"Education for Knowledge Science and Culture"

- **Dr Bapuji Salunkhe**

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE

KOLHAPUR

(AUTONOMOUS),

DEPARTMENT OF BIOTECHNOLOGY

Syllabus For

Bachelor of Science Part - II

BIOTECHNOLOGY (ENTIRE)

SEMESTER III AND IV - (CBCS)

(Syllabus to be implemented from June, 2022 onwards.)

CHOICE BASED CREDIT SYSTEM SYLLABUS
For Bachelor of Science Part - II BIOTECHNOLOGY (Entire)

1. TITLE: Biotechnology-Entire

2. YEAR OF IMPLEMENTATION:- CBCS Syllabus will be implemented from June, 2022 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students at first year of three years of B.Sc. degree course. Students learn Biotechnology as a separate subject from B.Sc. II. The goal

of the syllabus is to make the study of Biotechnology popular, interesting and encouraging to the students for higher Studies including research. The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE COURSE / PAPER:

1) To make the students knowledgeable with respect to the subject and it's practicable

Applicability.

2) To promote understanding of basic and advanced concepts in Biotechnology.

3) To expose the students to various emerging areas of Biotechnology.

4) To prepare students for further studies, helping in their bright career in the subject.

5) To expose the students to different processes used in industries and in research field.

6) To prepare the students to accept the challenges in life sciences.

7) To develop skills required in various industries, research labs and in the field of human health.

5. DURATION

• **The course shall be three year full time course.**

6. PATTERN:-

Pattern of theory Examination will be Semester. Practical examination will be annual

7. MEDIUM OF INSTRUCTION:

The medium of instruction shall be English.

3) OTHER FEATURES:

(A) LIBRARY:

Reference and Text Books, Journals and Periodicals, Reference Books. – List Attached

(B) LABORATORY SAFETY EQUIPMENT:

1) Fire extinguisher

2) First aid kit

3) Fumigation chamber

4) Stabilized power supply

5) Insulated wiring for electric supply.

6) Good valves & regulators for gas supply.

7) Operational manuals for instruments.

8) Emergency exits.

- Guidelines shall be as per B. Sc. Regular Program.
- Rules and Regulations shall be as per B. Sc. Regular Program except

CBCS. B. Sc. II Structure of Program and List of Courses. Preamble:

This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students of B. Sc. Biotechnology Entire Program. Students learn Biotechnology as a separate course (Subject) from B. Sc. II.

- The goal of the syllabus is to make the study of Biotechnology popular, Interesting and encouraging students for higher studies including Research.

Structure of Program and List of Courses are as follows:

B.Sc Part II CBCS Biotechnology (Entire) (Sem III and IV)

Course code	Name of Course	Credit	Course code	Name of course	Credit
Semester III			**Semester IV**		
DSC 1345C	Genetics	**2**	**DSC 1345D**	Immunology	**2**
DSC 1346C	Biophysics and Enzymology	**2**	**DSC 1346D**	Advances in Cell Biology	**2**
DSC 1347C	Metabolic Pathways	**2**	**DSC 1347D**	Plant Biochemistry	**2**
DSC 1348C	Ecology	**2**	**DSC 1348D**	Environmental Biotechnology	**2**
DSC 1349C	Molecular Biology-I	**2**	**DSC 1349D**	Molecular Biology-II	**2**
DSC 1350C	Plant Tissue Culture	**2**	**DSC 1350D**	Animal Tissue Culture	**2**
AECC-C& D	Environmental Studies		(Theory + Project)		**4**

AECC – C & D: - Ability Enhancement Compulsory Course: Environmental Studies

Practical V	Techniques in Genetics, Immunology and Cell Biology	**8**	**Practical VI**	Techniques in Plant Tissue Culture and Environmental Biotechnology	**8**
Practical VII	Techniques in Molecular Biology and Metabolic Pathways	**8**			

CBCS credit Structure of B.Sc. II - Biotechnology (Entire)

Semester III -Duration - 6 Months.- for 2022-23

Sr.No.	Course Subject Title	Teaching scheme						Examination Scheme							
		Theory			Practical			Theory							
		Credit	No .of Lecture	Hours	Credit	No .of Lecture	Hours	Hrs.	Max Marks	Min.	Total			Total	
											Max	Min	Hours	Max	Min
1	DSC-1345 - C Genetics	2	3	2.4	4	6.4	8	2	35	12	15	06	0.5	50	18
2	DSC-1346-C Biophysics & Enzymolgy	2	3	2.4				2	35	12	15	06	0.5	50	18
3	DSC-1347-C Metabolic Pathways	2	3	2.4	4	6.4	8	2	35	12	15	06	0.5	50	18
4	DSC-1348-C Ecology	2	3	2.4				2	35	12	15	06	0.5	50	18
5	DSC-1349-C - Molecular Bio - I	2	3	2.4	4	6.4	8	2	35	12	15	06	0.5	50	18
6	DSC-1350-C - Plant Tissue Culture	2	3	2.4				2	35	12	15	06	0.5	50	18
7	SEC- Skill enhancement course - Basics of Forensic sci SEC-C -1PC	2													
		14	**18**	**14.4**	**12**	**19.2**	**24**		240	84				**300**	

