NOIDA INTERNATIONAL UNIVERSITY

DEPARTMENT OF BIOTECHNOLOGY & MICROBIOLOGY

SYLLABUS OF COURSES TO BE OFFERED

POSTGRADUATE PROGRAMME (BIOTECHNOLOGY)

Choice Based Credit System (CBCS)

PEOs, POs & PSOs of M.Sc. Biotechnology Programme

Programme Educational Objectives (PEOs): The Program Educational Objectives (PEOs) for the M.Sc. Biotechnology program enlists the accomplishments that a graduate aims to attain within two years after graduation.

PEO1: To motivate graduates to pursue research career in industry and academia by providing fundamental and practical knowledge foundation in branch of Biotechnology.

PEO2: To develop biotechnologists with high professional ethics to cope up with global and societal issues for overall development.

PEO3: To educate students with analytical and research skills, and empower them to critically analyze the research problems depending on area of specialization and also will nurture their entrepreneurial endeavors.

Programme Outcomes (POs): The Graduates of Masters programs (M.Sc. Biotechnology) will be able to:

PO1: Master of Science knowledge: Apply the knowledge of biotechnology, microbiology, biochemistry fundamentals, and bioinformatics to the solution of complex biological problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex biological problems reaching substantiated conclusions using various principles of biotechnology, bioinformatics, microbiology, biochemistry, cell and molecular biology sciences.

PO3: Conduct investigations of complex problems: Use the various protocols developed through extensive research-based knowledge and methods including design of experiments, analysis and interpretation of data, and provide valid and reproducible conclusions.

PO4: Post Graduate Student and society: Apply the classic and modern biological theoretical and practical knowledge gained to address societal, health, microbial and plant biodiversity studies,

safety, ethical and cultural issues and the consequent responsibilities relevant to the professional up-gradation of the student and society as a whole.

PO5: Individual and team work: Be an independent thinker and researcher effectively as an individual, and as a member or leader of different teams, and in multidisciplinary research Institutions and Universities.

PO6: Communication: Communicate effectively on complex research activities with the scientific community and with society at large, as a scientist or a teacher, be well versed with scientific writing and write effective reports and design research projects, make effective presentations, and be able to defend it efficiently.

PO7: Project management and finance: Write good research and development projects relevant to the needs of society and environment and attract extra mural funds for himself and his team in the Institute or University from various funding agencies and manage R&D projects effectively.

Programme Specific Outcome (PSOs): After the successful completion of M.Sc. Biotechnology program, the students will able to:

PSO1: Have basic and advanced understanding of Biotechnology in its various domains including, health, nutrition, agriculture, biodiversity conservation, Biosafety etc.

PSO2: Address research questions related to all the above mentioned domains through carrying out specific experiments.

PSO3: Appear and successfully qualify the higher level examinations of various agencies like DBT (Department of Biotechnology), CSIR (Council of Scientific and Industrial Research), ARS (Agriculture Research Services), ICAR (Indian Council of Agriculture Research) and many more, so as to get chance to do research from reputed institutes within country and abroad with sound fellowships.

PSO4: Have enough subject knowledge to move ahead in entrepreneurship endeavors in biotechnology.

NOIDA INTERNATIONAL UNIVERSITY
SCHOOL OF SCIENCES

Study & Evaluation Scheme for M.Sc. (Biotechnology)

M.Sc. Biotechnology 1st Year
SEMESTER-I

S.No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit
									External Exam		
			L	T	P	CA	TA	Total			
1	STPB-101	Cell Biology	4	0	0	20	20	40	60	100	4
2	STPB-102	Principles of Genetics	4	0	0	20	20	40	60	100	4
3	STPB-103	Diversity of Prokaryotes & Eukaryotes	4	0	0	20	20	40	60	100	4
4	STPB-104	Basics of Medical Biotechnology & Molecular Medicine	4	0	0	20	20	40	60	100	4
5	STPB-105/ TC	Bioethics, Biosafety and IPR/ Technical Communication	2	0	0	20	20	40	60	100	2
Practical											
1	SPPB-101	Cell Biology Lab	0	0	2			25	25	50	2
2	SPPB-102	Principles of Genetics Lab	0	0	2			25	25	50	2
3	SPPB-103	Diversity of Prokaryotes & Eukaryotes Lab	0	0	2			25	25	50	2
4	SPPB-104	Basics of Medical Biotechnology & Molecular Medicine lab /seminar	0	0	2			25	25	50	2
Total										**700**	**26**
Note: List of Practical will be supplied at the Start of every Semester											

M.Sc. Biotechnology 1st Year

SEMESTER-II

S.No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit
									External Exam		
			L	T	P	CA	TA	Total			
1	STPB-201	Molecular Biochemistry	4	0	0	20	20	40	60	100	4
2	STPB-202	Molecular Biology	4	0	0	20	20	40	60	100	4
3	STPB-203	Immunotechnology	4	0	0	20	20	40	60	100	4
4	STPB-204	Biostatistics, Computer Applications and Bioinformatics	4	0	0	20	20	40	60	100	4
5	STPB-205	"Seminar" Modern research in biotechnology	2	0	0	15	10	25	75	100	2
Practical											
1	SPPB-201	Molecular Biochemistry	0	0	2			25	25	50	2
2	SPPB-202	Molecular Biology	0	0	2			25	25	50	2
3	SPPB-203	Immunotechnology	0	0	2			25	25	50	2
4	SPPB-204	Biostatistics, Computer Applications and Bioinformatics	0	0	2			25	25	50	2
Total										**700**	**26**
Note: List of Practical will be supplied at the Start of every Semester											

M.Sc. Biotechnology 2nd Year
SEMESTER-III

S.No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit
									External Exam		
			L	T	P	CA	TA	Total			
1	STPB-301	Enzymology & Bioprocess Technology	4	0	0	20	20	40	60	100	4
2	STPB-302	Plant and Animal Biotechnology	4	0	0	20	20	40	60	100	4
3	STPB-303	Recombinant DNA Technology	4	0	0	20	20	40	60	100	4
4	STPB-304	Host-pathogen interaction	4	0	0	20	20	40	60	100	4
5	STPB-305/STPB-306	CBCS Genomics and Proteomics /Bioinformatics	2	0	0	20	20	40	60	100	2
Practical											
1	SPPB-301	Enzymology & Bioprocess Technology	0	2				25	25	50	2
2	SPPB-302	Plant and Animal Biotechnology	0	2				25	25	50	2
2	SPPB-303	Recombinant DNA Technology	0	2				25	25	50	2
3	SPPB-304	Host-pathogen interaction Lab	0	2				25	25	50	2
Total										**700**	**26**
Note: List of Practical will be supplied at the Start of every Semester											

M.Sc. Biotechnology 2nd Year
SEMESTER-IV

S.No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit
									External Exam		
			L	T	P	CA	TA	Total			
1	STPB-401	Environmental Biotechnology	4	0	0	20	20	40	60	100	4
2	STPB-402	Clinical research and Entrepreneurship	4	0	0	20	20	40	60	100	4
Total										**200**	**8**
Note: List of Practical will be supplied at the Start of every Semester											

