जननायक चंद्रशेखर विश्वविद्यालय, बलिया

Jananayak Chandrashekhar University, Ballia

New

(w. e. f. 2022- 2023)

SYLLABUS STRUCTURE SEMESTER WISE
M.Sc. (BIOTECHNOLOGY)

Jananayak Chandrashekhar Vishwavidyalaya, Ballia
M. Sc. Biotechnology Syllabus
(w.e.f. 2022-23)
Programme Name: M.Sc. (Biotechnology) Programme Code: PG BIOT 100

INTRODUCTION:

Biotechnology, as the word suggests, is combination of biology and technology. Biotechnology is the use of technology to use, modify or upgrade the part or whole of biological system for industrial and human welfare. Bio-Technology is the use of living things especially cells and bacteria for production of various products for benefiting human beings. It is a combination of various technologies, applied together to living cells, including not only biology, but also subjects like mathematics, physics, chemistry and engineering. Its application ranges from agriculture (Animal Husbandry, cropping system, Soil science and Soil Conservation, Plant Physiology, Seed Technology etc and Crop Management) to industry (food, pharmaceutical, chemical, by products, textiles etc.), medicine, nutrition, environmental conservation, Cell Biology, making it one of the fastest growing fields. Biotechnology is to modify genetic structure in animals and plants to improve them in desired way for getting beneficial products

Programme Structure: The programme structure of post-graduation in Biotechnology is as follows:

- The post-graduation programme in Biotechnology of this University will comprise of four semesters.
- Every semester will have 5 (4 theory and 1 practical) papers of 4 credits each.
- In 1st or 2nd semester, the student will have to opt for a **minor elective paper** of 4/5 credits from a faculty other than his main faculty.
- In every semester, the student has to do a **research project** of 4 credits (thus, a total of 16 credits in 4 semesters) under the supervision of a supervisor as nominated by the head of the department.
- There may be a co-supervisor also from any industry, company, technical or research institute.
- These projects may be inter-disciplinary or multi-disciplinary and may be in the form of research project/industrial training/internship/survey work etc.
- The reports of the projects carried out in 1st and 2nd semesters will be jointly compiled and submitted in the form of one PROJECT REPORT/DISSERTATION at the end of first year. It will be evaluated out of 100 marks (8 credits) at the end of the first year jointly by the supervisor and the external examiner appointed by the University.
- Similarly, the reports of the projects carried out in 3rd and 4th semesters will also be jointly compiled and submitted in the form of another PROJECT REPORT/DISSERTATION at the end of the second year. It will also be evaluated out of 100 marks (8 credits) at the end of the second year jointly by the supervisor and the external examiner appointed by the University.
- If a student publishes a research paper out of his research project in a UGC-CARE listed journal, he may be given up to 25 additional marks, provided the maximum marks of the project will remain 100. The marks of the research projects will be converted into grades that will be incorporated in the final calculation of CGPA too. The final result of M.Sc. (Biotechnology) programme will be declared on the basis of CGPA.
- The courses to be taught in these semesters are given below:

M.Sc. BIOTECHNOLOGY-PREVIOUS YEAR

M.Sc. (BIOTECHNOLOGY) 1St Semester

SN	Paper (Course Code)	Course Name	Marks	Credit	Hours
1	Paper I (PG BIOT 101)	CELL BIOLOGY	100	4	60
2	Paper 2 (PG BIOT 102)	GENETICS AND MOLECULAR BIOLOGY	100	4	60
3	Paper 3 (PG BIOT 103)	BIOCHEMISTRY	100	4	60
4	Paper 4 (PG BIOT 104)	BIOPHYSICS	100	4	60
5	Practical (PG BIOTP 105)	BASED ON PAPER 101-104	100	4	120
6	Project		(To be evaluated at the end of 2nd Sem.)	4	120
		TOTAL	500	24	480
7	One minor elective subject from other faculty in First or Second Sem.		100	4/5	60

M.Sc. (BIOTECHNOLOGY) 2nd Semester

SN	Paper (Course Code)	Course Name	Marks	Credit	Hours
1	Paper I (PG BIOT 201)	GENERAL MICROBIOLOGY	100	4	60
2	Paper 2 (PG BIOT 202)	RECOMBINANT DNA TECHNOLOGY	100	4	60
3	Paper 3 (PG BIOT 203)	IMMUNOLOGY AND IMMUNOTECHNOLOGY	100	4	60
4	Paper 4 (PG BIOT 204)	BIOSTATISTICS & BIOINFORMATICS	100	4	60
5	Practical (PG BIOTP 205)	BASED ON PAPER 201-204	100	4	120
6	Project 2		(Project 1+ Project 2 in the form of Dissertation) 100	4	120
		TOTAL	600	24	480
7	One minor elective subject from other faculty in First or Second Sem.		100	4/5	60

M.Sc. (BIOTECHNOLOGY) FINAL YEAR
M.Sc. BIOTECHNOLOGY 3rd Semester

SN	Paper (Course Code)	Course Name	Marks	Credit	Hours
1	Paper I (PG BIOT 301)	INDUSTRIAL MICROBIOLOGY	100	4	60
2	Paper 2 (PG BIOT 302)	CELL AND TISSUE CULTURE	100	4	60
3	Paper 3 (PG BIOT 303)	APPLIED MOLECULAR BIOLOGY	100	4	60
4	Paper 4 (PG BIOT 304)	ENVIRONMENTAL BIOTECHNOLOGY	100	4	60
5	Practical (PG BIOTP 305)	BASED ON PAPER 301-304	100	4	120
6	Project 3	(To be evaluated at the end of 4th Sem.)		4	120
		TOTAL	500	24	480

M.Sc. BIOTECHNOLOGY 4th Semester

SN	Paper (Course Code)	Course Name	Marks	Credit	Hours
1	Paper I (PG BIOT 401)	BIOCHEMICAL ENGINEERING	100	4	60
2	Paper 2 (PG BIOT 402)	GENOMICS, PROTEOMICS &NANOBIOTECHNOLOGY	100	4	60
3	Paper 3 (PG BIOT 403)	ETHICS, PATENTING AND RESEARCH METHODOLOGY	100	4	60
4	Paper 4 (PG BIOT 404)	MEDICAL GENETICS	100	4	60
5	Practical (PG BIOTP 405)	PRACTICAL BASED ON 401-404	100	4	120
	Project 4		(Project 3+ Project 4 in the form of Dissertation) 100	4	120
		TOTAL	600	24	480

Semester :1 **Programme Name and Code: M. Sc. (Biotechnology)**

Course code and Name: **PG BIOT 101 –Cell Biology** **MM: 25+75=100**

Objectives:

1. This paper aims to understand the basic structure and function of cell and its organelles
2. To know about the integration and bidirectional communication of cells to integrate into tissues.
3. develop the understanding about the chromosome structure and its banding patterns with special reference to understand the structural and numerical changes in chromosomes.