Semester IV -Duration - 6 Months. For 2022-23

Sr.No.	Course Subjecct Title	Teaching scheme						Examination Scheme							
		Theory			Practical			Theory							
		Credit	No.of Lecture	Hours	Credit	No.of Lecture	Hours	Hrs.	Max Marks	Min.	Total			Total	
											Max	Min	Hours	Max	Min
1	DSC-1345 - D - Immunology	2	3	2.4	4	6.4	8	2	35	12	15	06	0.5	50	18
2	DSC-1346 - D - Adv. In Cell biology	2	3	2.4				2	35	12	15	06	0.5	50	18
3	DSC-1347- D - Plant Biochemistry	2	3	2.4	4	6.4	8	2	35	12	15	06	0.5	50	18
4	DSC-1348 - D - Environmental Biotechnology	2	3	2.4				2	35	12	15	06	0.5	50	18
5	DSC-1349 - D -Molecular Biology - II	2	3	2.4	4	6.4	8	2	35	12	15	06	0.5	50	18
6	DSC-1350 - D - Animal Tissue culture	2	3	2.4				2	35	12	15	06	0.5	50	18
7	AECC - Environmental Studies	4	4	3.2											
8	SEC- Skill enhancement course - D- Basics of Forensic sci SEC –BIOTECH (Entire)	2							100	40	NA	NA			
	Total	**18**	22	**17.6**	**12**	**19.2**	12							**300**	
	Total Credit B.Sc .II Biotechnology (Entire) Sem.III & IV	**32**	**40**	**32**	**24**	**38.4**	**24**								

CBCS credit Structure of
B.Sc .II - Biotechnology
(Entire)

Student contact hre /week 32 hours per min.

Theory & Practical lectures -48 Min/each
DSC Discipline Specific core course- All Paper compulsory

AECC - Ablity enhancement compulsory course EVS theory 70 Marks & Project 30 Marks

There shall be separate passing for theory, Internal & Practical Course including EVS

Total Marks excluding EVS = 900
Total Credit B.Sc .II Biotechnology (Entire) Sem.III & IV

Theory 32+ Practical 24 = 56

Practical	Max	Min	
Pra.V	100	35	
Pra.VI	100	35	
Pra.VII	100	35	
	300		

Theory + Practical excluding EVS **900**

Topic No.	DSC 1345C- Genetics	Lectures 30
	Credit-I	
1	**Mendel's law of Inheritance** – Mendel's Experiment, Dominance and recessiveness, Principle of segregation, independent assortment, back and test cross. **Deviations of Mendel laws -** Incomplete dominance, co-dominance, multiple allele. Modifiers, suppressors, pleiotropic gene. **Interaction of gene**-Dominant and Recessive Epistasis. **Linkage -** Definition, coupling and repulsion hypothesis, linkage groups. **Crossing over**-Mechanism and theory. **Structural and numerical changes in chromosomes**. **Extra chromosomal or cytoplasmic or organellar inheritance**-mitochondrial and plastid.	**15**
	Credit II	
2.	**Mutation:** Definition, Types (spontaneous and Induced) Mechanism of Mutagenesis- Base analogue, Nitrous acid, hydroxyl amine, alkylation agent, Acridine dyes, U.V. Light. **Plasmid**- Types, Structure, properties and applications. **Genetic recombination in bacteria-** Definition, fate of exogenote in recipient cell, transformation, conjugation, transduction. **Genetics Disease:** Autosomal and Sex Linked	**15**

References:

1. Strickberger "Genetics"
2. Freifelder "Genetics"
5. Stanier "General Microbiology"
6. P. K. Gupta "Genetics"
7. C. Sarin "Genetics"
8. Larry Snyder Wendy Champness "Molecular Genetics of Bacteria"

Topics No	DSC 1346C- Biophysics and Enzymology	Lectures 30
	Credit- I	
1.	**Atomic Absorption Spectroscopy:** Introduction, Principle, Instrumentation, Applications. **X-ray Crystallography-** Expression for interplaner distance, Bragg's Law, X-Ray diffraction by crystal **NMR-** Introduction, Quantum Description of NMR, spin spin coupling, Chemical shift, Instrumentation, Application. **IR spectroscopy** – Introduction, vibration spectra (without proof), possible modes of vibrations of atoms in polyatomic molecules, Instrumentation, Applications. **ESR Spectroscopy** – Principle, Instrumentation, Applications.	**15**
	Credit-II	
2.	**Factors affecting enzyme activity-** Temperature, pH, substrate concentration, inhibitors, enzyme concentration Activators **Factors affecting catalytic activity efficiency of enzyme –** Proximity orientation, Strain and Distortion, Covalent catalysis, Acid- base catalysis. **Allosteric enzymes-** Definition, properties, models explaining mechanism of action- sequential model, Symmetry Model.(Aspartate transcarbamylase). **Isozyme**- Example Lactate dehydrogenase structure and function. **Immobilization of enzyme -** Advantage and disadvantages, Application, Methods of immobilization, Methods of immobilization--Physical adsorption , Covalent bonding, Entrapment, Encapsulation, Cross-linking **Biosensor-**Definition, Components, Features, Types of Biosensor-Enzyme electrode(glucose oxidase), Bacterial electrode / Cell based electrode, Enzyme immunosensor, Environmental Biosensor, Bioreporter	**15**

