiment 20 Marks
Q.2 Minor Experiment 10 Marks
Q.3 Spotting 05 Marks (5 spots- each carry one marks)
Q.4 viva voice 05 Marks
Q.5 Journal/notebook 10 Marks
Total = 50 marks

VSC-PR-IV- VSC07BTE59- Techniques in Enzymology -- Total 25 M

Q.1 Major Experiment 10 Marks
Q.2 Minor Experiment 05 Marks
Q.3 Spotting 04 Marks (4 spots- each carry one marks)
Q.4 viva voice 03 Marks
Q.5 Journal 03 Marks

VSC-PR-V- VSC07BTE69- Techniques in Plant Tissue culture -- Total 25 M

Q.1 Major Experiment 10 Marks
Q.2 Minor Experiment 05 Marks
Q.3 Spotting 04 Marks (4 spots- each carry one marks)
Q.4 viva voice 03 Marks
Q.5 Journal 03 Marks

Seat Number	_____

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR

Semester: _____ Examination: _____

Class: _____ Subject: _____ Paper No: _____

Subject Code: _____ Q. Paper Code: _____

Date: _____

Time: _____ Total Marks:40

Instructions: - 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat labeled diagram wherever necessary.

Q1. Choose the correct alternative and rewrite the following sentences: 8 Marks

(i)
(ii)
(iii)
(iv)
(v)
(Vi)
(Vii)
(viii)

Q2 Attempt any two of the following (two out of three) 16 marks

(i)
(ii)
(iii)

Q3 Attempt any four of the following (four out of six) 16 marks

(i)
(ii)
(iii)
(iv)
(v)
(vi)

Nature of Theory Question Paper- 40 Marks		
Q. No. 1	**Multiple Choice based objective type question (four options for each question be given)**	**08 Marks**
Q. No. 2	**Attempt any two of the following (out of three)**	**16 Marks**
Q. No. 3	**Attempt any four of the following (4 out of 6)**	**16 Marks**
	Total	**40 Marks**

Internal Marks evaluation – for 10 Marks in the form of either of the following as Short answer/ one-word answer Assignment/ short note/ MCQ/ long answer/Seminar/Fill In the Blanks etc. Minimum Qualify 4 M for Internal Exam.

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