UNIT – 1		Credit	Hours
1a	i. History of cytology ii. Cell Structure and function: Cell theory, organization of eukaryotic cell and plant cell wall. iii. A brief account of structure and function of plasma membrane	1	15
1b	i. Golgi complex, Glycosylation and cell secretion. ii. Endoplasmic reticulum and protein segregation.		
UNIT – 2		Credit	Hours
2a	i. Mitochondria structure and its function. ii. Chloroplast structure and function iii. Protein transport in mitochondria and chloroplast	1	15
2b	i. Lysosomes, peroxisomes, glyoxisomes and their role in cell metabolism. ii. Centrosome and spindle apparatus		
UNIT – 3		Credit	Hours
3a	i. Nucleus: Nuclear envelope, chromatin and chromosomes organization, euchromatin and heterochromatin, metaphase chromosome. ii. Genes and chromosomes, C-value paradox, centromere, telomere, karyotype and chromosome banding, in-situ hybridization and chromosome painting.	1	15
3b	i. Structural and numerical changes in chromosomes with special emphasis on translocation, deletions in tumors, syndromes and ploidy in plants. ii. Cell cycle and its regulation.		
UNIT – 4		Credit	Hours
4	i. Cell interaction and cell-cell adhesion. ii. Cytoskeleton: microfilaments, microtubules and intermediate filaments.	1	15

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10

Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to identify the basic architecture of cell and its organelles which will augment them to enhances their research activities for Ph.D. Programme. The understanding of chromosomal structure and their abnormalities will boost their knowledge, required for understanding the concept of Genetics and Medical Biotechnology.

Book References

1. De Robertis, E.D.P. & De Robertis, Jr. E.M.F. (1987). Cell and Molecular biology. Lea and Febiger, U. S.
2. Gupta, P.K. (2014). Cell and Molecular Biology. Rastogi Publications, Meerut.
3. Karp, G. (2013). Cell Biology, Wiley.
4. Rastogi, S.C. (2005). Cell Biology. New age Publishers, New Delhi.
5. Powar, C.B. (2010). Cell Biology. Himalaya publishing house, Mumbai.
6. Sheeler, P. & Bianchi, D.E. (2009). Cell and Molecular Biology. Wiley.
7. Verma, P.S. & Agarwal, V.K. (2016). Cell biology. S. Chand & Company Ltd., New Delhi.

Semester :1 Programme Name and Code: M.Sc. (Biotechnology)

Course code and Name: PG BIOT 102 –GENETICS AND MOLECULAR BIOLOGY

MM:25+75=100

Objectives:

1. This paper aims to understand about gene, its structure and function.
2. This also focuses on how each and every character of an organism is controlled genetically.
3. This paper focuses on central dogma and how cell signaling is working among cells of a body.

UNIT–1		Credit	Hours
1a	1. Recapitulation of Mendel's Laws of Inheritance and gene interaction. 2. Transposable elements.	1	15
1b	i. Linkage, crossing over (molecular mechanisms of genetic recombination in pro- and eukaryotes) . ii. Genome mapping.		
UNIT–2		Credit	Hours
2a	I. Genetic code: deciphering genetic code, unusual codons in mitochondria and prokaryotes. ii. Mutations: types, mechanisms, mapping, mutagens,	1	15
2b	i. Ames test for mutagens. ii. Replication of genetic material in prokaryotes and eukaryotes, a brief description of initiation at replication origins and its cell cycle regulation.		
UNIT–3		Credit	Hours
3a	i. DNA damage and repair, types of damage and their repair (repair by proofreading, mismatch repair (Mut HLS system of E.coli), Excision repair (UvrABC) mechanism of E.coli),repair of double strand breaks, photo reactivation, SOS repair , ii. Gene organization in prokaryotes and eukaryotes, polycistronic genes, split genes promoters, enhancers	1	15
3b	1. Mechanism of transcription in prokaryotes and eukaryotes: transcription factors, RNA polymerases, initiation, elongation and termination 2. RNA processing: processing of mRNA, tRNA and rRNA.		
UNIT–4		Credit	Hours
4a	i Translation in prokaryotes and eukaryotes. ii. Regulation of gene expression: Prokaryotes- lac and trp operons in *E. coli.* An overview of regulation of gene expression in eukaryotes.		
4b	i. Signaling: an introduction to signaling, different type of ligands, receptors, G-proteins, second messengers, Ras and RTK signaling. ii. Cell cycle and its regulation: role of growth factors, cyclins, Cdks with yeasts and higher eukaryotic cells as examples.	1	15

INTERNALASSESSMENT

Attendance:5

Assignment / Presentation:

10Classtest:10

TRANSACTIONAL STRATEGIES

Lectures,tutorials,demonstrations,field practicals,teaching tools (photographs,models,charts,etc.),OERs,digital libraries,etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to understand how characters are genetically controlled and how cells communicate with each other. This will help them in identifying genetic cause of a disease and will help them in treating disease.

Book References:

1. Benjamin Lewin, Gene VIII, Oxford University press, U.K.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Molecular Biology of the Cell, Garland, USA.
3. David L. Nelson, Michael M. Cox, Lehninger: Principles of Biochemistry, W.H.Freeman, USA.
4. Gardner, E.J., Simmons, M.J. & Snustad, D.P. (2006). Principles of Genetics. Wiley.
5. Gupta, P.K. (2007). Cytogenetics. Rastogi Publishers, Meerut.
6. Gupta, P.K. (2009). Genetics. Rastogi Publishers, Meerut
7. Hartl and Jones, Genetics, Jones and Bartlett publishers, USA.
8. H.K.Das, Textbook of Biotechnology, Wiley Dreamtech India Pvt. Ltd.
9. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Molecular Biology of Genes, The Benjamin/ Cummings Publishing Company, New York.
10. Klug, W.S., Cummings, M.R., Spencer, C.A. & Palladino, M.A. (2016). Concepts of Genetics. Pearson Education, India.
11. Lubert Stryer, Jeremy Berg, John Tymoczko Biochemistry, W.H. Freeman, USA.
12. Prasad, G. (2013). Introduction to Cytogenetics. Kalyani Publisher, New Delhi
13. Roy, D. (2009). Cytogenetics. Narosa Publishing House, New Delhi
14. Strickberger, M.W. (2015). Genetics. Pearson Education, India.
15. Singh, B.D. (2009). Genetics. Kalyani Publishers, New Delhi
16. T. A. Brown, Genomes, Wiley Publishers (Asia Pvt Ltd).
17. Voet and Voet, Biochemistry, John Wiley and sons (Asia Pvt Ltd).

Semester :1 Programme Name and Code: M. Sc. (Biotechnology)

Course code and Name: PG BIOT 103 –Biochemistry MM: 25+75=100

Objectives:

1. This paper aims to understand the basic principle of biochemistry
2. To know about the mechanisms of metabolic pathways which is necessary to sustain our life.
3. develop the understanding about the working mechanisms of vital biomolecules like vitamins, hormones etc..