References:

1. Handbook on Analytical Instruments –R. S. Khandpur. (Mc. Graw Hill).
2. Biophysical Chemistry - Upadhyay, Nath, Upadhyay (Himalaya Publishing House).
3. Introduction to Molecular Spectroscopy – C.N.Banwell.
4. Biophysics ,Mohan P. Arora, Himalaya Publishing House, Delhi
5. Practical Biochemistry- Wilson and Walker
6. Enzymology by palmer
7. Biophysics by Daniel

Topic No.	DSC 1347C - Metabolic Pathways	Lectures 30
1.	**Credit- I**	**15**
	Metabolism:- Introduction to metabolism, anabolism & catabolism, catabolism & its three stages, types of metabolic reactions, Methods employed to study metabolism (by cell free extract, using auxotrophic mutants, radioisotopes), High energy compounds enlist some examples 5 to 6. **Carbohydrates Metabolism:-**Reactions and energetics of Glycolysis, Gluconeogenesis, TCA cycle, Glyoxylate cycle, HMP and its significance. Shuttle system- Malate Aspartate shuttle system, Glycerol 3 Phosphate shuttle system. Cori Cycle	
2.	**Credit-II**	**15**
	Lipid Metabolism: Biosynthesis of fatty acid with respect to Palmitic acid & degradation of fatty acid (β-oxidation) with respect to Palmitic acid. **Respiration:-** Aerobic:-Flow of electrons in ETC, Redox potential components of ETC, Mechanism of ATP generation- Chemiosmotic hypothesis, ATP synthase complex. Inhibitors of ETC **Anaerobic Respiration:-** Alcoholic and Lactic acid fermentation**.**	

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References:-

1) Biochemistry- Lubert Stryer
2) Biochemistry- Nelson and Cox
3) Practical Biochemistry- Wilson and Walker
4) Fundamentals of Biochemistry – J. L. Jain
5) Principals of Biochemistry- Voet and Voet
6) Fundamentals of Plant Physiology- V. K. Jain

Topic No.	DSC 1348C – Ecology	Lectures 30
	Credit- I	
1.	**Ecosystem-** Concept, structure, function. **Productivity-** Kinds of productivity. **Food chain-** types of food chain, food web, concept of tropic level, **Ecological pyramids-** concepts and types. **Energy flow in ecosystem** –concept of energy, unit of energy, ecological energetics, laws governing energy transformation, ecological efficiency, **Biogeochemical cycle** Carbon cycle, Nitrogen cycle, Sulphur cycle, Phosphorus cycle **Concept - Habitat and Niche** **Concept of Ecological Succession**	**15**
	Credit-II	
2.	**Population Ecology-** Introduction, population characteristics, Natality, Mortality, survivor ship curves, age structure, age pyramid. **Population growth-** Exponential and logistic, r and k strategists. **Evolution :-** Theories of evolution-Lamarckism, Darwinism, Modern synthetic theory & mutational theory. Evidences of evolution and Adaptive radiation and Adaptive conversation. Concept of species and speciation. **Hardy-Weinberg law and Equation.**	**15**

References:

1. Fundamentals of ecology ; E.P Odum.
2. Concept of ecology ; Dash.
3. Enviornmental Biology,Verma & Agarwal
4. Enviornmental Science., Saigo, Canninhham
5. General ecology., H.D.Kumar

No.	DSC 1349C - Molecular Biology- I	30
	Credit I	
1.	**Experimental Evidences for DNA as a genetic material:-** Griffith's Exp., Avery, Macleod, McCarty Exp., Blender Exp., RNA As a genetic material Gierer and Schram expt. **Properties and Function of DNA:-** Tm, Cot Curve, Purity of DNA, Acid- Base Nature, Buoyant Density Concept of Gene, Unit of Gene (Cistron, Recon, and Muton), Fine Structure of gene, One gene One Polypeptide Hypothesis, interrupted gene. **Organization of genome:-**Viral (Lambda, T4), Bacteria (E. *coli*), Eukaryote, Typical Structure of chromosome (Euchromatin & Heterochromatin), Packaging of DNA (Nucleosome, Solenoid Model).	**15**
	Credit II	
2.	**Nucleic Acid biosynthesis:-** De novo synthesis of Purine and Pyrimidine ring, Salvage Pathway, Feedback inhibition. **DNA Replication-** Semi conservative model of replication (M.S Expt.). Direction of replication (Uni & Bidirectional). Prokaryotic and eukaryotic replication- Enzymes involved in replication, initiation, elongation and termination. Rolling circle model and telomere replication. **DNA Repair** DNA repair- Direct repair, Excision repair (Nucleotide and Base), Mismatch repair, SOS repair, Recombination repair, Repair of double strand DNA break.	**15**