S.No	Course Code	Subject	Project Report	Report Presentation	Viva Voce	Subject Total	Credit
1	STPB-403	Project	100	50	50	**200**	**8**

OVERALL CREDIT SCHEME

S. No.	SEMESTER	Theory Total	Practical Total	Subject Total	Total Credit
1	I	400	200	700	26
2	II	500	200	700	26
3	III	500	200	700	26
4	IV	200	200	400	16
			Grand Total	**2500**	**94**

Assessment method:

Assessment method	Theory				Practical	
	Internal assessment	Mid-term examination	End-term examination	Maximum Mark	Practical examination	Maximum Mark
Mark	20	20	60	100	50 Mark	50 Mark
%	20%	20%	60%	100%	100%	100%

M.Sc. Biotechnology 1st Year

SEMESTER-I

CELL BIOLOGY (STPB-101)

L	T	P
4	0	2

Course Name: Cell Biology
Course Code: STPB-101
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

The aim of the course is to provide students with in depth knowledge of cell as a functional unit of life. The intra and intercellular interactions among the various cellular organelles, their structure and function communication that facilitates optimal function and development of any organism.

Course Description:

This course consists of theoretical as well as practical approach to understand cellular mechanism that are involved in maintenance proper cellular homeostasis. This includes cell structure and function at molecular level, cell cycle and developmental mechanisms involved in division of cell, interaction of cell with the outside environment and internal cellular communication and immune mechanism.

Course Contents:

Unit I: Membrane structure and function. Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

Unit II: Structural organization and function of intracellular organelles. Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Unit III: Organization of genes and chromosomes. Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. Cell division and cell cycle (Mitosis and meiosis, their regulation, Steps in cell cycle, Regulation and control of cell cycle).

Unit IV: Cell Signaling: Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers,

regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

Unit V: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Course Learning Outcomes (CLOs):

At the end of this course the postgraduate student:

CLO1: Will have understanding of Cell membrane as a dynamic entity with numerous functions that facilitates normal cellular function as well as cellular transport.

CLO2. Will have a clear understanding of the structural organization and function of all intracellular organelles.

CLO3. Insight on regulation of cell cycle and organization gene and chromosomes.

CLO4. How pathogens interact with their host in higher eukaryotes. Deciphering disease mechanisms.

CLO5. Basic concept of all the pathways and mechanisms involved in cell signalling and communication

Text Books:

- GM Cooper, Cell: A Molecular approach, 8th edition, Oxford University Press, 9781605358635, 1605358630, 2018
- deRobertis and deRobertis, Cell and Molecular Biology, 8th edition, Lea & Febiger, 9780812110128

Reference Books:

- G. Karp, Cell and Molecular, Biology, 6th Edition, John Wiley & Sons, 9780470578858, 0470578858
- B Alberts et al Molecular Biology of the Cell. 6th edition, Garland Science, Taylor and Francis group, 9781317563754, 1317563751

Online links for study and reference materials:
www.biologydiscussion.com
www.khanacademy.org
https://www.ncbi.nlm.nih.gov/pmc

PRINCIPLES OF GENETICS-(STPB-102)

L	T	P
4	0	2

Course Name: Principles of Genetics **Course Code:** STPB-102
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

The objective of this course is to build knowledge on the fundamentals of genetics, heredity, or inheritance. To build the foundation on the understanding of biological principles.

Course Description:

This course provides a detailed understanding of Mendelian and non-Mendelian inheritance; various techniques and methodologies that decipher genetic recombination and gene mapping.

Course Contents:

Unit I: Mendelian principles & Extensions: Dominance, segregation, independent assortment. Co-dominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit II: Concept of gene and Gene mapping methods : Gene Concept, Allele, Multiple alleles, Pseudoallele, Complementation tests, Benzer's work on rII locus in T4 phases. Linkage maps, Tetrad analysis, Three- Point Test cross, Cytological basis of crossing over, Interference and Coincidence, Crossing over and Chiasma formation, Factor affecting recombination frequencies, Mapping with molecular markers, Mapping by using somatic cell hybrids, Development of mapping population in plants.

Unit III: Genetics of Sex Determination and Differentiation: Sex-linked, Sex- limited and Sex-influenced traits in Drosophila and Human beings, Theories of Sex-determination- Chromosomal theory, environmental theory and genic balance theory, Sex- determination in dioeciously plants, Sex reversal and Gynandromorphs, Human sex anomalies (Klinefelter's Syndrome and Turner's Syndrome), brief idea of Dosage Compensation and Lyon's hypothesis.

Unit IV: Extra chromosomal inheritance and Biochemical Genetics: Criteria for extra-chromosomal inheritance, Inheritance of Mitochondrial and chloroplast genes, plastid inheritance in Mirabilis, iojapa in corn, Kappa particles in Paramecium, Coiling in snails, male sterility in

plants. Inborn errors of Metabolism in man, eye transplantation in Drosophila, Biochemical mutations in *Neurospora*, Biosynthetic pathways and Biochemical mutations.

Unit V: Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Course Learning Outcomes (CLOs):
After successful completion of the course the students:

CLO 1. Will have knowledge of Mendelian, non- Mendelian inheritance and an insight of Gene concept and alleles

CLO 2. Will have an understanding of various methods employed in Gene mapping

CLO 3. Insight of differentiation of sex in plants and animals and various diseases associated with improper differentiation of sex. Evaluate difference between extra-chromosomal inheritances from chromosomal inheritance.

CLO 4. Biochemical changes that lead to difference in inheritance of characters & their expression

CLO 5. Various techniques involved in studying human genetics and their quantification

Text Books:

- P. K. Gupta, GENETICS. Rastogi Publication. 9788171338429, 8171338429
- Strickberger M. W., Genetics. Mac Millan Publishing Co., 9780024180902

Reference Books:

- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., "Molecular Biology of the Gene", 5th Ed., Pearson Education, 9780321762436, 0321762436

Online links for study and reference materials:
www.biologydiscussion.com
www.khanacademy.org
https://www.ncbi.nlm.nih.gov/pmc

DIVERSITY OF PROKARYOTES AND EUKARYOTES - (STPB-103)

L	T	P
4	0	2

Course Name: Diversity of Prokaryotes and Eukaryotes **Course Code:** STPB-103
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

The primary objective of the course is to build a strong foundation in the area of prokaryotic cell structure, division, survival and propagation. The course will enable students to understand the taxonomical classification, phenotypic and biochemical identification of food associated molds, yeasts, yeast-like fungi and bacteria.

Course Description:

This course introduces students to the diversity among prokaryotes and eukaryotes. It will make student familiar with various aseptic techniques and isolation methods. This course will introduce the host pathogen interaction.

Course Contents:

UNIT I: Beginnings of Microbiology; Contributions of Lister, Koch and Pasteur; Microscopy-brief account of various types and their applications.