UNIT – 1		Credit	Hours
1a	i. Introduction to biochemistry and biomolecules. ii. Chemical foundations of biology- pH, pK, acids, bases and buffers.	1	15
1b	i. Metabolism of Carbohydrates- Gluconeogenesis, Glycolysis and Feeder pathways. ii. Secondary pathway of glucose oxidation-PPP & glucuronic acid pathway & TCA, glyoxylate cycle		
UNIT – 2		Credit	Hours
2a	Metabolism of Fatty acids-ß-oxidation of saturated and unsaturated (mono & poly), odd & even chain fatty acids.	1	15
2b	i. Oxidation of amino acids and urea cycle ii. Introduction to biosynthesis of amino acids, purines and pyrimidines.		
UNIT – 3		Credit	Hours
3a	1. Introduction to vitamins, hormones, phytohormones and their role. 2. Introduction to secondary metabolic products- alkaloids, terpenoids, flavonoids, steroids and pigments.	1	15
3b	1. Photosynthesis- (C3 cycle, C4 cycle), Oxidative phosphorylation and Photophosphorylation and photorespiration (C2 cycle).		
UNIT – 4		Credit	Hours
4a	i. Classification, nomenclature and general properties of enzymes; kinetics of enzyme actions, rate of enzyme catalyzed reactions with special reference to Michaelis Menten laws; units of enzyme activity. ii. Factors affecting enzyme activity (substrate concentration, temperature, pH and inhibitors). iii. A brief description of various types of coenzymes, isozymes and zymogens. Enzyme inhibition- competitive, non-competitive and uncompetitive types. Brief introduction to active site	1	15
4b	i. Amino acids, peptide classification and their general chemical properties, peptide sequence.	Credit 1	15

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10

Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able grow their knowledge regarding the basic metabolic pathways, their mechanisms along with their regulations which plays a major role to sustain our life on the earth. The basic signaling mechanism of hormones will elucidate the students to understand the fine tunning of nature to homeostat our life from surrounding environment. This basic knowledge of biochemistry will also provide a new avenue to the students to explore their knowledge in various biological streams both academically as well as practically.

Book References:

1. De Robertis, E.D.P. & De Robertis, Jr. E.M.F. (1987). Cell and Molecular biology. Lea and Febiger, U. S.
2. Gupta, P.K. (2014). Cell and Molecular Biology. Rastogi Publications, Meerut.
3. Karp, G. (2013). Cell Biology, Wiley.
4. Powar, C.B. (2010). Cell Biology. Himalaya publishing house, Mumbai.
5. Rastogi, S.C. (2005). Cell Biology. New age Publishers, New Delhi.
6. Sheeler, P. & Bianchi, D.E. (2009). Cell and Molecular Biology. Wiley.
7. Verma, P.S. & Agarwal, V.K. (2016). Cell biology. S. Chand & Company Ltd., New Delhi.

Semester :1 Programme Name and Code: M.Sc. (Biotechnology)
Course code and Name: PG BIOT 104 –Biophysics **MM:25+75=100**

Objectives:

1. This paper aims to understand the type of bonding in biomolecule, nucleic acid
2. To know about structure shape, size and spatial arrangement of molecule and effect on physical factor
3. To study to biomolecule using biophysical technique
4. To Study role of nanoparticle in biomedical field .

UNIT–1			
1a	i. Chemical inactions- characteristics of chemical bonds, Types and importance of weak and strong chemical interactions, Intra and inter molecular interactions ii. Carbohydrates- Structure of carbohydrates; Monosaccharides- classification, optical activity, mutarotation and isomerism; iii. Disaccharides, Polysaccharides- Homopolymers and Heteropolymers, Glycoproteins.	Credit 1	Hours 15
1b	i. Nucleic Acids- Nucleic acid composition, Glycosidic bond rotation, Sugar ring conformation, backbone torsional angles and forces stabilizing ordered secondary structures. ii. Topology of DNA, A, B and Z types of DNA, DNA melting curves and hypochromocity, tRNA, micro-RNA.		
UNIT–2			
2a	i Proteins- Amino acids: General properties, classification and characteristics, peptide bonds, disulfide cross links, conformational properties of dipeptides. Ramachandran Plots & its use to predict sterically permissible structures ii Hierarchies of protein structure-primary, secondary structures (helix and sheet), Domains, Motifs and folds. Forces stabilizing molecular structure, tertiary structure and quaternary structure. Fibrous and Globular proteins iii. Lipids- Classification, structure and function	Credit 1	Hours 15
2b	i. Biological transport- Theory and thermodynamics of biological transport, principles of biological transport, ii Different types of transports across membrane, simple diffusion, facilitated diffusion, primary and secondary active transport and group translocation		
UNIT–3			
3a	i.Microscopic techniques: A brief description of Light, Phase Contrast, Fluorescence microscopy techniques and their application in cell biology. Basics of Confocal microscopy, Transmission and Scanning electron Microscopy	Credit 1	Hours 15
3b	ii. Other techniques: Fluorescence activated cell sorting, Autoradiography, Centrifugation, Biosensors, Electrophoresis of proteins and nucleic acids.		
UNIT–4			
4	i. Biophysical methods: Analysis of biomolecules, use of UV/VIS Spectrophotometry, Fluorescence, Circular Dichroism, NMR and ESR Spectroscopy ii Nanobiotechnology: Nanoparticles, Preparation of different types of nanoparticles and their biological applications.	Credit 1	Hours 15

INTERNALASSESSMENT

Attendance:5

Assignment / Presentation:

10Classtest:10

TRANSACTIONALSTRATEGIES

Lectures, tutorials, demonstrations, fieldpracticals, teachingtools (photographs,models,charts,etc.), OERs, digitallibraries, etc

LEARNINGOUTCOMES:

Upon completion of this course, students will be able to identify the structure, shape size of biomolecule and its effect on physical factor which will augment them to enhance their research activities for Ph.D. Programme. The understanding of biological technique and nanoparticle will boost their knowledge, required for disease diagnosis and disease detection and understanding the concept Medical Biotechnology.

Book References

1. Conn, E.E., Stumpf, P.K., Bruening, G. & Doi, R.H. (2006). Outlines of Biochemistry. Wiley.
2. Day, P.M. & Harborne, J.B. (1997). Plant Biochemistry. Academic Press, UK
3. Goodwin, T.W. & Mercer, E.I. (2003). Introduction to Plant biochemistry. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
4. Jain, J.L., Jain, S. & Jain, N. (2016). Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
5. Lehninger, A.L. (2013). Biochemistry. Kalyani publishers, New Delhi.
6. Wilson, K. & Walker, J. (2013). Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press, London.

Semester :2 Programme Name and Code: M. Sc. (Biotechnology)

Course code and Name: PG BIOT 201 –General Microbiology MM: 25+75=100

Objectives:

1.This paper aims to understand the basic structure and function of prokaryotic cells.

2.To know about the different types of microorganisms and their metabolic pathways which provide them unique feature to Responsible for their sustainability in different environmental conditions.

3.develop the understanding about the sterilization techniques and culture media required for maintainace of microorganisms in a contamination free environment.

UNIT – 1		Credit	Hours
1a	i . Introduction, history, scope and relation with other sciences ii. Structure and functions of prokaryotic cells and their components- cell wall, cell membrane, capsule, pilli, mesosomes, nucleoid, flagella, etc..	1	15
1b	i. Types of Microorganisms- General structure and classification. ii. Different staining procedures of microorganisms.		
UNIT – 2		Credit	Hours
2a	i. Introduction to Archea- extremophiles. ii Introduction to growth, reproduction and nutrition in bacteria. Factors affecting growth	1	15
2b	i. Different types of culture media for bacterial culture. ii. Sterilization techniques.		
UNIT – 3		Credit	Hours
3a	i.solation and cultivation of bacteria and fungi. ii. Bacterial viruses- types and multiplication.	1	15
3b	i.Introduction to generalized microbial metabolism. ii.Specialized metabolic pathway related to bacteria.		
UNIT – 4		Credit	Hours
4a	i. Brief account of transformation, transduction and conjugation in bacteria ii. Microorganism in relation to plants, animals and human beings.	1	15
4b	i. Role of microorganisms in elemental recycling.		

