“Education for Knowledge, Science and Culture”

Shikshan Maharshi Dr Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha’s

Department of Biotechnology(Entire)
B.Sc. Part II
Semester III & IV (CBCS)

Syllabus with effect from June 2019 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, 2019 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:

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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**			

DSC 1345C- Genetics

Topic No.		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. Incomplete dominance, co-dominance, multiple allele. Modifiers, suppressors, pleiotropic gene. Interaction of gene- Epistasis, complimentary gene, duplicate gene. **Linkage** Definition, coupling and repulsion hypothesis, linkage groups. Crossing over-Mechanism and theory. Structural and numerical changes in chromosomes. Maternal effect- Concept and example. 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

Subject Outcome for Genetics:

- To understand basic principles of Mendelian inheritance.
- To study cell division & chromosome segregation
- To explore the Linkage inheritance.
- To acquire the chromosome structure, chromatin organization and variation.
- To learn the concepts of Linkage concept of sex determination and sex Linked inheritance.
- To gain knowledge about the organellar inheritance.

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"

DSC 1346C- Biophysics and Enzymology

Topic No.		Lectures 30
	Credit- I	
1.	**IR spectroscopy** – Introduction, vibration spectra (without proof), possible modes of vibrations of atoms in polyatomic molecules, Instrumentation, Applications. **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.	**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)	**15**

Subject Outcome for Biophysics and Enzymology:

- Biophysics and Enzymology deals with study of detailed of spectroscopy, crystallography, NMR with respect to functions and factors affecting Enzymes catalysis.
- The course will give opportunity to understand following concepts;

a) Proximity orientation, Strain and Distortion, Covalent catalysis, Acid- base catalysis
b) Steady state kinetics
c) Allosteric Enzyme
d) models explaining mechanism of action- sequential model, Symmetry Model.

References:

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

DSC 1347C - Metabolic Pathways

Topic No.		Lectures 30
	Credit- I	
1.	**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.	**15**
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. Anaerobic Respiration:- Alcoholic and Lactic acid fermentation**.**	

Subject Outcome for Metabolic Pathways:

- Have knowledge of cellular metabolism, including central catabolic and anabolic pathways.
- Understand the principals and importance of metabolic control.
- Be able to describe the main mechanisms through which metabolic processes are controlled, and appreciate that control occurs at multiple levels.
- Understand how different control mechanisms may be integrated to coordinate cell metabolism and function.
- Understand how metabolism is coordinated in mammals, and have knowledge of how disturbances in metabolism contribute to disease.

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

DSC 1348C – Ecology

Topic No.		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 **Biodiversity** Types of biodiversity, causes of loss of biodiversity, conservation of biodiversity, importance of biodiversity, Hot Spots.	**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. Concept of species and speciation. Hardy-Weinberg law and Equation.	**15**

Subject Outcome for Ecology:

- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Understand the Biogeochemical cycle and its functioning interactions across local to global scales.
- Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

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

DSC 1349C - Molecular Biology- I

Topic		Lectures

No.		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, 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 (Nuclesome, Solenoid Model).	**15**
	Credit II	
2.	**Nucleic Acid biosynthesis:-** De novo synthesis of Purine and Pyrimidine ring, Salvage Pathway, Synthesis of Deoxyribonucleotide, 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**

Subject Outcome for Molecular Biology-I

- Molecular Biology-I gives knowledge about structure and function of the macromolecules, essential to life. Molecular Biology gives detailed knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.
- Students will gain an understanding of chemical and molecular processes that occur in and between cells. Students understanding will become such that they will able to describe and explain processes such replication and repair of DNA.
- Students will gain insight into the most significant molecular and cell-based methods used today to expand our understanding of biology.