Methods in microbiology: Pure culture techniques, theory and practice of sterilization, Principles of microbial nutrition, culture media.

UNIT- II

Microbial Systematics and Taxonomy: Approaches to bacterial taxonomy, Classification including ribotyping; Ribosomal RNA sequencing, characteristics of primary domains; taxonomy, nomenclature and Bergey's manual (Introduction).

UNIT- III: Prokaryotic diversity: Bacteria: Purple and green bacteria, cyanobacteria, Mycobacteria, rickettsias, chlamydias and mycoplasms. Archaea: Archaea as earliest life forms: halophiles, methanogens, hperthermomphilic archaea, thermoplasma. Eukarya: An introduction to protista, algae, fungi and slime molds.

UNIT – IV: Metabolic diversity among microorganisms: Pathways of glucose dissimilation in aerobic and anaerobic microbes, fermentation (alcoholic and acidic), nitrogen metabolism, nitrogen fixation.

UNIT – V: Microflora of human (skin, oral cavity, gastrointestinal tract) entry of pathogens into the host, types of toxins (exo-, endo-) and their structure, mode of actions-infectious disease transmission; virulence and pathogenesis. Chemotherapy/antibiotics: antimicrobial agents, sulfa drugs, antibiotics: broad-spectrum antibiotics, mode of action.

Course Learning Outcomes (CLOs):

CLO1. Demonstrate theory and practical skills in microscopy and their handling techniques and staining.
CLO2. Procedures and understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea.
CLO3. Know various Culture media and their applications and also understand various physical and chemical means of sterilization and general bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae.
CLO4. Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively.
CLO5. Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

Text Books:

- J. Willey, L. Sherwood, C. J. Woolverton, Prescott's Microbiology. 10th edition. McGraw Hill Education. 2017. ISBN No. 9780073375267, 0073375268
- M. Madigan, K. Bender, D. Buckley, W. Sattley, D. Stahl. Brock Biology of Microorganisms. 15th Edition. Pearson Education. 2018. ISBN No. 9781292018317, 1292018313

Reference Books:

- Ricardo Cavicchioli, Archaea Molecular and Cellular Biology. American Society of Microbiology. 2007. ISBN No. 1555813917, 9781555813918
- D. White, J. Drummond, C. Fuqua, The Physiology and Biochemistry of Prokaryotes. 4 th Edition. Oxford University Press. 2011. ISBN No. 9780195393040, 019539304X.

Online links for study & reference materials:
https://www.khanacademy.org/
https://swayam.gov.in/
https://nptel.ac.in/

BASIC OF MEDICAL BIOTECHNOLOGY & MOLECULAR MEDICINE (STPB-104)

L	T	P
4	0	2

Course Name: Basic of Med. Biotechnology & Mole. Medicine **Course Code:** STPB-104
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

It is intended to impart basic knowledge in the area of Medical Biotechnology & Molecular Medicine. This course will introduce the students with basic concept of biotechnology, medical genetics and Medical oncology and therapeutics.

Course Description:

This course is mainly focused on the Biotechnology and Molecular Medicine which includes Different classes of Biotechnology and its application, DNA Mapping, DNA Marker, Cloning of DNA, Medical Genetics and Genetic Diseases. This course also includes medical oncology, Tumour and Cytogenetic Markers, rDNA derived Drugs, Gene Therapy, Hybridoma Technology and Bioethics & Biosafety in Research

Course Contents:

Unit 1: Medical Biotechnology & Molecular Technology

Introduction to Biotechnology, Different classes of Biotechnology and its application: Medical Biotechnology, DNA Mapping, DNA Marker, Cloning of DNA, DNA Sequencing, Recombinant DNA technology, Mutation & Polymorphism.

Unit 2: Medical Genetics

Introduction of Medical Genetics and Genetic Diseases. Thalassaemia – Model for Molecular Genetics, Chromosomal Disorders, Heterogeneity, Genetic counseling, Stem cell and its application.

Unit 3: Medical Oncology

Introduction of medical oncology, Tumour and Cytogenetic Markers, Gene regulation in cancer: Oncongenes and Tumour Suppressor genes, Genetic Models and Cancer, Diagnostic Application & Therapeutics.

Unit 4: Therapeutics

rDNA derived Drugs, Gene Therapy, Hybridoma Technology, Monitoring & Response to Therapy Immunotherapy.

Unit 5: Bioethical issues and Forensic Medicine

Introduction to Bioethics & Biosafety in Research, Human Genome Project, Introduction to Forensic Medicine, Tissue identification and DNA profiling.

Course Learning Outcomes (CLOs):

CO1. Basic concept of Medical Biotechnology and its scope.
CO2. Develop an understanding of medical genetics and chromosomal disorder.
CO3. Understand basic concept of Molecular Oncology, and Gene regulation in cancer development.
CO4. Explain the basic concept of gene therapy and its application
CO5. Discuss the basic introduction to Bioethics & Biosafety in Research and concept of forensic medicine.

Text Books:

- An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology, Wiley, ed. 2, 2011
- Campbell, M.A and Heyer L.J., Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, CSHL Press, Pearson/Benzamin Cummings San Francisco, USA, 2007.
- Andrew Read and Dian Donnai, New Clinical Genetics, Scion Publishing Ltd, Oxfordshire, UK, 2007.

Reference Books:

- S.R. Maloy, J.E. Cronan, D. Friefelder, Microbial Genetics, 2nd Edition, Jones and Bartlett Publishers, 1994.
- New Clinical Genetics, Scion Publishing Ltd, Oxford shire, UK, 2007
- Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, CSHL Press, Pearson/Benzamin Cummings San Francisco, USA, 2007
- Strachan T and Read A P, Human molecular genetics, 3rd Edition Wiley Bios, 2006.

Online links for study & reference materials:
http://www.onlinebiologynotes.com
http://www.ornl.gov/TechResources/Human_Genome/home.html
https://www.biotecharticles.com

CBCS** BIOETHICS, BIOSAFETY & IPR - (STPB-105)

L	T	P
2	0	0

Course Name: Bioethics, Biosafety and IPR
Course Code: STPB-105
Course Credit Hour: 2 hrs
Total Contact hour: 30 hrs

Course Objective:

To apprise the students of the various societal, governance and regulatory issues in biotechnology with special emphasis on ethics, safety and intellectual property rights. Through this course, the students develop a perspective on the importance of these aspects in the success of biotechnology products and services in the market. At the end of the course, they should be able to apply this perspective and the specific principles, laws, regulations etc., in academic and industrial settings for regulatory oversight and enforcement.

Course Description:

This course is mainly focused on the Bioethics, Biosafety and Intellectual Property Rights which includes basic concept of patents, patent regime (in India and abroad) registration aspects and other details.

Course Contents:

Unit I

Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding, biotechnology in international relations, globalization and development divide.

Unit II

Introduction to bioethics: Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.

Unit III

Biosafety: Definition of bio-safety, Biotechnology and bio-safety concerns at the level of individuals, institutions, society, region, country and world with special emphasis on Indian concerns. Biosafety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety. Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions (Indian context).