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10

Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to identify the different culture and types of bacteria. The basic knowledge about the culture of bacterial strain will enhance the students to improve their knowledge regarding genetic engineering as well as other biotechnological streams like, immunology, industrial microbiology, etc.

Book References:

1. De Robertis, E.D.P. & De Robertis, Jr. E.M.F. (1987). Cell and Molecular biology. Lea and Febiger, U.
2. Gupta, P.K. (2014). Cell and Molecular Biology. Rastogi Publications, Meerut.
3. Karp, G. (2013). Cell Biology, Wiley.
4. Powar, C.B. (2010). Cell Biology. Himalaya publishing house, Mumbai.
5. Rastogi, S.C. (2005). Cell Biology. New age Publishers, New Delhi.
6. Sheeler, P. & Bianchi, D.E. (2009). Cell and Molecular Biology. Wiley
7. Verma, P.S. & Agarwal, V.K. (2016). Cell biology. S. Chand & Company Ltd., New Delhi

Semester :2 Programme Name and Code: M.Sc. (Biotechnology)
Course code and Name: PG BIOT 202 – RECOMBINANT DNA TECHNOLOGY

Objectives: **MM:25+75=100**

1.This paper aims to understand the vector host system and different enzymes used in DNA manipulation s
2.To Know about protocol of DNA and RNA isolation which help the to know gene analysis of organisms and formation of gene library.
3.To study blotting technique and PCR which help the sequence detection and amplification of specific gene.
4.To study method of DNA sequencing and site directed mutagenesis

UNIT–1			
1a	i . Vectors: Host system, ii.Cloning vectors (Plasmids, Phases, Cosmids, Bacterial Artificial Chromosomes and Yeast Artificial Chromosomes). iii Shuttle Vectors, Expression Vectors)	Credit 1	Hours 15
1b	i. Enzyme used for manipulating DNA (Restriction endocleases , methylases polymerase ligases kinases, nucleases). ii. Ligation, preparation of component cells and their transformation		
UNIT–2			
2a	i Isolation of DNA (Plasmid, Phage, Cosmid and Genomic DNA and RNA from prokaryotes and eukaryotes using Electrophoresis) ii Construction of Genomic and c DNA libraries.	Credit 1	Hours 15
2b	i Screening and characterization of cloned DNA, Restriction mapping and RFLP analysis.		
UNIT–3			
3a	i Southern, Northern and Western Blotting, probe preparation and hybridization. ii PCR and its application	Credit 1	Hours 15
3b	i. DNA sequencing ii. Site directed mutagenesis.		
UNIT–4			
4a	i. DNA-Protein interaction: Gel Shift Assay, Foot-printing. ii. Protein-protein interaction: Immunocoprecipitations, Yeast Two Hybrid System.	Credit 1	Hours 15
4b	Modulation of gene expression- RNAi, Antisense RNA.		

INTERNALASSESSMENT

Attendance:5
Assignment / Presentation:
10Classtest:10

TRANSACTIONALSTRATEGIES

Lectures,tutorials,demonstrations,fieldpracticals,teachingtools (photographs,models,charts,etc.),OERs,digitallibraries,etc

LEARNINGOUTCOMES:

Upon completion of this course, students will be able to know about molecular basis of gene transfer mechanism into host cells. This is basis knowledge of biotechnology transfer of new gene into host cell or protoplast will help to understand how genetically modified organism produce or how pharmaceutical product form using RDT. This will boost their knowledge, required for understanding the concept of transgenic animal and plant.

Book References:

1. Bhojwani, S.S. & Razdan, M.K. (1996). Plant tissue Culture: Theory and Practice. Elsevier Science Publisher, New York.
2. Chawla, H.S.(2006).Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd., N.Delhi.
3. Dube, R.C. (2014). A Text Book of Biotechnology. S. Chand & Company Ltd., New Delhi
4. Govil, C.M., Aggarwal, A. & Sharma, J. (2017). Plant Biotechnology and Genetic Engineering. PHI Learning Pvt Ltd,Delhi.
5. Gupta, P.K. (2016). Plant Biotechnology. Rastogi Publications, Meerut.
6. Janarthanan, S. & Vincent, S. (2009). Practical Biotechnology. Universities Press, Hyderabad.
7. Kumaresan, V. & Arumugam, N. (2016). Fundamentals of Biotechnology. Saras Publication, Kanyakumari.
8. Singh, B.D. (2012). Biotechnology. Kalyani Publishers, New Delhi.
9. Slater, a., Scott, N. & Fowler, M. (2010). Plant biotechnology: The Genetic manipulation of Plants. Oxford University Press, oxford.

Semester :2 Programme Name and Code: M.Sc. (Biotechnology)

Course code and Name: PG BIOT 203 – IMMUNOLOGY AND IMMUNOTECHNOLOGY

MM:25+75=100

Objectives:

1. This paper aims to understand about defence system of a body.
2. This also focuses on how a body defend the foreign particles.
3. This paper also deals with identification of a disease by the help of antibodies.

UNIT–1		Credit	Hours
1a	i. Basic concepts of Immunology: (a) Innate and acquired immunity. (b) Concept of Humoral & Cell Mediated Immunity. Transposable elements. ii. Organization and structure of Lymphoid organs	1	15
1b	ii. Cells of the Immune system: B-Lymphocytes, T- Lymphocytes, Macrophages, Dendritic cells, N K Cells, Eosinophils, Basophils, Neutrophils, Mast cells. ii. Nature and Biology of antigen, superantigen		
UNIT–2		Credit	Hours
2a	i. Immunoglobins: Structure, Types and Functions. ii. Generation of Antibody Diversity, BCR, TCR.	1	15
2b	i. Antibody-Antigen Interaction: Precipitation Reactions, Agglutination reactions, Radio Immunoassay and ELISA. ii. Major Histocompatibility Complex.		
UNIT–3		Credit	Hours
3a	i. Antigen processing and presentation., ii. Generation of Humoral and cell Mediated immune response.	1	15
3b	i. Cell Mediated Cytotoxicity: Mechanism of T-cells and N K cell mediated lysis. ADCC, macrophage mediated cytotoxicity. ii. Complement System Components, activation, regulation and biological consequences.		
UNIT–4		Credit	Hours
4a	i Hypersensitivity- (2) - Classification, mediators, regulation, detection and therapy. ii. Transplantation immunology and AIDS.	1	15
4b	i. Immunization (Active & Passive) and Vaccines (Types and Importance). ii.. Hybridoma Technology and Monoclonal Antibodies.		

INTERNALASSESSMENT

Attendance:5

Assignment / Presentation:10

Classtest:10

TRANSACTIONAL STRATEGIES

Lectures,tutorials,demonstrations,field practicals,teaching tools (photographs,models,charts,etc.),OERs,digital libraries,etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to understand how our defense system protects us from different diseases. Students will be able to detect disease by the help of antibodies.

