Program Objectives and outcomes:

Program objectives:

1) To give the exposure to the students to become self-employed.

2) To develop the skills to make students handle instruments independently required to perform various experiments.

3) To inculcate research aptitude in students

4) To train the student in various techniques related to Cell biology and genetics, molecular biology, genetic engineering and bioinformatics

5) To make students understand the applications of Cell biology and genetics, molecular biology, genetic engineering and bioinformatics in the field of research and industry.

Course structure of SYBSc Vocational Biotechnology

Semester	Paper code	Paper Title	Number of credits	Number of lectures or practicals
III	21SBBT 231	Cell biology and microbial genetics	2	36
	21SBBT 232	Molecular biology	2	36
	21SBBT 233	Practical in cell and molecular biology	2	12 Practicals
IV	21SBBT 241	Recombinant DNA technology	2	36
	21SBBT 242	Bioinformatics	2	36
	21SBBT 243	Practical in Recombinant DNA technology and bioinformatics	2	12 Practicals

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Course/ Paper Title	Cell Biology and Microbial Genetics
Course Code	21SBBT 231
Semester	III
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To make student understand the concept and structure of plant and animal cells
2.	To make the students familiar with the concepts of genetics
3.	To inculcate the knowledge of cell membrane, membrane transport and cell signaling
4.	To make students understand the concept of operons
5.	To introduce the concepts of cancer genetics

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concept of and structure of cells as well as cell organelles
2.	Students will have the knowledge regarding microbial genetics and different mechanisms of gene transfer
3.	Students will understand the role of genes in oncology

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	**Cell Biology**	**18**
1	Cell theory and morphology of cell	**1**
2	Types of Cells i. Plant Cell ii. Animal Cell	**1**
3	Structure and functions of cell organelles i. Golgi Complexes ii. Endoplasmic Reticulum iii. Lysosomes iv. Nucleus v. Mitochondria vi. Chloroplast	**6**
4	Cell membrane i. Components: Lipids And Proteins ii. Fluid Mosaic Model	**1**
5	Introduction to Membrane Transport	**1**
6	Introduction to Cell signaling	**1**
7	Neoplasia &Apoptosis: Intrinsic & Extrinsic pathway	**2**
8	**Cell junctions Cell Junction Molecules** i. Selectins ii. Cadherins iii. Integrins iv. Immunoglobulin superfamily **Types of cell junctions** i. Adherent ii. Tight junctions iii. Gap Junctions iv. Desmosomes v. Hemidesmosomes vi. Plasmodesmata	**4**

9	Extracellular matrix (ECM) and cell matrix interaction	**1**
Credit II	**Microbial Genetics**	**(18)**
1	i. Transformation Discovery of transformation – Griffith's experiment ii. Mechanism of Transformation : Eg. *Streptococcus pneumonia, Hemophillis influenzae*	3
2	Transduction: i. Concept ii. Generalized and Specialized transduction	2
3	Conjugation i. Discovery of conjugation **ii.** Types of conjugation (F+ ,F-, Hfr)	2
4	Recombination i. Definition of recombination ii. Types of recombination iii. Homologous recombination (Holliday model)	2
5	**Transposons:** i. IS elements ii. DNA transposons iii. Retrotransposons	3
6	**Concept of Operons:** i. Lac operon iv. Arabinose	2
7	**Cancer genetics:** i. Introduction ii. Oncogenes iii. Tumor suppressor genes iv. Cancer and cell cycle	4

References:

1. Molecular Cell Biology Fifth Edition by Lodish, Harvey; Berk, Arnold; Matsudaira, Paul; Kaiser, Chri published by W. H. Freeman Hardcover

2. Cell: a molecular. 5th Edition–Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter.

3. Gene VIII- Benjamin Lewin, Publisher Pearson (16 December 2003)

4. Lehninger. A.L Principles of Biochemistrry 2nd edition 1993, CBS Publications

5. General Microbiology by Roger Y Stainer, John L Ingraham , Mark L Wheelis, Page R Painter, Author - Roger Y Stainer, 5th edition, Macmillon publication