References:

1) Molecular biology by Watson
2) Genetics by Strickberger
3) Molecular Biology by Glickpastornack
4) Molecular biolage Geralad Carph
5) Gene By Levin

Topics No	DSC 1350C - Plant Tissue Culture	Lectures 30
	Credit- I	
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, equipments and instruments required and other requirements. **Aseptic Techniques-** Washing and preparation of glassware's, 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. **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.	**15**
	Credit-II	
2.	**Anther & Pollen Culture Technique-** Introduction, principle, protocol, factors affecting and applications. **Micropropagation-** Introduction, stages of Micropropagation, factors affecting, advantages and applications. **Different Pathways of Micropropagation-** Auxiliary bud proliferation, somatic embryogenesis, organogenesis and meristem culture. **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.	**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

Topic No.	DSC – 1345 D Immunology	30
	Credit- I	
1.	**Introduction-** **Types of immunity**-i)Innate (specific and non-specific) ii) Acquired (Active and Passive), **Types of Defense-** a) first line of defense (barriers at the portal of entry, physical and chemical barriers) b) second line of defense (Phagocytosis– oxygen dependent and independent) c) third line of defense-specific defense mechanism. **Introduction to cells and organs of immune system-** Organs of immune system-primary and secondary lymphoid organs-structure and their role. Cells of immune system-a)broad categories of leucocytes, their role and properties b) B-lymphocytes c) T-cells-subsets d) other cells (APC, Null, NK)	**15**
	Credit-II	
2.	**Antigen and Antibody** **Antigen-** definition, nature, types of antigen, factors affecting antigenicity. **Antibody-** definition, nature, basic structure of immunoglobulin molecule, major human immunoglobulin classes, properties and functions. Theories of antibody production. **Immune response**-primary and secondary immune response, **Antigen Antibody reactions**-Principle and applications of a)agglutination b) Precipitation c) complement fixation d) ELISA. **Hypersensitivity-** Concept and types with example. (Type-I,II,III)	**15**

References:

1. Riott “Essential Immunology”
2. Kuby “Immunology”
3. Ashim Chakravar “Immunology and Serology”
4. Tizzard “Immunology-An Introduction”-4th Edition
5. S. K. Gupta “Essentials of Immunology”
6. M. P. Arora “Immunology”

DSE 1346D- Advances in Cell Biology		
Topic No	**Credit-I**	**Lectures 30**
1.	**Secretary pathway and protein trafficking** Secretary pathway-ER associated ribosomal translation, co-translational vectoral transport of nascent polypeptide chain to ER lumen. Transport to Golgi apparatus, secretary granules. Transport of proteins to- mitochondria, chloroplast, peroxisomes, nucleus. **Cell signaling** Introduction, general principles of cell signaling. Types of cell signaling-contact dependent signaling, autocrine, paracrine, synaptic, endocrine, gap junctions, combinatorial signaling. Cell surface receptor proteins- Ion channel linked receptors, G-protein linked receptors and enzyme linked receptors. Signaling through G-protein coupled receptors.	**15**
	Credit II	
2.	**Cell division cycle** Introduction, definition, phases of cell cycle. Regulation of cell cycle- CDK and cyclins (G-CDK, S-CDK, M-CDK and APC). Cell cycle checkpoint-Start checkpoint, G2/M checkpoint, Metaphase to anaphase transition Programmed cell death. Cancer - types, characteristics of cancer cells, causes of cancer, tumor suppressor genes. **Cell division** Introduction and types of cell division-amitosis, mitosis and meiosis. Mitosis- history, phases in mitosis, significance. Meiosis -history, phases in meiosis, significance. Role of spindle fibers in chromosome separation. Condensation of chromosome. Synaptonemal complex.	**15**

References:-

1) Molecular biology of cell-Albert
2) Molecular biology & cell biology – Loddish et al
3) Cell biology –De Robertis
4) Cell biology-Genetics, molecular biology-P.S. Warma & Agarwal
5) Genes- Lewin
6) Cell biology –Geral karp
7) Practical biochemistry – Keith Wilson and Walke

Topic No.	DSC 1347D -Plant Biochemistry	Lectures 30
	Credit - I	
1.	**Plant Water Relation:-** Introduction, Absorption of water-Mechanism, Theories (Active and Passive), Translocation of water- Mechanism, Theories (Root pressure, Capillary), Transpiration. **Photosynthesis:-**Ultra structure of chloroplast, Photosynthetic pigments, red drop and Emerson's enhancement effect, mechanism of photosynthesis, light reaction, dark reaction, C-3 pathway, C-4 pathway, CAM, photorespiration.	**15**
2.	**Credit-II**	**15**
	Nitrogen Metabolism: - Role of nitrogen in plants, source of nitrogen, nitrogen fixation- symbiotic & Non-symbiotic, Mechanism of Nitrogen fixation, nif gene- concept and significance, transamination. **Introduction to Plant Hormones** Biosynthesis of plant hormones- Auxin, Cytokinin, Gibberellin. **Secondary metabolite:** Introduction, Classification and its biological application **Concept**: Photoperiodism and Vernalisation.	