Book References:

1. Abbas, Basic Immunology: Functions& disorders of the immune system, WB Sanders Co. Philadelphia.
2. Annadurai, B. (2010). A Textbook of Immunology and Immunotechnology. S. Chand & Co. Ltd., New Delhi.
3. Basir, S.F. (2012). Textbook of Immunology. PHI Learning Pvt. Ltd., New Delhi.
4. Chakravarty, A.K. (2006). Immunology and Immunotechnology. Oxford University press. New Delhi.
5. David Male, Jonathan Brostoff, David Roth & Ivan Roitt: Immunology: 7th Edition:Mosbey Title: Philadelphia.
6. DP Stites, AL Terr, TG Parslow: Medical Immunology, 10th Edition, Appleton and Lange , New York
7. EP Diamandsis and Theodore K Christopoulos: Immunoassay, Academic press, Sandiego, USA.
8. Fatima, D. & Arumugam, N. (12014). Immunology. Saras publication, Kanyakumari, TN.
9. Moran, A. (2001). Immunotechnology- Principles, concepts and applications. Wiley-Blackwell, NY

10. Paul, A. (2016). Textbook of Immunology: Including Immunotechnology and Immunotherapy. Books & Allied (P) Ltd., Kolkata.
11. Pandian, M.R. & Kumar, B.S. (2007). Immunology and Immunotechnology. Panima Publishes, New Delhi.
12. Madhavee, L.P. (2012). A Textbook of Immunology. S. Chand & Co. Ltd. , New Delhi. 10. Richard A Goldsby, Thomas J Kindt, Barbara S Osborne: Kuby's Immunology. 5th Edition, W.H.Freeman & Coy , New York
13. Ramesh, S.R. (2017). Immunology. McGraw Hill Education India Pvt. Ltd., New Delhi.
14. Roitt : Essential Immunology :9th Edition, Blackwell Science ltd. Londo
15. Ronald W Ellis: Vaccines- new approaches to immunological problems , Butterworth Henimann, Boston, USA.
16. William Paul : Fundamental Immunology , Lippincot Raven, Philadelphia

Semester :2 Programme Name and Code: M. Sc. (Biotechnology)

Course code and Name: PG BIOT 204 –Biostatistics & Bioinformatics

MM: 25+75=100

Objectives:

1. This paper aims to understand the basic statistic calculations and concepts for applications in biological sciences.
2. To draw the different types of statistical graphs from collected data.
3. develop the understanding about the predication of different types of statistical data which will play a pivotal role to design the experiments.

UNIT – 1			
1a	4. Scope of biostatistics, Variables in biology 5. Collection, classification, tabulation, diagrammatic and graphic presentation of data. 6. Concepts of statistical population and sample.	Credit 1	Hours 15
1b	iii. Measures of Central Tendencies and Dispersion. ii. Simple measure of Skewness and kurtosis		
UNIT – 2			
2a	i. Probability: Definition, Simple and simple applications of probability. ii. Correlation, correlation coefficient, standard error of estimate and regression, linear regression, least square method of fitting.	Credit 1	Hours 15
2b	i. Basic idea of significance, testing level of significance, random variations. ii. Chi-square (X^2) test, ANOVA.		
UNIT – 3			
3a	ii. Introduction, classification and generation of Computers, components of a computer system, input and output devices. Biological Data Base: Primary, Secondary and Composite data base.	Credit 1	Hours 15
3b	3. Nucleotide sequence data base. 4. Protein sequence data base.		
UNIT – 4			
4a	i. Structural sequence data base. ii. Sequence analysis; Sequence alignment; types and methods.	Credit 1	Hours 15
4b	i. Primer designing ii. Role of Bioinformatics in drug discovery and development		

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10

Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to arranged and analyze the data, collected during experiments. Students will be able to design, analyze and evaluate their experiments. Thus, the proper knowledge of biostatistics will be proved a boon for degree section students to enhance their research activities during their M.Sc. and Ph.D. programs.

Book References

1. Attwood, T. (2007). Introduction to Bioinformatics. Pearson, India., New Delhi.
2. Ambrosius, W.T. (2010). Topics in Biostatistics. Humana Press. New Jersey
3. Banerjee, P.K. (2007). Introduction to Biostatistics. Rastogi publication, Meerut.
4. Ghosh, Z. & Mallick, B. (2008). Bioinformatics: Principles and Application. Oxford Higher Education, India.
5. Prasad, S. (2009). Elements of Biostatistics. Rastogi Publication, Meerut.
6. Ramakrishna, P. (2015). Biostatistics. Saras Publication, Kanyakumari, TN.
7. Rastogi, V.B. (2015). Biostatistics. Meditech Publishers, New Delhi.
8. Rastogi, S.C., Mendiratta, N. & Rastogi, P. (2009). Bioinformatics: Concepts, Skills and Applications. CBS Publishers & Distributors, New Delhi

Semester :3 Programme Name and Code: M. Sc. (Biotechnology)

Course code and Name: **PG BIOT 301 –Industrial Microbiology**

MM: 25+ 75 = 100

Objectives:

1.This paper aims to understand the basic of industrial microbiology
2.To know about the production and regulation of commercially valuable products at industrial level
3. develop the understanding about the primary and secondary metabolites of microorganisms and their regulation of production to commercialize with application of biotechnological tools.

UNIT – 1		Credit	Hours
1a	iv. Introduction, history, scope and relation with other sciences. v. Screening for new metabolites: Primary and secondary products.	1	15
1b	i. Strain development through selection, mutations and recombination, and other recent genetic/biochemical methods. ii. Substrates for fermentation: Nature, types and availability.		
UNIT – 2		Credit	Hours
2a	i. Fermentation: different types and systems for optimization of productivity. ii. Design and working of typical bioreactor	1	15
2b	i. Bioreactor for immobilized cells/enzyme system ii. Scale up, automation and use of computers in fermentation.		
UNIT – 3		Credit	Hours
3a	iii. Downstream process for product recovery: isolation, purification and concentration through physical/ chemical means. iv. Production of Alcohols (Ethanol), Organic acids, (Citric acid), Amino acids (Lysine & Glutamic acid), Solvents (Glycerol, Acetone & Butanol).	1	15
3b	iii. Production of Biologically active compounds: Antibiotics (Penicillin), Vitamins (B-12, Riboflavin), enzymes (Amylase, Protease). Cell cycle and its regulation		
UNIT – 4		Credit	Hours
4a	i. Steroid transformation ii. Production of microbial food and Single Cell Protein.	1	15
4b	i. Mushroom: production, nutritive and medicinal value. ii. Microorganisms as Biofertilizers and Biopesticides.		

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10

Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practical's, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc.

LEARNING OUTCOMES:

Upon completion of this course, students will be able to identify the industrially valuable microorganism and their products which can be comerisilaze for large scale productions. The area of industrial microbiology will provide a new avenue to the students to explore their job opportunity throughout the world.