6. The cell: A Molecular approach by Goeffler M Cooper and Robert E Heisman, 6th Edition, ASM press 2004

7. Cell and Molecular biology by Gerald Carp, Janet Owasa, Wallace Marshall, 6th edition, Wiley Publisher.

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Course/ Paper Title	**Molecular biology**
Course Code	21SBBT 232
Semester	III
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To make students familiar with the basic knowledge of nucleic acids with respect to it's structure and function
2.	To introduce the concept of central dogma of molecular biology
3.	To introduce the process of genome organization in prokaryotes and eukaryotes.
4.	To make students understand the process of replication of DNA, transcription and translation process in prokaryotes and eukaryotes.
5.	To inculcate the knowledge of post transcriptional and post translational modifications.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be aquianted with the knowledge of central dogma of molecular biology
2.	Students will understand the process, role of enzymes and proteins involved in the process of replication of DNA, transcription and translation.
3.	Students will have the knowledge of prokaryotic and eukaryotic genome organization

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	**Genome organization and replication of DNA in prokaryotes and eukaryotes.**	**18**
1	Introduction to molecular biology - Overview of structure of DNA and its components	01
2	Genome organization - Prokaryotic genome organization- Features of prokaryotic genome, DNA supercoiling, proteins involved in prokaryotic genome organization and process of prokaryotic genome organization. - Eukaryotic genome organization- Features of eukaryotic genome, levels of eukaryotic genome organization (Nucleosome model, chromatosome model, solenoid model, scaffold model, chromatid model and chromosome model)	08
3	Replication of DNA - Definition and features of replication of DNA - Semiconservative model of DNA (Messelson and Stahl's experiment) - Enzymes and proteins involved in replication of DNA - Process of prokaryotic replication of DNA - Overview of eukaryotic replication of DNA	09
Credit II	**Process of transcription of DNA and translation in prokaryotes and eukaryotes**	**18**
4	Transcription of DNA - Definition and features of transcription - Enzymes and proteins involved in transcription - Process of prokaryotic transcription - Overview of eukaryotic transcription - Post transcriptional modifications : 5' capping, 3' polyadenylation, overview on intron removal	08

5	Translation - Features of genetic code, Wobble hypothesis, structure of t-RNA, m-RNA and ribosomes - Role of enzymes and proteins involved in translation - Process of Prokaryotic translation - Overview of eukaryotic translation	09
6	Introduction to Post translational modifications- Example - glycosylation	01

References:

1. Molecular Biology of gene, 6th Edition, James D Watson, Tania Baker

2. Genetics: A Molecular approach, Peter J Russell, 3rd edition, published by Benjamin Cummings.

3. Genes X, 10th edition (2009) Benjamin Lewin, publisher – Jones and Barlet Publishers Inc. USA

4. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA.

5. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.Biochemistry. 4th Edition(2008), Reginald Garett and Charles Grisham, Brook/Cole, Cengage Learning, Boston, USA.

6. Molecular biology by Clark David, Pazdernik Nanette Jean, 2nd edition, Publisher Academic press

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Course/ Paper Title	**Practical in cell and molecular biology**
Course Code	21SBBT233
Semester	III
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To introduce the process of isolation of genomic DNA and plasmid DNA from various sources.
2.	To help students understand the concept of differencial centrifugation and it's application in isolation of sub cellular organelles
3.	To help students understand the process of quantification of DNA and RNA by spectrophotometric methods
4.	To inculcate practical knowledge of cell and molecular biology in various areas of research and industry
5.	To help students understand the role and applications of basic techniqus of cell biology and molecular biology in different areas of life science

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will have the knowledge of isolation of genomic DNA and plasmid from a given source and it's applications in life science
2.	Students will be familiar with the concept of differencial centrifugation and it's applications in isolation of sub cellular organelles
3.	Students will understand the practical importance of the concepts of cell biology and molecular biology in research and industry.