Unit IV

Introduction to IPR: IPR, forms of IPR and Intellectual property protection. Concept of property with respect to intellectual creativity, Tangible and Intangible property. WTO: agency controlling trade among nations, WTO with reference to biotechnological affairs, TRIPs. WIPO, EPO.

Course Learning Outcomes (CLOs):

CLO1. The students shall get an adequate knowledge on patent and copyright. This provide further way for developing their idea or innovations.

CLO2. Identify the role of regulatory committees in controlling the risk.

CLO3. Students should get enough information on ethical issues linked to research on animal models, transgenics, clinical trials.

CLO4. Students to consider Intellectual Property (IP) as a career option as IP Counsel/Patent Examiner/Patent agent.

Text Books:

- Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.
- Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

Reference Books:

- Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
- Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
- V Sreekrishna, 2017. Bioethics and Biosafety in Biotechnology by New Age International publishers.

Online links for study & reference materials:
http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

M.Sc. Biotechnology 1st Year
SEMESTER-II

MOLECULAR BIOCHEMISTRY (STPB-201)

L	T	P
4	0	2

Course Name: Molecular Biochemistry **Course Code:** STPB-201
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

This course deals with characteristics, properties and biological significance of the biomolecules of life.

Course Description:

This course introduces students to the general families of biomolecules that comprise the science of biochemistry and to the principles that integrate biochemistry with other chemical and biological disciplines. They acquire knowledge in the quantitative and qualitative estimation of biomolecules.

Course Contents:

UNIT-I: Chemical foundations of Biology – pH, pK, acids, bases, buffers, weak bonds and covalent bonds. Classification, structure, properties and biological significance of carbohydrates. Monosaccharides, Disaccharides, and Polysaccharides. Biological role of peptidoglycans, glycosaminoglycans and Lectins. Lipids - classification, structure and properties of fatty acids, triglycerides, phospholipids, sphingolipids and cholesterol.

UNIT-II: Amino acids - Classification, structure and physico-chemical properties. Chemical synthesis of peptides – solid phase peptide synthesis. Proteins - classification, purification and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Confirmation of proteins – Ramachandran plots. Denaturation of proteins. Hetero cyclic compounds – Heme and Chlorophylls.

UNIT-III: Structure and properties of purines, pyrimidines, nucleosides, and nucleotides. Covalent structure of DNA and different forms of DNA - A, B and Z. DNA super coiling. Types of RNA and covalent structure of t-RNA. Classification, structure and physiological roles of Vitamins.

UNIT-IV: Hormones- classification and mechanism of action of steroid and protein hormones. Signal transduction cascade by cyclic AMP, Phosphoinositate and calcium (Ca+), G-proteins, growth factors and membrane receptor tyrosine kinases. Phytohormones and their physiological roles.

Course Learning Outcomes:
After studying this paper, Postgraduate students will be able to:

CLO1: Understand biochemistry at the atomic level, draw molecules and reaction mechanisms perfectly and detail about amino acid structures, types of amino acids, classifications, structure of proteins and types of proteins

CLO2: Recognize the structural levels of organization of proteins,3D structure of proteins, its functions, denaturation (hemoglobin, myoglobin etc.) and be able to describe/recognize lipid and porphyrin structures, lipoproteins and functions of porphyrins (heme, chlorophyll etc.).

CLO3: Learn how amino acids and proteins are metabolized, emphasizing the role of few intermediates of their metabolism, monitoring the deficiency and abundance disorders of amino acid metabolisms and the role of enzymes in the regulation of the pathways

CLO4: Understand the structure and function of genetic material.

Text Books:

- A.L., Lehninger, PRINCIPLES OF BIOCHEMISTRY (1982), Worth Publishers, Inc. New York, ISBN: 9780716743392, 0716743396
- L. Stryer , BIOCHEMISTRY (1995) W.H. Freeman Press, San Francisco, USA, ISBN: 9781319248086, 131924808X.

Reference Books:

- Voet, D. and Voet, J.G., Biochemistry, (2004). 3rd Edition, John Wiley & Sons, Inc.USA,
- U. Sathyanarayana, Biochemistry by Books and Allied (P) Ltd. Kolkata, ISBN 0-87893- 214-3, (2014), ISBN: 9788187134800, 8187134801

Online links for study & reference materials:
https://www.khanacademy.org/test-prep/mcat/biomolecules
https://nptel.ac.in/courses/104/105/104105076/

MOLECULAR BIOLOGY (STPB-202)

L	T	P
4	0	2

Course Name: Molecular Biology
Course Code: STPB-202
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

To acquaint the students with basic and advanced knowledge of molecular biology. Course objectives is focus discuss the better understanding of molecular Biological processes like DNA replication, transcription and repair systems, different genes regulation and replication.

Course Description:

This course presents the genetics at molecular level Goals: On successful completion of the subject the student should have understood the molecular aspects of Molecular biology

Course Contents:

Unit I: Organization of genetic material - Packing of DNA in to chromatin - protein components of chromatin, histones, nucleosome organization. Solenoids loops, domains & scaffolds. Gene amplification, polytene chromosomes. DNA replication – apparatus, enzymes involved and mechanism. Replication at telomeres. DNA damage and repair mechanism. Nuclear genome.C - value paradox. Mitochondrial & plastid genomes and genes. Fine structure of the eukaryotic gene. Split genes. Different kinds of genes: overlapping, assembled, polyprotein & nested genes.

Unit II: Transcription in prokaryotes and eukaryotes. Mechanism of transcription, enzymes and transcription factors, zinc finger, leucine zipper mechanism. Maturation and processing of mRNA, splicing, 5' end capping & 3' end tailing. RNA editing and transport. RNAi and small RNAs.

Unit III: Translation in prokaryotes and eukaryotes: Genetic code - properties of the genetic code, deciphering of the genetic code. Ribosome as a translation factory. t - RNA as an adaptor, its mode of function. Post translational modifications. Leader sequences & protein targeting.

Unit IV: Regulation of gene expression in prokaryotes - The operon concept, lac &tryp operons. Transcriptional control. Post translational control. Regulation in eukaryotes - Control by promoter, enhancer and silencers. Cis-trans elements. Environmental & developmental regulation. DNA methylation & gene expression. Chromatin structure & gene expression.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept molecular biology especially organization of genetic material.
CLO2. Describe the basic knowledge of transcription in prokaryotes and eukaryotes.
CLO3. Describe the basic knowledge of translation in prokaryotes and eukaryotes.
CLO5. Discuss the basic concept of regulation of gene expression in prokaryotes and eukaryotes.