Book References

1. Ahmed, N., Qureshi, F.M. & Khan, O.Y. (2001). Industrial and Environmental Biotechnology. Garland Science, New Delhi.
2. Mahapatra, P.K. (2008). Textbook of Environmental Microbiology. IK International Publishing House Pvt. Ltd., New Delhi.
3. Maheshwari, & Dubey, R.C. (2013).A Text Book of Microbiology. S. Chand & Co. New Delhi.
4. Pramanik, K. & Patra, K.K. (2014). Industrial and Environmental Biotechnology. Studium Press India Pvt Ltd.
5. Sastry, A.S. & Bhat, K.S. (2018). Essentials of Practical Microbiology. Jaypee Brothers Medical Publishers, New Delhi.
6.Sharma, P.D. (2016). Microbiology. Rastogi Publishers, Meerut, U.P

Semester :3 Programme Name and Code: M.Sc. (Biotechnology)
Course code and Name: PG BIOT 302 – Cell and Tissue Culture

MM:25+75=100

Objectives:

1.This paper aims to understand the basic aseptic technique used for tissue culture and media composition used in plant tissue culture and cell induction.
2.To know about the somatic hybrid formation and useful variation arise during tissue culture, cryopreservation which is basic technique in cell culture technology.
3.To study the composition of animal cell culture media and formation of primary cell from tissue
4.To study the formation of cell line and cytotoxic test.

UNIT–1		Credit	Hours
1a	i. Laboratory requirements and basic aseptic techniques ii. Culture media: composition and preparation	1	15
1b	i. Cell Culture: Initiation and maintenance of callus and suspension cultures ii. Organogenesis, somatic embryogenesis, factors affecting somatic embryogenesis, artificial seeds		
UNIT–2		Credit	Hours
2a	i. Protoplast isolation, culture and fusion, selection of hybrid cells. ii. Somaclonal and gametoclonal variations. iii. Clonal propagation/Micropropagation	1	15
2b	i. Cryopreservation and germplasm conservation ii. Introduction to intellectual property and IPR, importance of IPR.		
UNIT–3		Credit	Hours
3a	i. Equipment and materials animal cell culture technology. ii. Physiochemical properties of media, balanced salt solution, complete media and serum. iii. Serum free media.	1	15
3b	i. Biology and characterization of cultured cells. ii. Basic technique of mammalian cell culture in vitro; disaggregation of the tissue, primary culture, cell separation. 4. .		
UNIT–4		Credit	Hours
4a	i. Cell lines(finite and continuous) selection and routine maintenance ii. Cell cloning, selection and quantitation. iii. Measurement of viability and cytotoxicity	1	15
4b	. i. Biosafety issue in biotechnology, safety protocols. ii. Introduction to Bioethics		

INTERNALASSESSMENT

Attendance:5
Assignment / Presentation:
10Classtest:10

TRANSACTIONALSTRATEGIES

Lectures,tutorials,demonstrations,fieldpracticals,teachingtools (photographs,models,charts,etc.),OERs,digitallibraries,etc

LEARNINGOUTCOMES:

Upon completion of this course, students will be able to know about basic aseptic technique used in plant and animal culture, in vitro culture of plant and animal cell is basic technique in plant and animal biotechnology. This programs will help to uderstant the molecular mechanism of somatic hybrid transgenic plant and transgenic animal. .

Book References:

1. Aruni, A.W. & Ramadass, P. (2011). Animal Tissue Culture. www.mjppublishers. Com
2. Bhojwani, S.S. & Razdan, M.K. (1996). Plant tissue Culture: Theory and Practice. Elsevier Science Publisher, New York
2. De, K.K. (2008). Plant Tissue Culture. New Central Book Agency, Allahabad.
3. Mathur, S. (2006). Animal Cell and Tissue culture. Agrobios (India), Jodhpur.
4. Masters, J.R.W. (2000). Animal Cell Culture: A Practical approach. Oxford University Press, London
5. Narayanaswamy, S. (1992). Plant Cell and Tissue Culture. McGraw Hill Education, New Delhi.
6. Pullaiah, E., Subba Rao, M.V. & Sreedevi, E. (2017). Plant tissue Culture: Theory & Practicals. Scientific Pub., Jodhpur
7. Razdan, M.K. (2005). Introduction to Plant Tissue Culture. Oxford & IBH Pub., New Delhi.
8. Sambrani, S.A. (2015). Plant and Animal Tissue Culture. Vision Pub., New Delhi.

Semester :3 Programme Name and Code: M.Sc. (Biotechnology)

Course code and Name: PG BIOT 303- APPLIED MOLECULAR BIOLOGY

MM:25+75=100

Objectives:

1. This paper aims to understand molecular technology which helps in diagnosing diseases.
2. This also focuses on technology which helps to improve plants and animal qualitatively and quantitatively.
3. This paper also deals to develop pesticide resistant plants.

UNIT–1		Credit	Hours
1a	Genome Analysis: strategies of human genome project, organization of human genome and comparison with genomes of other organisms (Drosophila and Yeast).	1	15
1b	Embryonic stem cells, neural and hematopoietic stem cells. UNIT		
UNIT–2		Credit	Hours
2a	Gene therapy: current status, problems and future prospects.	1	15
2b	Gene delivery methods for animals: Viral vectors and vectorless or direct DNA Transfer, Particle bombardment, electroporation, microinjection and chemical methods, creation of animal models for human diseases.		
UNIT–3		Credit	Hours
3a	DNA fingerprinting: applications and limitations, forensic applications	1	15
3b	Transgenesis: Methodologies in plants, recent plant transformation technologies, basis of tumor formation, hairy root features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use of Ti and Ri plasmids as vectors, binary vectors.		
UNIT–4		Credit	Hours
4a	Application of plant transformation for productivity and performance: herbicide resistance, phosphoinothricin, glyphosate, sulphonyl urea, atrazine, insect resistance, Bt genes, non-Bt like protease inhibitors, virus resistance, coat protein mediated disease resistance, long self-life of fruits and flowers.		
4b	DNA vaccines, micro arrays, proteomics, pharmacogenomics	1	15

INTERNALASSESSMENT

Attendance:5

Assignment / Presentation:

10Classtest:10

TRANSACTIONAL STRATEGIES

Lectures,tutorials,demonstrations,field practicals,teaching tools (photographs,models,charts,etc.),OERs,digital libraries,etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to understand how a molecular technology helps to diagnose cause of a disease. As well as students will be able to develop genetically modified plants and animals.

Book References:

1. De Robertis, E.D.P. & De Robertis, Jr. E.M.F. (1987). Cell and Molecular biology. Lea and Febiger, U. S.
2. Gupta, P.K. (2014). Cell and Molecular Biology. Rastogi Publications, Meerut
3. Gupta, P.K. (2005). Molecular Biology and Genetic engineering. Rastogi Publications, Meerut.
4. Lee, C-H. (2009). Applied Molecular Biology. campus Books, Texas, USA.
5. Rastogi, S.C. (2010). Molecular Biology of the Cell. New Age International publisher, New Delhi.

Sheeler, P. & Bianchi, D.E. (2009). Cell and Molecular Biology. Wiley Eastern, New Delhi.

6. Vidyavathi, N. & Chetan, D.M. (2009). Molecular biology. I.K.International Publishing House Pvt. Ltd., New Delhi

Semester :3 Programme Name and Code: M. Sc. (Biotechnology)
Course code and Name: PG BIOT 304 –Environmental Biotechnology

MM: 25+75=100

Objectives:

1. This paper aims to understand the basic of environmental architecture, biotic and abiotic factors as well as their influence on environment
2. To draw an attention about the environmental hazards and their adverse effects on our environment.
3. develop the understanding about the waste management and their importance in recycling of wastes products.