Syllabus

Expt. No.	Topics	No. of Practicals
1	Isolation of Nuclei and Mitochondria	2
2	Isolation of Chloroplast and lysosome	2
3	Preparation of molecular buffers and Agarose gel elctrophoresis	2
4	Isolation of Genomic DNA extraction from bacteria	2
5	Quantification of DNA by UV spectroscopy Diphenylamine method.	1
6	Isolation of plasmid DNA from bacteria	2
7	Quantification of RNA by Orcinol method	1

References:

1. Biochemical methods by S.Sadasivam and A. Manickam, 2nd edition, New Age International (P) Ltd., Publishers.

2. Practical methods in Molecular biology by Robert F. SchleifPieter C. Wensink, llustrated edition, Springer New York Publisher.

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Semester IV

S.Y.B.Sc Biotechnology (Vocational)

2022-23 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	**Recombinant DNA technology**
Course Code	**21SBBT 241**
Semester	IV
No. of Credits	**2**

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To introduce the concept of recombinant DNA technology
2.	To help students understand the tools involved in recombinant DNA technology
3.	To make students familiar with the applications of recombinant DNA technology in various fields such as medicine, environment and industry.
4.	To help students understand the principle and process of PCR and its applications in diagnostics
5.	To inculcate the knowledge of DNA sequencing methods

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will have the knowledge of basic concept of recombinant DNA technology
2.	Students will understand the applications of recombinant DNA technology in various fields like medicine, environment and industry.
3.	Students will understand the technique of DNA sequencing methods, PCR and it's applications in various fields.

Syllabus

Sr.No		No. of Lectures
Credit I	**Tools used in recombinant DNA technology**	**18**
1	Introduction to recombinant DNA technology	01
2	Enzymes used in recombinant DNA technology - Restriction enzymes and it's types, DNA ligases, DNA modifying enzymes	04
3	Vectors used in recombinant DNA technology - Features of an ideal vector - Types of vectors - cloning vectors and expression vectors. - Examples of cloning vectors- I. Plasmids - pBR322 II. Phage vectors - Lambda insertion vectors, Replacement vectors, Lambda phage genome and it's features. III. Cosmids IV. Artificial chromosomes - BAC, YAC	09
4	Methods of introducing recombinant DNA into the host cell - Transformation method - Calcium chloride method to make host cells competent - Transfection methods – Electroporation, Particle gun method	04
Credit II	**Techniques in recombinant DNA technology**	**18**
5	Methods for screening and selection of transformants - Non-radioactive detection methods - Use of biotin-labelled probe, Use of enzyme labelled probe - Blotting or hybridization techniques - Southern blotting, Northern blotting, Western blotting	07
6	DNA sequencing methods - Chemical method - Maxam Gilbert method - Enzymatic method - Sanger's method - Automated sequencing - Pyrosequencing method	04
7	Polymerase Chain reaction (PCR) - Basic principle of PCR, procedure, and applications of PCR - Types of PCR -Example; RT-PCR	03

8.	Applications of recombinant DNA technology - Applications in Animal pharming and transgenic animals - Example- Dolly -The sheep. - Applications in Plant biotechnology - Process of delaying fruit ripening by antisense RNA technology, transgenic plants - golden rice - Applications in medicine and diagnostics - Recombinant insulin, recombinant vaccines. - Applications in environment and industry	04

References:

1. Gene cloning and analysis, 5th edition by TA Brown

2. Principles of gene analysis, Sixth edition by Sandy B. Primrose and Richard Twyman

3. Singh, B. D.; Plant breeding; principles and methods, 11th edition, (2009), Kalyani Publisher, India.

4. An introduction to genetic engineering by Desmond S T Nicholl, 3rd edition , Publisher - Cambridge University Press.

5. Recombinant DNA technology by Keya Chaudhari , Publisher - The energy and resources institute, 1st edition

6. Molecular Biotechnology; Principles and applications of recombinant DNA technology, by Bernard R Glick, Jack J Pasternak, 3rd edition , Publisher -American society of Microbiology.

7. Recombinant DNA : Genes and Genomes by James Watson, Amy A Caudy, Richard M Myers, Jan A Witkowski, 3rd edition, Publisher - W H Freeman.