References:-

1) Biochemistry- Lubert Stryer
2) Biochemistry- Nelson and Cox
3) Practical Biochemistry- Wilson and Walker
4) Fundamentals of Biochemistry – J. L. Jain
5) Principals of Biochemistry- Voet and Voet
6) Fundamentals of Plant Physiology- V. K.Jain

Topic No.	DSC 1348D Environmental Biotechnology	Lectures 30
	Credit - I	
1.	**Water Pollution** -Definition, Sources and Types-Physical, Chemical and Biological, Hardness [Mechanism, Determination, Types],Water softening methods [Clark's method, Use of cation and anion exchange resins], COD and BOD [Concept, Determination], Eutrophication (Concept, Types and Control), Purification of water (Physical Methods-UV Treatment, Distillation, Chemical Methods- Chlorination, Ozonization) **Air Pollution** -Definition, Sources, London and LA Smogs (Mechanisms of Formation), Greenhouse Effect (Concept, Reasons, Role of dipole moment of gaseous molecules), Ozone Depletion (Role of CFCs, Control) **Soil Pollution** -Definition, Sources, Role of pesticide in soil pollution, control Measures. **Environmental Toxicology** Definition, classification and concept, Pesticide Toxicity –Classification (Organic and Inorganic), Mode of action of toxicants (Metals, organophosphates, carbamates and mutagens), Bioconcentration, Bioaccumulation, Biomagnification, Control of Toxic effects-Biotransformation and excretion.	**15**
	Credit II	
2.	**Environmental Impact Assessment-** Introduction, History, Process, salient features and Importance **Bio Fuel production** Production of Bio ethanol from sugary and starchy sources. Production ,Advantages and limitation of Biodiesel **Bioremediation Techniques** -Definition, Principle, *Insitu and Exsitu* Bioremediation, Bioremediation of waste waters (MSW, BSW and ISW), Activated Sludge Process, Lagoons, Oxidation ponds, Trickling filter. Solid Waste Treatment [Plastics and Aromatics], Slurry Phase Treatment, Agricultural Bioremediation- Microbial Composting, Biogas, Land Farming and pest Control, Bioremediation of Industrial wastes, Xenobiotics, Bioaugmentation and Biofiltration.	**15**

References:-

1. Applied and enviornmental Microbiology; Amann, R.I Stromely,J.Stahl.
2. Enviornmental Biotechnology. , Chattergy.
3. Enviornmental Biology,Verma Agerwal
4. Enviornmental pollution, Peavy and Rowe.
5. Enviornmental problems and solution. and Enviornmental Science., Saigo,

Topic No	DSC 1349D – Molecular Biology-II	Lecture 30
	Credit-I	
1.	**Transcription in prokaryote and Eukaryote** Mechanism of transcription-Enzyme involved, initiation, elongation and termination. Inhibitors of transcription, Post transcriptional modification, Transcriptional control by hormones. **Genetic Code** Properties of genetic code. Assignment of codons with Unknown sequences a) Polyuridylic b) Acid Copolymers method. Assignment of codons with known sequences a) Binding technique b) Repetitive seq. technique. Wobble Hypothesis, Variation in genetic code.	**15**
2.	**Translation in prokaryote and Eukaryote** Structure and role of ribosome in translation, Amino acid t-RNA complex formation, Initiation, Elongation, termination of translation Inhibitors of translation. Post- translation modifications (Protein folding, Removal of Leader sequences, Phosphorylation, Glycosylation). **Regulation of gene expression in prokaryote and eukaryote.** Regulation of gene expression in prokaryote a) Lac operon b) Tryptophan operon c) Arabinose operon. **Regulation of gene expression at transcriptional and translation level.**	**15**

References:

1) Molecular biology by Watson
2) Genetics by Strickberger
3) Molecular Biology by Glickpastornack
4) Molecular biolage Geralad Carph
5) Gene by Levin
6) Genome by T.A. Brown

Topic No	DSC 1350D Animal Tissue Culture	Lectures 30
	Credit - I	
1.	**History and Introduction of Animal Cell culture**- History of animal cell culture **Requirements of Animal cell 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). **Laboratory design and layout**-Construction and services, layout of aspetic room (sterile handling area, laminar air flow, service bench), incubation (incubators, hot room), preparation area (media preparation, washing area, storage). **Cultured cells- Biology and Characterization-** Characteristics of cultured cells, cell adhesion, cell proliferation, cell differentiation, metabolism of cultured cells, Initiation of cell culture, Evolution and development of cell lines. **Characterization of cultured cells-** Morphology of cells, species of origin of cells, Identification of tissue of origin, transformed cells, Identification of specific 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, Maintainance of cell culture, Subculture, Stem cell cultures **Scale up of Animal cell 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, Microcarrier 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] Animal tissue culture- Paul
2] Culture of animal cell 3rd edition-R Ian Freshney
3] 3] Animal cell culture-
R.W.Masters
4] Animal biotechnology-M.M.Ranga