UNIT – 1			
1a	3. Water, soil and air as a component of Environment. 4. Environment: Physico-chemical and biological characters.	Credit 1	Hours 15
1b	7.Pollutants: Nature, origin, source, monitoring and their impacts. ii. Toxicology of common pollutants: Carcinogens and mutagens.		
UNIT – 2			
2a	i. Water pollution: Industrial effluents, domestic wastes and agrochemicals ii. Basic account of Air, soil and noise pollution.	Credit 1	Hours 15
2b	i. Radiations as an environmental pollutant, hazards, monitoring and disposal. ii. Noise pollution and its impact on living system.		
UNIT – 3			
3a	iv. Types of solid wastes, transport, recycling, reuse and disposal for waste management. ii. Waste as a source of biofuels and biomass production.	Credit 1	Hours 15
3b	iii. Sewage treatment: Aerobic and anaerobic processes.		
UNIT – 4			
4a	i. Treatment scheme for waste water of dairy, distillery, tannery, sugar and antibiotic industries. ii. Environmental management, biological monitoring Programme.	Credit 1	Hours 15
4b	i. Impact assessment, bioleaching, biomineralization and biodegradation of xenobiotic compounds.		

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10

Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to understand their environment and the factors responsible for the hazardous effects on our environment. Students will be able to understand the role of environment for healthy life and will be aware for the challenges responsible for adverse effects on our environment. On the other hand, techniques of waste management and recycling of the waste products will provide a new window of opportunity to the students towards the research field as well as in industries .

Book References

1. Ambrosius, W.T. (2010). Topics in Biostatistics. Humana Press. New Jersey.
2. Attwood, T. (2007). Introduction to Bioinformatics. Pearson, India., New Delhi.

3. Banerjee, P.K. (2007). Introduction to Biostatistics. Rastogi publication, Meerut.
4. Ghosh, Z. & Mallick, B. (2008). Bioinformatics: Principles and Application. Oxford Higher Education, India.
Prasad, S. (2009). Elements of Biostatistics. Rastogi Publication, Meerut.
5. Rastogi, V.B. (2015). Biostatistics. Meditech Publishers, New Delhi.
6. Ramakrishna, P. (2015). Biostatistics. Saras Publication, Kanyakumari, TN.
7. Rastogi, S.C., Mendiratta, N. & Rastogi, P. (2009). Bioinformatics: Concepts, Skills and Applications. CBS Publishers & Distributors, New Delhi

Semester :4 Programme Name and Code: M. Sc. (Biotechnology)

Course code and Name: PG BIOT 401- BIOCHEMICAL ENGINEERING

MM:25+75=100

Objectives:

1. This paper aims to understand to how microbes are cultured in fermenter, upstream and downstream processing.
2. This paper also deals to culture animal and plant cell culture.

UNIT–1		Credit	Hours
1a	Scope and history	1	15
1b	Microbial growth kinetics: Batch culture, Continuous culture, Fed-batch culture.		
UNIT–2		Credit	Hours
2a	Transport phenomenon in bioprocess culture: Introduction, Oxygen requirement in Industrial fermentations. Oxygen supply and oxygen transfer rate. Factors affecting oxygen transfer rate.	1	15
2b	Determination of KLa values and factors affecting KLa values, non-Newtonian fluids, Heat transfer and heat transfer correlations, Mass and energy balance.		
UNIT–3		Credit	Hours
3a	Bioreactors: Ideal bioreactors, Reactor dynamics, Reactor with non-idea mixing, Sterilization reactors, Multiphase bioreactors, Animal and plant cell reactor technology, Instrumentation and control.	1	15
3b	Method of measuring process variables: Temperature, Flow, Pressure, Dissolved oxygen, pH and other chemical factors.		
UNIT–4		Credit	Hours
4a	Control systems: Manual, Automatic, Computers and Interface.		
4b	Immobilization technology: Techniques and trends.	1	15

INTERNALASSESSMENT

Attendance:5

Assignment / Presentation:

10Classtest:10

TRANSACTIONAL STRATEGIES

Lectures,tutorials,demonstrations,field practicals,teaching tools (photographs, models ,charts, etc.),OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, students will be able to understand how a molecular technology helps to diagnose cause of a disease. As well as students will be able to develop genetically modified plants and animals.

Book References:

1. Bailey, J.E. & Ollis, D.F. (2017). Biochemical Engineering Fundamentals. McGraw Hill Education.
2. Bailey, J.S. & Bhatia, S.C. (2009) Biochemical Engineering. CBS Publishers & Distributors, New Delhi.
3. Dutta, R. (2008). Fundamentals of Biochemical Engineering. Springer, India.
4. Doble, M. & Gummadi, S.N. (2007). Biochemical Engineering. PHI Learning Pvt. Ltd. New Delhi.
5. Rao, D.G. (2009). Introduction to Biochemical Engineering. McGraw Hill Education, New Delhi.

Semester :4 Programme Name and Code: M. Sc. (Biotechnology)
Course code and Name: PG BIOT 402- GENOMICS, PROTEOMICS &NANOBIOTECHNOLOGY
MM: 25+ 75 = 100

Objectives:

1. To acquaint the student with genome organization, gene identification, expression and applications of genomics analysis. Also, about proteomics, analysis and its applications.
2. To understand the fabrication of nanoparticles and their utilization for biological Research.

UNIT–1		Credit	Hours
1a	Introduction – Organization and structure of genomes, Genome size, Sequence complexity, Introns and Exons, Genome structure in viruses and prokaryotes.	1	15
1b	Mapping of Genome: Genetic and physical maps, physical mapping and map-based cloning, molecular markers in genome analysis; RELP, RAPD, STS, Microsatellite, SCAR (Sequence characterized amplified regions).		
UNIT–2		Credit	Hours
2a	Functional genomics: DNA chips and their use in transcriptome analysis; mutants and RNAi in functional genomics.	1	15
2b	Proteomic technology, identification and analysis of proteins by 2D analysis, mass spectrophotometry, NMR and X-ray crystallography, MALDI-TOF, Differential display proteomics, protein-protein interactions, yeast hybrid two system and phage display.		
UNIT–3		Credit	Hours
3a	Analysis of proteomes - Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilization, Reduction, Detecting proteins in polyacrylamide gels	1	15
3b	Applications of Proteomics and Genomics- Analysis of Genomes – Human & Bacteria. - drug development and toxicology, Pharmaceutical Applications, Proteomics in drug Discovery in human. Proteomics in plant genetics and breeding.		
UNIT–4		Credit	Hours
4a	Preparation and characterization of nanoparticles; Nanoparticular carrier system; Micro- and Nano-fluidics; Drug and gene delivery system	1	15
4b	Microfabrication, Biosensors, Chip technologies, Nano-imaging, gene therapy. Biomedical application of nanotechnology.		

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10 Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

Learning Outcome:

Upon completion of this course, students will be able to understand the application of genomics and proteomics in the field of modern Biology, like drug design, whole genome analysis and protein profiling. The area of nanobiotechnology will improve the concept and fabrication of nanoparticles in biomedical sciences.