Text Books:

- Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith, Wayne M. Becker. Becker's World of the Cell, 8th edition, Benajmin Cummings, 9780321689634, 0321689631, (2012).
- EDP De Robertis and EMF De Robertis. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, 9780781734936, 0781734932, (2006)

Reference Books:

- Gerald Karp, Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc, 9780470483374, 0470483377 (2010)
- G.M. Cooper, and R.E. Hausman. The Cell: A Molecular Approach. 5th Edition. ASM Press 780878931064, 0878931066 (2009)

Online links for study and reference materials:
http://www.open2study.com/cellbiology
https://nptel.ac.in/courses/102103012/

IMMUNOTECHNOLOGY (STPB-203)

L	T	P
4	0	2

Course Name: Immunotechnology
Course Code: STPB-203
Course Credit Hour: 4 hrs
Total Contact hour: 42 hrs

Course Objective:

This course is mainly focused on the host immune system which includes concept of immunology, Type of immune system, Classes of immune cells, Antigen-Antibody interaction immune cell tolerance, vaccine technology, and other immunotechnology related topics. Basic of immunology and molecular biological techniques are usually two major courses form the essential prerequisites for Immunotechnology.

Course Description:
This course is mainly focused on the host immune system which includes basic concept of immunology, Type of immune system, Classes of immune cells, Antigen-Antibody interaction immune cell tolerance, vaccine technology and other relevant topics. It also discuss the basic concept of Vaccine technology including DNA vaccines, immunodiagnosis of Infectious diseases.

Course Contents:

Unit 1:
Introduction to immunology: History and scope of immunology; types of immunity; anatomy of lymphoid organs- primary and secondary lymphoid organs; immunoglobulin structure and function; memory cells, lymphocyte differentiation.

Unit 2:
Biology of complement systems: Structure and function of MHC class I and II molecules; antigen recognition and presentation; humoral and Cell mediated immune responses; hypersensitivity reaction; immune suppression and immune tolerance; auto immune disorders.

Unit 3:
Antigen & Antibodies: Antigen- isolation, purification and characterization of various antigens and haptens; antibodies- production, purification and quantification of immunoglobulins; antigen - antibody reaction; hybridoma and monoclonal antibody production; immuno-diagnosis and applications; human monoclonal antibodies; complement fixation.

Unit 4:
Immunotechnology: Purification of mononuclear cells from peripheral blood; isolation and characterization of T cells subsets; Antigen processing and presentation; fluorescent activated cell sorter (FACs); mitogen and antigen induced lympho-proliferation assay; mixed lymphocyte reaction (MLR); Assay of macrophage activation; Macrophage & Dendritic cells culture.

Unit 5:

Vaccine Technology: Introduction to Vaccine technology including DNA vaccines - identification of T and B epitopes for vaccine development. immunodiagnosis of Infectious diseases.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept immune system, types of immunity and immunoglobulin structure and function.
CLO2. Discuss Structure and function of MHC class I and II molecules, antigen recognition and presentation.
CLO3. Describe the Basic characteristics of an antigen and Structure, Types, Functions and Properties of antibodies.
CLO4. Explain the isolation and characterization of different immune cells, Antigen processing and presentation.
CLO5. Discuss the basic concept of Vaccine technology including DNA vaccines, immunodiagnosis of Infectious diseases.

Text Books:

- Immunology, V Edition - Richard A.Goldsby, Thomas. J. Kindt, A. Osborne, JanisKuby, 2003. W.H. Freeman and company.
- Topley and Wilson principles of bacteriology, Virology and immunology, G. Wilson, A.Miles, M.T.Paker, 2004.
- Arnold, HeinemanAbbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
- Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition WileyBlackwellScientific Publication, Oxford.

Reference Books:

- Basic and Clinical Immunology, 2010, D.P. Stities and J.D. Stobo.
- Vaccines, New Approaches to immunization, F.Brown, KA Lerner, 1986. Cold spring Harborolab.Goldsby RA, Kindt TJ, Osborne BA. (2007).
- Kuby's Immunology. 6th edition W.H. Freeman andCompany, New York.
- Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
- Immunology, Richard A. Goldsby, Thomas J. Kindt. Barbara, A. Osborne, Janis Kuby 5th Edition, 2003. W. H. Freeman & Company.

Online links for study & reference materials:

https://nptel.ac.in/courses/102103038/
https://nptel.ac.in/courses/102103041/18

BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS (STPB-204)

L	T	P
4	0	2

Course Name: Biostatistics, Computer Applications and Bioinformatics **Course Code:** STPB-204
Course Credit Hour: 4 hrs **Total Contact hour:** 60 hrs

Course Objective:

The objective of this course is to impart fundamental knowledge of computers, and biostatistics which is used in population genetics and evolutionary studies and understand how the biological data generated through various biological branches can be assimilated and studied using computer application.

Course Description:

This course provides students with in depth knowledge Bioinformatics, its application and various tools and their usage. It also provides information regarding the various algorithms used in the bioinformatics tools that enable easier processing of biological data and also enables to identify interaction across various or subbranches of bioinformatics like genomics, proteomics, drug designing, chemical interactions between molecules etc.

Course Contents:

UNIT-I Introduction to Bioinformatics – Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB. Database searching using BLAST and FASTA.

UNIT-II Sequence and Phylogeny analysis - Sequence Alignments, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT-III Dynamic programming- Gene and Genome annotation – Tools used. Physical map of genomes. Molecular phylogeny - Concept methods of tree construction.

UNIT-IV: Bioinformatics tools in proteomics: Introduction, strategies and methods. Bioinformatics tools in proteomics. Application of proteomics. Protein-protein interactions. Basic introduction of Proteomics technologies: 2D-electrophoresis, MALDI-TOF mass spectrometry. Biological Protein Databases: PDB, SWISSPROT, TREMBL. Protein secondary structure prediction. Protein 3D structure prediction.

UNIT-V: Basics of Biostatistics: Brief description and tabulation of data and its graphical representation. Measures of central tendency and dispersion - mean, median, mode, range, standard deviation, variance. Simple linear regression and correlation. Types of errors and level of significance. Tests of significance – F & t tests, chi-square tests, ANOVA.

Course Learning Outcomes (CLOs):
After successful completion of the course the students:

CLO1. Outlines the basic background of Bioinformatics, terminology, history and introduction to various databases

CLO2. Describe in detail the various mechanisms involved sequence similarity, algorithm matrices MSA and Phylogenetic analysis

CLO3. Introduces various programming and software tools involved in genome annotation, mol. Phylogeny.

CLO4. Discuss the basic background of proteomic and various tools and their application in understanding the proteome and its analysis

CLO5. Describes the mathematical tools involved in evaluation of the various dataset generated and their evaluation via statistics.

Text Books:

- D. Mount, Bioinformatics – Sequence and Genome Analysis, 2nd Ed. Cold Spring Harbor Laboratory Press, 9780879697129, 0879697121
- William Mendenhall, Robert J. Beaver, Barbara M. Beaver, Introduction to Probability & Statistics, 14th Edition, Cengage Learning,1133103758, 9781133103752,

Reference Books:

- Arthur M.Lesk, Introduction to Bioinformatics, 4th Ed. Oxford press, 9780199651566, 0199651566

Online links for study and reference materials:
https://nptel.ac.in/courses/102/106/102106065/
www.ncbi.nlm.gov

"SEMINAR" (STPB-205)
MODERN RESEARCH IN BIOTECHNOLOGY

L	T	P
2	0	0

Course Name: Modern Research in Biotechnology
Course Code: STPB-205
Course Credit Hour: 2 hrs
Total Contact hour: 30 hrs

Course Objective:

Develop an ability to understand and present a seminar on the latest scientific and technological developments in the field of biotechnology which enhances writing as well as oral communication skills.