Practical V -Techniques in Genetics, Immunology and Cell Biology	
Sr. No.	**Name of the Practical**
Major Experiments	
1	Isolation of Lac negative mutants of *E. coli* by visual detection method.
2	Isolation of Streptomycin resistant mutants by gradient plate technique.
3	Conjugation in *E. coli.*
4	U.V survival curve.
5	ELISA-dot ELISA.
6	Rocket Immuno electrophoresis
Minor Experiments	
1	Radial immune diffusion Assay.
2	Immuno electrophoresis- (Qualitative).
3	Widal test – Qualitative and Quantitative.
4	RPR card test.
5	Problems based on Mendelian Inheritance, linkage and crossing over.
6	Testing of Carcinogenicity of substance by Ame's Test.
Techniques in Cell Biology	
Sr. No.	**Name of the Practical**
Major Experiments	
1	Isolation of chloroplast.
2	Isolation of nucleus.
3	Isolation of mitochondria.
4	Study of Meiosis.
5	Study of Mitosis.
6	Estimation of Amount of Chlorophyll present in leaf/ plant tissue
Minor Experiments	
1	Study of bacterial cell lysis.
2	Use of dialysis to separate smaller molecules than larger molecules.
3	Effect of temperature and organic solvent on membrane permeability of cells
4	Measurement of size of pollens/cell organelle/spores by micrometry.
5	Study of plasmolysis.
6	Protoplast isolation form plant tissue.

Practical-VI Techniques in Molecular Biology and Metabolic Pathways	
Techniques in Molecular Biology	
Sr. No.	**Name of the Practical**
Major Experiments	
1	Eukaryotic DNA Isolation from Plant Material.
2	Eukaryotic DNA isolation from Animal Material.
3	Purification of DNA by silica membrane (solution based).
4	Plasmid isolation from Bacteria.
5	Isolation of RNA from plant.
6	SDS-PAGE for separation of protein using CCB.
Minor Experiments	
1	Genomic DNA isolation from bacteria.
2	Agarose gel electrophoresis to separate DNA.
3	Agarose gel electrophoresis to separate RNA.
4	Restriction digestion of DNA.
5	Silica Gel Extraction by spin column method.
6	Plasmid isolation by spin column method.
Techniques in Metabolic Pathways	
Sr. No.	**Name of the Practical**
Major Experiments	
1	Estimation of fructose by Resorcinol method.
2	Estimation of DNA by Diphenylamine method.
3	Estimation of RNA by Orcinol Method.
4	Isolation of Amylase from germinating seed and determination of its activity.
5	Estimation of Total Phenolic Content of Plant Extract of by Folin - Ciocalteau Method
6	Determination of Km of Amylase.
Minor Experiments	
1	Effect of Activator on enzyme activity of amylase
2	Effect of Inhibitor on enzyme activity of amylase.
3	Study of nitrate reductase activity.
4	Estimation of Indole-3 Acetic Acid by (Salkowaski reagent) Colorimetric method.
5	Determination of Antioxidant activity of Plant extract by suitable method
6	Separation of Chlorophyll pigment by Silica Gel Column Chromatography.

Practical VII- Techniques in Plant Tissue Culture and Environmental Biotechnology	
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- Initiation of culture and study of callus morphology.
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
Techniques in Environmental Biotechnology	
Sr. No.	**Name of the Practical**
Major Experiments	
1	Estimation of COD of Industrial Effluent sample.
2	Estimation of BOD of domestic waste sample.
3	IMVIC Test
4	Determination of phenol coefficient of phenol derivative.
5	Determination of total and permanent hardness of water sample.
6	Isolation of phages of *E. coli* from sewage.
Minor Experiments	
1	Determination of TDS of water sample.
2	Routine bacteriological analysis of water Presumptive, Confirmatory, Completed, MPN.
3	Isolation of microorganism from air by solid impaction technique.
4	Study of effect of heavy metal on growth of organisms.
5	Determination of total ash content of given sample.
6	Determination of moisture content of given soil sample.

List of minimum equipment's-for Biotechnology

1) *Hot air oven - 1*
2) *Incubator - 1*
3) *Autoclave - 1*
4) *Refrigerator - 1*
5) *Students microscopes (oil immersion) - 10 nos. for one batch*
6) *Digital balance - 2*
7) *pH meter - 1*
8) *Centrifuge - 1*
9) *Colorimeter - 1*
10) *Distilled Water Plant - 1*
11) *Laminar air flow cabinet - 1*
12) *Colony counter - 1*
13) *Water bath - 1*
14) *Arrangements for gas supply and fitting of two burners per table.*
15) *One working table of 6' x 2½' for two students.*
16) *One separate sterilization room attach to the laboratory (10' x 15')*
17) *At least one wash basin for a group of five students*
18) *One separate instrument room attached to lab (10' x 15')*
19) *One laboratory for one batch including working tables (6' x 2½') per two students for One batch*
20) *Store room (10' x 15')*

Practical Examination

(A) The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course online laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Note:- At least 90% Practical's should be covered in practical examination.