Book References:

1. Discovery Genomics, Proteomics and Bioinformatics, Campbell AM & Heyer L, 2004, Pearson Education
2. Genomes by T.A. Brown, John Wiley & Sons Ltd, New York.
3. Genome analysis (Volume I, II, III and IV) a Laboratory Manual by Bruce Birren, Eric Green, Sue Klapholz, Richard M. Myers and Jane Roskams, Cold Spring Harbor Laboratory Press.
4. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. Nalwa HS. 2005. American Scientific publication.
5. Methods in Proteome and Protein Analysis, Kamp RM, 2004, Springer
6. Nanobiotechnology, Niemeyer CM & Mirkin CA, 2005 Wiley Interscience.

Semester :4 Programme Name and Code: M. Sc. (Biotechnology)

Course code and Name: PG BIOT 403 – Ethics, Patenting and Research methodology

MM:25+75=100

Objectives:

1. This paper aims to understand production of biotechnological product, and genetically modified organism and its benefits for society.
2. To study the Intellectual property right which enhance the research and development.
3. To know about entrepreneurship and learn about business procedure by utilizing biotechnology skill.
4. To study the procedure of funding from funding agency and making policy for business.

UNIT–1		Credit	Hours
1a	Ethics: Benefits of biotechnology, ELSI of biotechnology, Recombinant therapeutic products for human health care, Genetic modifications and food consumption, release of genetically engineered organisms,	1	15
1b	Applications of human genetic r DNA research, human embryonic stem cell research		
UNIT–2		Credit	Hours
2a	Patenting: Patent and Trademark, Biotechnology products and processes Intellectual property rights, Plant breeders' rights,	1	15
2b	Biotechnology in developing countries. Biosafety and its implementation, Quality control in Biotechnology.		
UNIT–3		Credit	Hours
3a	i. History of science and science methodologies; Empirical science; scientific method; manipulative experiments and controls; ii. deductive and inductive reasoning; descriptive science; reductionist vs holistic biology,	1	15
3b	i. biotech company roadmap, ii. legal, regulatory and other business factors		
UNIT–4		Credit	Hours
4a	Funding of biotech business: (Financing alternatives, VC funding, funding for biotech in India, Exit strategy, licensing strategies, valuation), support mechanisms for entrepreneurship (Bio-entrepreneurship efforts in India, difficulties in India experienced, organizations supporting biotech growth, areas of scope, Funding agencies in India, biotech policy initiatives	1	15
4b	Role of knowledge centers and R&D (knowledge centers like universities and research institutions, Role of technology and upgradation.		

INTERNALASSESSMENT

Attendance:5

Assignment / Presentation:

10Classtest:10

TRANSACTIONALSTRATEGIES

Lectures,tutorials,demonstrations,fieldpracticals,teachingtools (photographs,models,charts,etc.),OERs,digitallibraries,etc

LEARNINGOUTCOMES:

Upon completion of this course, students will be able to know about different type of biotechnological product for commercial purpose and know about benefit of biotechnology for society which will

enhance the research and development activity.. The understanding of bio entrepreneurship, funding agency for research and development required for biotech growth,

Book References

1.Dyson, A. & Harris, J. (2002). Ethics and Biotechnology (Social Ethics and Policy). Routledge Pub. (Kindle Edition)
Goel, D. & Parasar, S. (2013). IPR, Biosafety and Bioethics. Pearson Pub., New Delhi. . (Kindle Edition) vii.

2.Gruber, A.C. (2009). Biotech Funding Trends. Wiley VCH.

3. Prasad, L. (2015). Patenting in India: Policy, Procedure and Public Funding. IK International Publishing House, New Delhi. . (Kindle Edition)

4. Sherlock, R., Morrey, J.D., Agar, N. & Altieri, M. (2002). Ehical Issues in Biotechnology. Rowman & Littlefield Publishers. . (Kindle Edition)

Semester:4 Programme Name and Code: M. Sc. (Biotechnology)

Course code and Name: **PG BIOT 404 –Medical Genetics** **MM: 25+75=100**

Objectives:

1.This paper aims to understand the basic of pedigree and related genetic disorders based on family history.
2.To know about different types of genetic diseases and the probable treatments to sustain the life.
3. develop the understanding about the chromosome structure and the diseases related to the alteration in chromosome structure.

UNIT – 1		Credit	Hours
1a	Pedigree analysis and monogenic traits: autosomal, sex-linked and sex-influenced traits, mitochondrial inheritance. Complications to the basic pedigree patterns: non-penetrance, Pleiotropy, late onset, anticipation, genomic imprinting.	1	15
1b	Monogenic disorders: cystic, fibrosis. Inborn errors of metabolism: Phenylketonuria.		
UNIT – 2 Genetic disorders of various systems		Credit	Hours
2a	**Hematological disorders:** Sickle cell anaemia, Thalassemias, Haemophilia. **Neurological disorders:** Charcot-Marie tooth syndrome, Alzheimer's.	1	15
2b	**Muscular disorders:** Deuchnne muscular dystrophy, Baker's muscular dystrophy. **Eye disorders:** Colour blindness, Retinitis pigmentosa.		
UNIT – 3		Credit	Hours
3a	Complex traits: Polygenic and multifactorial alcoholism, atherosclerosis, diabetes mellitus. Chromosomal disorders: Human karyotype, banding and nomenclature, common syndromes due to numerical and structural alterations.	1	15
3b	Syndromes due to triplet repeat expansion (Huntington's chorea, fragile X syndrome) Cell cycle and its regulation.		
UNIT – 4		Credit	Hours
4a	Cancer: chromosomal disorders, oncogenes and tumor suppressor genes; Leukemia, retinoblastoma and breast cancer. Introduction to genetic counselling: risk assessment, pre-implantation, pre-natal and postnatal diagnosis.	1	15
4b	Legal and ethical consideration of testing and counselling.		

INTERNAL ASSESSMENT

Attendance: 5

Assignment / Presentation: 10

Class test: 10

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc.

LEARNING OUTCOMES:

Upon completion of this course, students will be able to understand the chromosomal basis of inheritance and the related complexities expressed phenotypically. The proper understanding of different types of genetic diseases and their chromosomal basis of inheritance will provide opportunities for research in the field of genetics and molecular biology. The syllabus will also make the students to understand about ethical consideration of testing and counselling.

Book References

1. De Robertis, E.D.P. & De Robertis, Jr. E.M.F. (1987). Cell and Molecular biology. Lea and Febiger, U. S.
2. Gupta, P.K. (2014). Cell and Molecular Biology. Rastogi Publications, Meerut.
3. Karp, G. (2013). Cell Biology, Wiley
4. Powar, C.B. (2010). Cell Biology. Himalaya publishing house, Mumbai.
5. Rastogi, S.C. (2005). Cell Biology. New age Publishers, New Delhi.
6. Sheeler, P. & Bianchi, D.E. (2009). Cell and Molecular Biology. Wiley.
7. Verma, P.S. & Agarwal, V.K. (2016). Cell biology. S. Chand & Company Ltd., New Delhi

Online consult
External expert
(Prof CPM Tripathi)