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Semester IV

S.Y.B.Sc Biotechnology (Vocational)

2022-23 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	**Bioinformatics and Nanotechnology**
Course Code	**21SBBT242**
Semester	IV
No. of Credits	**2**

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To introduce the concepts of bioinformatics and its application to students
2.	To make students aware about the use of online tools for studying bioinformatics and mining data
3.	To introduce the concept of nanotechnology

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will get acquainted with the concepts of Bioinformatics and its applications
2.	Students will be able to use software for processing information related to genes and proteins
3.	To make students acquainted with the concept and applications of nanotechnology

Syllabus

Sr.No		No. of Lectures
Credit I	**Bioinformatics**	**18**
1	i. Introduction and Definition ii. Application in various fields	**2**
2	Open Access Bibliographic Resources And Literature Databases: i) PubMed ii) PubMed Central iii) BioMed Central iv) Public Library of Sciences (PloS)	**4**
3	SEQUENCE DATABASES: i. formats, querying & retrieval ii. Nucleic acid sequence databases: GenBank iii. Protein sequence databases: SWISS-PROT iv.Specialized Genome Databases at NCBI, SANGER	**4**
4	DATABASE SEARCHES i. Basic concepts of sequence similarity, identity and homology ii. Definitions of homologues, orthologues, paralogues iii. Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. iv. Keyword-based Entrez and SRS, Sequence-based: BLAST & FASTA, Use of these methods for sequence analysis including the online use of the tools and interpretation of results from various sequence and structural as well as bibliographic databases.	**8**

Credit II	Nanotechnology	18
1.	Introduction to Nanobiotechnology- History, Timelines and progress of nanotechnology, Recent advances and overview	3
2.	Biological production of nanoparticles from: i. Plant Sources ii. Microbial Sources	4
3.	Nanobiotechnological applications in health and disease- Infectious and chronic: nanoparticle based treatments ,drug delivery mechanisms.	6
4.	Nanobiotechnological applications in : 1) Environment: Waste water and contaminated soil treatment ,remediation ,sensors.	5

References:

1. Bioinformatics Databases, Tools and Algorithms: OrpitaBosu, SimminderKaurThukral

2. Bioinformatics Sequence and Genome Analysis, Second edition by David Mount.

3. Text Books: 1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004

4. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

5. Nanobiotechnology- Concepts, applications and perspectives (2004), Christof Niemeyer

6. Nanobiotechnology- Concepts and applications, Chad A Mirkin

7. Nanotechnology in Biology and Medicine: Methods, devices and applications

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S.Y.B.Sc. Biotechnology (Vocational)

2022-23 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	**Practical in Recombinant DNA technology and Bioinformatics**
Course Code	21SBBT243
Semester	IV
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To help students understand the techniques of restriction digestion and ligation of DNA
2.	To introduce the knowledge of procedure of PCR , it's types and applications in diagnostics.
3.	To help students understand the process and technique of transformation and it's role in recombinant DNA technology
4.	To make students familiar with different databases of proteins and nucleic acids
5.	To inculcate the knowledge of concepts of bioinformatics and it's application in life science.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will understand the procedure and applications of PCR
2.	Students will have the knowledge of databases of proteins and nucleic acids and thei applications in life science.
3.	Students will the practical knowledge of various techniques of recombinant DNA technology and bioinformatics.

Syllabus

Unit No	Title with Contents	Total number of Practicals
1	Restriction digestion of DNA	1
2	Ligation of DNA	1
3	Transformation: Making host cell as competent cells	1
4	PCR	1
5	Literature mining using PubMED, PubMED central and MEDLINE	2
6	Retrieving Protein and DNA Sequences using Entrez at NCBI, SRS at EBI	2
7	Website navigation to PDB, Swissprot, and Uniprot	2
8	Perform FASTA and BLAST search for DNA and Protein Data	2

References:

1. Biotechnology procedures and experiments handbook by S Harisha , Publisher - Jones and Bartlett Publishers Inc.
2. Techniques in biotechnology by V Kumaresan, Saras Publication.