Nature of Question Paper (Theory)

Instructions

1. All the questions are compulsory.
2. Figures to the right indicates full marks.
3. Draw neat labeled diagram wherever necessary.

Time: 2 Hrs **Total Marks**: **35**

Q. 1. (A) Rewrite the sentences by selecting correct alternative from the following. (5 Marks)

i.

a) b) c) d)

As above (i) to (v)

Q. 1. (B)fill in the blanks. (02 Marks)

(i)_____

(ii) _____

Q. 2. Attempt any two. (16 Marks)

i.

ii.

iii..

Q. 3. Attempt any four. (12 Marks)

i.

ii.

iii..

iv.

v.

Scheme of marking (Theory)

Semester	Core Course	Marks	Evaluation	Standard of passing
III.	DSC - C	35	semester wise	35% (12 M)
IV	DSC - D	35	semester wise	35% (12 M)

Scheme of marking (CIA - Continuous Internal Evaluation)

Semester	Core Course	Marks	Evaluation	Standard of passing
III.	DSC - C	15	semester wise	35% (6 M)
IV	DSC - D	15	semester wise	35% (6 M)

Scheme of marking (practical)

Semester	Marks	Evaluation	Standard of passing
III & IV	100	Annual	35% (18 M)

Note: For Semester I & II for both DSC-C & D, 6 subject theory papers of 30 Hrs. (36.5 Lectures) Credit - 2

Practical Examination Annual having 3 Practical V to VII (each having 100 Marks)

For Continuous Internal Evaluation/Examination - 15 Marks

"Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's
Vivekanand College Kolhapur, (Autonomous).

New course structure to be implemented after sanction(Draft)
For B.Sc-II Biotechnology -Entire 2022-2023

Nature of Internal and SEE(Semester End Examination)Examination

Sr. No.	Internal Examination DSC Course		Total = I (a + b)	Conversion of 30 marks in Total (I) (c)	SEE (Semester End Examination) DSC Course (d)	Total (II) (c + d)
	Two tests each of 10 marks (a)	Home assignment (b)				
1	20	10	30	15	35	**50**

1) For internal examination, there shall be two tests (online/offline) of ten marks and one home assignment of 10 marks for each paper per semester.
2) For internal examination there shall be conversion of 30 marks in 15 marks and for passing 6 marks is required out of 15.
3) For SEE (Semester End Examination), there shall be examination of 35 marks of each course per semester, and for passing 15 marks is required out of 35.
5) There shall be separate passing is mandatory for both internal and SEE (Semester End Examination).

Practical Examination B.Sc.II-Biotechnology -Entire for 2022-2023 (as per BoS guidelines)

Sr.No.	Lab work	Journal (Punctuality, Neatness)	Attendance, and participation in the practical's, motivation	Total
1	80	10	10	100

Vivekanand College, Kolhapur (Autonomous)
Department of Biotechnology
Course outcome of B.Sc-II (Entire) Biotechnology CBCS
Subject wise both Semester-III and IV
Implemented from 2022-23

Subject Offered Sem-III:- C	Course Outcome
DSC 1345C Genetics	At the end of this course students will be able to: CO 1. Outline of Mendelian inheritance. CO2. Demonstrate the chromosome structure, chromatin organization and variation using model. CO 3. Perceive knowledge about the genetic disease. CO 4. Predict and illustrate model of Pedigree analysis.
DSC 1346C Biophysics and Enzymology	At the end of this course students will be able to: CO 1. Illustrate the importance of spectroscopy. CO 2. Choose the appropriate spectroscopy for specific bimolecule to interpret its structure. CO 3. demonstrate the experimental optimization of Enzyme activity and factors influencing them. CO 4. Able to construct the models explaining the mechanism of enzyme action.
DSC 1347C Metabolic Pathways	At the end of this course students will be able to: CO 1. compare different biochemical reactions in cell CO 2. Explain different methods to study metabolism. CO 3. Conclude the stiochiometry of metabolic pathways. CO 4. To analyze the relation between ATP generation and Electron transport Chain.
DSC 1348C Ecology	At the end of this course students will be able to: CO 1. Appreciate the ethical, cross-cultural and historical context of environment with respect to classical Ecology. CO 2. Construct the relationship between different biogeochemical cycles. CO 3. Outline the importance of population ecology. CO 4. Reflect the importance of Evolution theories in Ecology.
DSC 1349C Molecular Biology-I	At the end of this course students will be able to: CO 1. Explain structure and function of the macromolecules CO2. List the underlined mechanism of Nucleotide Biosynthesis CO3. Compare the mechanism of replication in prokaryotes and eukaryotes. CO 4. Discuss DNA damage and repair mechanism,
DSC 1350C Plant Tissue Culture	At the end of this course students will be able to: CO 1. Construct the design required to set up plant tissue culture laboratory. CO 2. Differentiate between different PTC techniques. CO 3. Illustrate the importance of Asepsis. CO 4. to become entrepreneur in PTC.