Course Contents:

Every student, who has been enrolled in M.Sc.. (Biotechnology) course, shall have to deliver a Seminar on a Recent Topic related to Recent and Applied Developments in Biotechnology. Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members well in advance so that the same may be displayed on the notice board. The speaker has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.

Course Learning Outcomes (CLOs):

After completion of the course, students will understand about the Modern Research in Biotechnology and develop presentation skill during the discussion and presentation. Additionally, Student will develop a drafting and writing skill.

M.Sc. Biotechnology 2nd Year
SEMESTER-III

ENZYMOLOGY AND BIOPROCESS TECHNOLOGY (STPB-301)

L	T	P
4	0	2

Course Name: Enzymology and Bioprocess Technology
Course Code: STPB-301
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course focus on the basis of Enzymology, bioprocess technology and their techniques. It basically covers the Bioprocess parameters, spoilage of food stuffs and food processing.

Course Description:

This is a specialized branch of life sciences that deals with the biochemical nature and activity of enzymes and is a subject that has relevance to students from a wide range of disciplines. In addition, it will serve as an individual reference for students pursuing their post graduate degree programmes in life sciences and it could be recommended to anyone wishing to get an idea of the present day scope and applications of enzymology. The present course opens the door to all of the abundant careers in and out of the area of biological sciences including health/medical/ Environmental Sciences.

Course Contents:

Unit I: Isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, product decomposition, effect of environmental conditions. Bioreactors; Media for industrial fermentation, types of fermentation processes; Analysis of batch, Fed-batch and continuous bioreactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.).

Unit II: Measurement and control of bioprocess parameters, basic principles of feedback control, proportional, integral and derivative control; Downstream Processing: introduction, removal of microbial cells and solid matter, foam preparation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

Unit III: Enzyme and cell immobilization and their industrial applications; Use of microbes in mineral beneficiation and oil recovery; Industrial production of chemicals: Alcohol (ethanol), acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin,

streptomycin, tetracycline), amino acids (lysine, glutamic acid). Effluent treatment: DOC and COD treatment and disposal of effluents.

Unit IV: Introduction to Food Technology- elementary idea of canning and packing, sterilization and Pasteurization, technology of typical Food/Food products (bread, cheese, idli), food preservation, fermented foods and probiotics.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept preserving and maintenance of industrial microorganisms.
CLO2. Discuss the bioprocess parameters and their feedback control.
CLO3. Describe the basic characteristics of enzyme and cell immobilization and their industrial applications.
CLO4. Explain the Major Food Preserving techniques and their implimentations.

Text Books:

- Stanbury, A.H., A. Whittaker and Hall S.J. 1995. Principles of fermentation technology 2nd edition, Pergamon Press.
- Lehninger, Nelson, D. L. and Cox, M. M 2000. Principle of Biochemistry, Worth Publishers.

Reference Books:

- Stanburry P.P. and Whitaker, A. 1984. Principles of Fermentation Technology. Pergamon Press, OxfordUK.
- R2. Steinkraus, K.H. 1983. Handbook of Indigenous Fermented Foods. Marcel Dekker, New York.

Online links for study & reference materials:
www.bioprocessingsummit.com
https://biopharmaceutics.pharmaceuticalconferences.com

PLANT AND ANIMAL BIOTECHNOLOGY (STPB-302)

L	T	P
4	0	2

Course Name: Plant and Animal Biotechnology
Course Code: STPB-302
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

The course will include an introduction to theoretical aspects in Plant Biotechnology (Genomics) with emphasis on practical application. Theory and Applications of biotechnological techniques in the laboratory will provide students with the basic understanding of the molecular mechanisms that underlie cellular processes in plants, with reference examples on important Mediterranean cultivars utilized in advanced Agricultural / Horticultural and Pharmaceutical Industry. The subject covers animal molecular biology, recombinant DNA technology, production of transgenic animals, reproductive biotechnology, biotechnology in animal breeding and ethics.

Course Description:

This course are to introduce students to the principles, practices and application of animal biotechnology, plant tissue culture, plant and animal genomics, genetic transformation and molecular breeding of plants and animals.

Course Contents:

Unit I: Introduction Plant and Animal Biotechnology: Animal Tissue and Organ Culture, Plasma clot method, Raft method, Agar-gel method, Grid method, cyclic exposure to medium and Gas phase, advantages, limitations and applications, artificial skin. In Plant: Somaclonal variation and its use in crop improvement, embryo culture and its utility in hybridization programmes, Anther culture, haploid production and their uses, micro propagation in horticultural crops and forestry and its uses, artificial seeds, techniques of protoplast culture, regeneration and somatic cell hybridization, achievements , limitations, utility in improvement of crop plants.

Unit II: Cell Culture: Substrate and suspension culture, Culture Media, natural and artificial, initiation of cell culture, sub-cultures, Evaluation and Maintenance of cell culture lines, Large scale culture of cell lines, Monolayer, Suspension culture, Immobilized cultures, Somatic cell fusion, mechanism and applications, cell culture products and their applications, Interferons

Unit III: Transgenic Plants in dicots and monocots: Utility of Transgenic in basic studies and in crop improvement (resistance for herbicides, viruses, insects and abiotic stresses, Barnase and Barstar for hybrid seed production), Biosafety issues including risks associated with transgenic crops, biosafety regulations.

Unit IV: Plant Genetic Resources: Different kinds of PGR, Taxonomical Classification of PGR, Basic, derived and molecular, core collections, principles of germplasm characterization, evaluation, maintenance and regeneration, Plant quarantine aspects- Sanitary and Phytosanitary Systems, Techniques for conservation of plant germplasm, Role of IPGRI, NBPGR, FAO and CGIAR: in conservation of PGR.

Unit V: PGR and IPRs (Intellectual Property Rights): Patents, copyrights, Trademarks, GATT and TRIPs, Terminator and Traitor Techniques (v-GURT and t- GURT), Biodiversity Bill 2002, Geographic indicator bill.

Course Learning Outcomes (CLOs):

CLO1. Understand the basics of sterile techniques, media preparation, DNA extraction methods, gene isolation and nucleotide sequence analysis and acquaint with principles, technical requirement, scientific and commercial applications in Plant Biotechnology.
CLO2. Support methodologies in plant tissue/cell culture to plant improvement, as well as DNA handling with PCR-based detection diagnostic tools, and become motivated to set goals towards pursuing graduate school and higher level positions, such as lab manager and key scientist in plant biotechnological research institutes and industries.
CLO3. Be able to describe the structure of animal genes and genomes, describe how genes are expressed and what regulatory mechanisms contribute to control of gene expression.
CLO4: Be able to describe basic principles and techniques in genetic manipulation and genetic engineering, describe gene transfer technologies for animals and animal cell lines.
CLO5: Be able to describe techniques and problems both technical and ethical in animal cloning and the contribution 'functional genomics' is making and is likely to make in animal biotechnology now and in the future.