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

DSC 1350C - Plant Tissue Culture

Topic No.		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**- Axillary 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**

Subject Outcome for Plant Tissue Culture (PDP)

- To acquaint students with Techniques of Plant.
- To impart the skills of PTC.
- The students will be technically and critically trained with good practical exposure to perform both the plant and animal culture, which is the at most required in this field of science; skilled candidates are absorbed in well established and commercial tissue culture units.
- This area can be taken up as micro propagation business with smaller investment by entrepreneurs.

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

DSC 1345D-Immunology

Topic		Lectures

No.		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. **Immune response**-primary and secondary immune response, theories of antibody production. **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**

Subject Outcome for Immunology:

- The immune system governs defense against pathogens and is of importance for development of autoimmune diseases, allergy and cancer.
- The course discusses basic immunology including cellular and molecular processes that represents the human immune system.
- This subject offers detailed study of following concepts;

a) Immunological processes at a cellular and molecular level
b) Defense mechanism (Physico-chemical barriers)
c) Innate & Acquired Immunity
d) Antigen & Antibody (Reactions)
e) Hypersensitivity

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.		Lectures 30
	Credit I	
1.	**Secretary pathway and protein trafficking**	**15**

	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.	
	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**

Subject Outcome for Cell Biology:

- Describe cytological, biochemical, physiological and genetic aspects of the cell, including cellular processes common to all cells, to all eukaryotic cells as well as processes in certain specialized cells.
- Explain cellular processes and mechanisms that lead to physiological functions as well as examples of pathological state.
- . Students will understand the cellular components underlying mitotic cell division

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

DSC 1347D -Plant Biochemistry

Topic No.		Lectures 30
	Credit- I	**15**

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.	
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, Types and its application **Concept**: Photoperiodism and Vernalisation.	

Subject Outcome for Plant Biochemistry:

- . To understand plant structures in the context of physiological function plants.
- To understand plant water relations, i.e. how plants acquire, utilize, and regulate the flow of water between plant and environment.
- To understand the mineral nutrients plants require, and how they are obtained, metabolized, and transported.
- To understand the physiological details of photosynthesis and respiration, and how they are organized and regulated in plants.
- To understand plant growth and development, and its regulation by hormones and the environment.

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

DSC 1348D Environmental Biotechnology

Topic No.		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, Potentiation and Synergism, Control of Toxic effects- Biotransformation and excretion.	**15**
	Credit II	
2.	**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 paste Control, Bioremediation of Industrial wastes, Xenobiotics, Bioaugmentation and Biofiltration.	**15**

Learning Outcome for Environmental Biotechnology:

- Students who successfully complete this unit will be able to:
- Recognise the various global and regional environmental concerns due to natural causes and/or human activities, and the impact of these on various forms of life including native biodiversity.
- Investigate some examples of different types of environmental pollution and their impacts Describe the applications of various fields including chemistry, biochemistry, molecular biology and/or microbiology, in understanding and addressing the above issues, as well as exploring environmental resources for new technologies.
- Demonstrate an awareness of emerging concerns such as climate change, waste management or reductions in fossil fuels, and new technologies for addressing these.

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, Canninhham

DSC 1349D - Molecular Biology-II

Topic No.		Lectures 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, acetylation). **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**

Subject Outcome for Molecular Biology-I

- Molecular Biology-II gives knowledge about structure and function of the macromolecules, DNA blue print of life. Molecular Biology gives detailed knowledge of processes such as transcription and translation.
- Students will gain an understanding of chemical and molecular processes that occur in and between cells. Students understanding will become such that they will able to describe and explain processes such operon model, gene regulation etc .
- Students will gain insight into the most significant molecular and cell-based methods used today to expand our understanding of biology.

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

DSC 1350D Animal Tissue Culture

Topic No.		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**

Learning Outcome for Animal Tissue Culture:

- Students will be able to describe animal cell culture from a historical point of view.
- Appreciate the importance of and the progress in animal cell culture technology.
- Be familiar with the theoretical and practical aspects of culturing and sub-culturing established cell lines.
- Principles of regulating biological products as it apply to the pharmaceutical industry.
- Describe different methods and equipment employed in the scale-up of animal cell culture.