Subject Offered Sem-IV:- D	Course Outcome
DSC 1345D Immunology	At the end of this course students will be able to: CO 1. Differentiate between different types of immunity. CO 2. Classify cells of immune system. CO 3. Construct models demonstrating antigen-antibody interaction. CO 4. Perform various serological tests for diagnosis of various types' diseases.
DSC 1346D Advances in Cell Biology	At the end of this course students will be able to: CO 1. Elaborate the mechanism of cell communication. CO 2. Roles of different organelle in protein trafficking. CO 3. Predict causes of Cancer CO 4. Understand the mechanism of cell division
DSC 1347D Plant Biochemistry	At the end of this course students will be able to: CO 1. Explain mechanism of water absorption. CO 2.illustrate concept of photosynthesis. CO 3. Differentiate between symbiotic and non symbiotic Nitrogen fixation. CO4. Predict the relationship between vernalisation and photoperiodism.
DSC 1348D Environmental Biotechnology	At the end of this course students will be able to: CO 1. Classify different kinds of pollution CO 2.Describe the concept of toxicity. CO 3. Describe sources of bioethanol production CO4. Discover the different ways of Bioremediation
DSC 1349D Molecular Biology-II	At the end of this course students will be able to: CO 1. Compare the mechanism of Transcription & post-transcriptional modification in prokaryotes and eukaryotes CO 2.outline the character of genetic code CO 3. Compare the mechanism of Translation & post-translational modification in prokaryotes and eukaryotes CO4. Draw a contrast between operon model and normal gene expression.
DSC 1350D 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. Define scale up of animal cell culture. CO4. Appreciate the importance of stem cell technology.

Course Code	Course /SEC Titles (old)	Course / SECs Titles (Proposed new)	% of Proposed Change in syllabus	COs and POs with relevance to local/ regional /needs	COs & POs with relevance to national needs	COs & POs with relevance to global needs	Content that directly promotes employment/skills/entrepreneurship	Content with cross cutting issues such as Human values, gender and environment, sustainability, professional ethics
Dsc-1345-C	Genetics	Genetics	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Helps to set up genetic analysis lab	Clears the myths about genetic diseases
Dsc-1346-C	Biophysics &Enzymology	Biophysics &Enzymology	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Draws relation between local clinical lab and pathology lab skills	Promotes healthy work environment for Womens in labs
Dsc-1347-C	Metabolic Pathways	Metabolic Pathways	15%	Relevant to Regional /local needs	Fulfils National needs.	Fulfils Global needs.	Helps in developing biochemical fertilizer lab set up	Promotes healthy work environment for Womens in labs
Dsc-1348-C	Ecology	Ecology	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Promotes Skills development as per local needs	Help to understand the importance of nature and dependence of human kind on it
Dsc-1349-C	Molecular Biology-I	Molecular Biology-I	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Directly Promotes entrepreneurship by setting up a molecular biology analysis kits industry	Promotes healthy work environment for Womens in labs
Dsc-1350-C	Plant Tissue Culture	Plant Tissue Culture	15%	Relevant to Regional /local needs	Fulfils National needs.	Fulfils Global needs.	Helps local farmers to adopt new agricultural strategies and set up PTC lab	Clears the myths about the viability of plants obtained from Plant Tissue Culture
Dsc-1345-D	Immunology	Immunology	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Helps to set up genetic analysis lab and understand immunology	Promotes healthy work environment for Womens in labs
Dsc-1346-D	Advances in Cell biology	Advances in Cell biology	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Helps local scientist to adopt new culture strategies	Promotes healthy work environment for Womens in labs

Dsc-1347-D	Plant Biochemistry	Plant Biochemistry	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Helps in developing biochemical fertilizer lab set up	Promotes healthy work environment for Womens in labs
Dsc-1348-D	Environmental Biotechnology	Environmental Biotechnology	15%	Relevant to Regional /Needs	Fulfils National needs.	Fulfils Global needs.	Helps in developing chemical fertilizer and biofertilizer lab set up	Promotes healthy work environment for Womens in labs
Dsc1349-D	Molecular Bio-II	Molecular Bio-II	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Directly Promotes entrepreneurship by setting up a molecular biology analysis kits industry	Promotes healthy work environment for Womens in labs
Dsc-1350-D	Animal Tissue Culture	Animal Tissue Culture	15%	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Helps local scientist to adopt new culture strategies and set up ATC lab	Outline the need of Animal tissue culture and promote its importance
SEC-Biotech Entire	Basics in Forensic Science	Basics in Forensic Science	No change	Relevant to Regional / local needs	Fulfils National needs.	Fulfils Global needs.	Directly Promote Employment Skills	Help students understand importance forensics sciences and crime against womens.