Text Books:

- Razdan, M. K. (2003). Introduction to Plant Tissue Culture. Enfield, NH: Science. ISBN: 9781578082377, 1578082374
- Gordon, I. (2005). Reproductive Techniques in Farm Animals. Oxford: CAB International.ISBN: 9781780646022, 178064602X

Reference Books:

- Glick, B. R., & Pasternak, J. J. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington, D.C.: ASM Press. ISBN: 9781555811365, 1555811361
- Pörtner, R. (2007). Animal Cell Biotechnology: Methods and Protocols. Totowa, NJ: Humana Press. ISBN: 9781493963188, 149396318X

Online links for study & reference materials:
https://www.khanacademy.org/
https://nptel.ac.in/courses/
https://swayam.gov.in/

RECOMBINANT DNA TECHNOLOGY (STPB-303)

L	T	P
4	0	2

Course Name: Recombinant DNA Technology
Course Code: STPB-303
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

Following are the key course objectives:

- To make the students familiar about the translation machinery and concept of r-DNA technology and their application in advanced research
- To make the student to understood the concept of gene manipulation and gene transfer technologies
- To make aware the students about manipulation of genes, Transfer techniques, Expression systems and methods of selection

Course Description:

Course basically helps in getting basic concept about genetics principles and also to be aware of the tools for genetic engineering such as PCR, Restricting mapping and other relevant topics.

Course Contents:

Unit I: Genetic Engineering and Recombinant DNA technology: Introduction to the scope of genetic engineering. Overview of the principles and progress in genetic engineering. Basic steps involved in recombinant DNA technology: Isolation of DNA from various sources, fragmentation methods, ligation strategies, introduction of the chimeric DNA into various host cells and selection and screening of recombinant clones. Basic enzymes used in RDT.

Unit II: Cloning and expression vectors: Introduction to Plasmids; Lambda based vectors and derivatives (Insertion vectors, replacement vectors, cosmids, phasmids, phagemids, in-vitro packaging, selection schemes); high-cloning capacity vectors: single stranded DNA vectors (M13); YACs, BACs.

Unit III: Polymerase Chain Reaction: Basic principles and its modifications, designing of primers, Different schemes of PCR, application of PCR, Brief introduction to RT- PCR and Real-Time PCR.

Unit IV: Gene Sequencing methods: Introduction to Nucleic acid sequencing methodologies, Sequencing techniques: Maxam & Gilbert degradation method, Sanger's Dideoxy method, Organo-chemical gene synthesis mechanism, cDNA using reverse transcriptase.

Unit V: cDNA Libraries and molecular techniques: Construction and Screening of genomic and cDNA libraries, Different blotting techniques: Southern, Northern, Western blotting, DNA Fingerprinting, RFLP, VNTR, STR and its applications.

.

Course Learning Outcomes (CLOs):

CLO1. The students will have knowledge of tools and strategies used in genetic engineering
CLO2. Understanding of applications of recombinant DNA technology and genetic engineering (from academic and industrial perspective)
CLO3. Apply the knowledge of genetic engineering in problem solving and in practice
CLO4. Students will understand the basics of gene cloning, role of enzymes and vectors for genetic engineering.
CLO5. Students will be aquainted with Gene transfer methods, Techniques and safety measures of genetic engineering, genome mapping and gene therapy.

Text Books:

- Principles of Gene Manipulation by S.B. Primrose, RM Twyman and RW Old (6thEdition)
- Recombinant DNA: A Short Course by JD Watson, J. Tooze and DT Kurtz.
- Principles of Gene Manipulation and Genomics SEVENTH EDITION S.B. Primrose and R.M. Twyman

Reference Books:

- Molecular Cloning: a Laboratory Manual, J Sambrook, E F Fritsch and T Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
- Principles of Gene manipulation (1994) Old R.N. and Primrose S.B.
- Recombinant DNA (1992) Watson J.D., Witreowski J., Gilman M. and Zooller M.

Online links for study & reference materials:
www.microbenotes.com
www.nptel.ac.in
www.byjus.com

Host-pathogen interaction (STPB-304)

L	T	P
4	0	2

Course Name: Host-pathogen interaction
Course Code: STPB-304
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

This course will enable students to acquire knowledge on the fundamentals of Host-pathogen interaction. It enables them to understand emerging and advanced concept in host pathogen interaction and this course also focuses on the host parasite interaction which include etiology, pathogenicity, life cycle, lab diagnosis and treatment. This program will facilitate the students to acquire knowledge in fields various aspects and molecular tools used in clinical application in alleviation of human disease.

Course Description:

This course is mainly focused to understand emerging and advanced concept in molecular pathogenesis of disease and role of biotechnology in diagnosis, prevention and therapeutics. An understanding of the basic biology and life cycles of human parasites; human parasitic infections, including epidemiology, clinical features, laboratory diagnosis, treatment and prevention.

Course Contents:

Unit I: Introduction: Basic concept of Host-pathogen interaction, Basic concept of Parasites, Classification of Parasites, Host, Types of host, Relationship between host and parasites.

Unit II: Protozoan infection and host response: (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment): Amoeboids (*Entamoeba histolytica*), Flagellates (*Giardia* spp), Sporozoans (*Plasmodium* spp), Leishmania, Trypanosoma

Unit III: Platyhelminthes infection and host response: (Introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment): Taenia, Echinococcus

Unit IV: Nemathelminthes infection and host response: (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment): Ascaris, Ancylostoma, Necator, Enterobius, Wuchereria

Unit V: Lab Diagnosis: Different specimens of parasitology, Collection & transportation. Processing of parasitological specimens

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept Parasitology and its importance.
CLO2. Discuss etiology, pathogenicity, life cycle, lab diagnosis and treatment of protozoan parasite.
CLO3. Discuss etiology, pathogenicity, life cycle, lab diagnosis and treatment of Platyhelminthes.
CLO4. Discuss etiology, pathogenicity, life cycle, lab diagnosis and treatment of Nemathelminthes.
CLO5. Explain the method for collection and processing of parasitological specimens.

Text Books:

- Textbook of Microbiology' by CP Baveja, 2nd edition, 1998, Arya longman Pvt. Ltd
- Textbook of Medical Lab Technology' 2010, by Praful Godkar
- Text book of Medical Laboratory' by Satish Gupta, Edition - latest, 2006, J.P. Bros.