References:-

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

Practical V -Techniques in Genetics, Immunology and Cell Biology

Techniques in Genetics, Immunology

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.
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	Study of karyotype by using photograph.
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.
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.

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.
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.
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	Paper electrophoresis of Amino Acids.
6	Determination of Km of Amylase.
Minor Experiments	
1	Separation of Amino acids by TLC.
2	Effect of Activator and Inhibitor on enzyme activity of amylase.
3	Study of nitrate reductase activity.
4	Estimation of Indole-3 Acetic Acid by (Salkowaski reagent) Colorimetric method.

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 water sample.
2	Estimation of BOD of water 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.

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 indicate full marks.
3. Draw neat labeled diagram wherever necessary.

Time: 2 Hrs **Total Marks**: **40**

Q. 1. Rewrite the sentences by selecting correct alternative from the following. (8 Marks)

i.)

a) b) c) d)

As above (i) to (viii.)

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

i.
ii.
iii..

Q. 3. Attempt any four. (16 Marks)

i.
ii.
iii..
iv.
v.
vi.

Scheme of marking (Theory)

Semester	Core Course	Marks	Evaluation	Standard of passing
III.	DSC - C	40	semester wise	35% (14 M)
IV	DSC - D	40	semester wise	35% (14 M)

Scheme of marking (CIA - Continuous Internal Evaluation)

Semester	Core Course	Marks	Evaluation	Standard of passing
III.	DSC - C	10	semester wise	35% (4 M)
IV	DSC - D	10	semester wise	35% (4 M)

Scheme of marking (practical)

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

Note: For Semester III & IV for both DSC-C & D, 6 subject theory papers of 30 Hrs. (40 Lectures) Credit – 2Practical Examination Annual having 3 Practical V to VII each practical having 8 credit (each having 100 Marks)

For Continuous Internal Evaluation/Examination - 10 Marks Mandatory: 1. Presently -3 Marks

2. Any one of the following- 7 Marks -Unit Test / Home Assignment/ Seminar

Practical-
Annual Practical examination

A) Every candidate must produce a certificate from the Head of the Department in his college, stating that he has completed in a satisfactory manner a practical course on the lines laid down from time to time by the Academic Council on the recommendations of the Board of Studies and that the laboratory Journal has been properly maintained. Every candidate must have recorded his/her observations in the Laboratory journal and written a report on each exercise performed. Every journal is to be signed periodically by a member of the teaching staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journals at the practical examination and such journals will be taken into account by the examiners in assigning marks.

B) The practical examination will be conducted on two (2) consecutive days for each practical not less than 5 hours on each day of the practical exanimation.

Practical= V (Techniques in Genetics, Immunology and Cell Biology) and Practical VI (Techniques in Molecular Biology and Metabolic Pathways)

Q.1 Major Experiment 20 Marks
Q.2 Minor Experiment 10 Marks
Q.3 Spotting 10 Marks (5 spots- each carry two marks)
Based on Genetics, immunology/ Molecular Biology

Q.4 Major Experiment 20 Marks
Q.5 Minor Experiment 10 Marks
Q.6 Spotting 10 Marks (5 spots- each carry two marks)
Based on Cell Biology/ Metabolic Pathways
Q.7 Journal 10 Marks
Q.8 Viva-voice 10 Marks

Practical VII Techniques in Plant Tissue Culture and Environmental Biotechnology
Q.1 Major Experiment 20 Marks
Q.2 Minor Experiment 10 Marks
Q.3 Spotting 10 Marks (5 spots- each carry two marks)
Based on Plant tissue culture
Q.4 Major Experiment 20 Marks
Q.5 Minor Experiment 10 Marks
Q.6 Spotting 10 Marks (5 spots- each carry two marks)
Based on Environmental Biotechnology
Q.7 Tour Report 10 Marks
Q.8 Journal 10 Marks