Reference Books:

- Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
- Medical parasitology' by Chatarjee, 3th edition
- Medical Microbiology and Immunology' by Warren Levinson, eighth Edition, Lange Medical books/ McGraw-Hill Publication

Online links for study & reference materials:
https://www.cdc.gov/parasites/about.html
http://www.onlinebiologynotes.com/
http://www.biologydiscussion.com/parasites/classification-of-parasites-parasitology/62036

CBCS** GENOMICS AND PROTEOMICS (STPB-305A)

L	T	P
2	0	0

Course Name: Genomics and Proteomics
Course Code: STPB-305A
Course Credit Hour: 2 hrs
Total Contact hour: 30 hrs

Course Objective:

It is intended to impart basic postgraduate-level knowledge in the area of Genomics and Proteomics. It also aims to familiarize them with the developments in the experimental approaches used by researchers to understand the complexity and diversity of genomes. Recent advances in genomics have transformed the way in which biologists study cells and biological systems. Furthermore, this course also provides knowledge of the use of high throughput techniques to study the entire range of proteins present in any cell/tissue/organism under specific conditions, to obtain a global view of cellular processes at the protein level.

Course Description:
This course is mainly focused on the Genomics and Proteomics and discuss the basic concept of genomics, such as origin, evolution and application of genomics and proteomics. This course also focuses to elaborates the Genomic and Proteomics techniques; from basic to advance level. It covers basic understanding of Genomics, Annotation of whole genome sequence & functional genomics, Pharmacogenomics and Proteomics.

Course Contents:

Unit I: Origin and Evolution of genomics: Introduction to genomics, type of genome exist in nature, DNA Marker & microsatellite, DNA based phylogenetic trees, genomes and human evolution, Introduction to Shotgun Sequencing methods, evolution of mitochondrial and Chloroplast genome, Anticipated Benefits of Genome Research

Unit II: Annotation of whole genome sequence and functional genomics: Whole genome shotgun sequencing*, In silico* methods, insertion mutagenesis (T-DNA and transport insertion), gene expression and transcript profiling, EST contigs and unigene sets, use of DNA chips and microarrays.

Unit III: Pharmacogenomics: Introduction to Pharmacogenomics, Use in biomedicine involving diagnosis and treatment of diseases, genomics in medical practice, personalized medicine, DNA polymorphism and treatment of diseases, use of SNP in pharmacogenomics, future of pharmacogenomics.

Unit VI: Proteomics: Introduction, definition concepts and approaches of proteomics studies and activities. Introduction proteome analysis tool and technique: Western blotting technique,

Separation technique- Polyacrylamide gel electrophoresis (PAGE), 2DPAGE, Mass-spectrophotometery.

Course Learning Outcomes (CLOs):

CLO1. Gain an understanding of the basic concepts of genomics and its scope.
CLO2. Outline the fundamental of DNA based phylogenetic trees.
CLO3. Discuss the Annotation of whole genome sequence and functional genomics.
CLO4. Describe the basic concepts of pharmacogenomics and its future prospective.
CLO5. Explain the fundamentals of proteomics and advance molecular biology techniques.

Text Books:

- Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM & Heyer LJ, Benjamin Cummings 2007; CSH Press, NY.
- Introduction to Proteomics: Tools for the New Biology. Daniel C. Liebler, 2002 Humana Press Inc.
- Primrose SB and Twyman RM. Genomics: Applications in human biology. Blackwell Publishing, 2008 Oxford, U.K

Reference Books:

- Genome III – T.A. Brown Garland Science Publ. June 08, 2006
- Bioinformatics and Functional Genomics – Jonathan Pevsner - 2nd edition, Wiley-Blackwell, 2009.
- Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press

Online links for study & reference materials:
http://www.genomenewsnetwork.org/resources
http://www.pss.co.jp/english/sc_bio/contents4.html
http://www.premierbiosoft.com/tech_notes/microarray.html

CBCS** BIOINFORMATICS (STPB-305B)

L	T	P
2	0	0

Course Name: Bioinformatics
Course Code: STPB-305B
Course Credit Hour: 2 hrs
Total Contact hour: 30 hrs

Course Objective:

It is intended to impart basic postgraduate-level knowledge in the area of Bioinformatics. This course is beneficial for students to understand the principles of analyzing biological data, building models and testing hypotheses using computer science algorithms. This course is a survey of algorithms and tools in biological sequence analysis, genome-wide disease association, and precision medicine. Basic concept machine learning and its application in the analysis of biological data are also included in this course.

Course Description:

This course is mainly focused on the basic concept of bioinformatics and discuss the basic overview of various information repositories widely used in biological sciences; and tools for searching or querying those databases. This course will build the foundation of sequence alignment techniques and find evolutionary connections. It will help students to analyze genome data and mRNA expression data and gene annotations.

Course Contents:

Unit I: Introduction to computers and bioinformatics- Types of operating systems, concepts of networking and remote login, basic fundamentals of working with unix.

Unit II: Biological databases- Overview, modes of database search , mode of data storage (Flat file format, db-tables), flatfile formats of GenBank, EMBL, DDBJ, PDB.

Unit III: Sequence alignment –Concept of local and global sequence alignment, Pairwise sequence alignment, scoring an alignment, substitution matrices, multiple sequence alignment. **Phylogenetic analysis-** Basic concepts of phylogenetic analysis, rooted/uprooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbour joining, Maximum parsimony, Maximum likelihood).

Unit VI: Generation and analysis of high throughput sequence data- Assembly pipeline for clustering of HTGS data, format of ".ace" file, quality assessment of genomic assemblies, International norms for sequence data quality, Clustering of EST sequences, concept of Unigene.

Unit V: Annotation procedures for high through-put sequence data- Identification of various

genomic elements (protein coding genes, repeat elements, strategies for annotation of whole genome, functional annotation of EST clusters, gene ontology (GO) consortium.

Course Learning Outcomes (CLOs):

CLO1. Basic concept of computational analyses of biological sequences, genome-wide studies and relate the results to core principles of biology; use computational methods to help execute a biological research plan.
CLO2. Outline the fundamental of DNA based phylogenetic trees.
CLO3. Discuss the Annotation of whole genome sequence and functional genomics.
CLO4. Describe the basic concepts of pharmacogenomics and its future prospective.
CLO5. learn to align sequences using dot matrices, dynamic programming and heuristic approach; understand the notion of similarity, identity, and gaps in the context of sequence alignment and deduce evolutionary relationships among sequences.

Text Books:

- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Baxevanis A.D. and Ouellette, Third Edition. John Wiley and Son Inc., 2005.
- Bioinformatics Sequence and Genome Analysis by Mount D.W., CSHL Press, 2004
- Jonathan Pevsner. Bioinformatics and Functional Genomics, 2nd Edition. ISBN: 978-0-470-08585-1.
- Greg Gibson and Spencer V. Muse. A Primer of Genome Science, Third Edition. ISBN: 978-0-87893-309-9.

Reference Books:

- Bioinformatics and Functional Genomics – Jonathan Pevsner - 2nd edition, Wiley-Blackwell, 2009.
- Introduction to Bioinformatics by Tramontano A., Chapman & Hall/CRC, 2007.
- Understanding Bioinformatics by Zvelebil, M. and Baum, Chapman & Hall/CRC, 2008.

Online links for study & reference materials:
http://www.genomenewsnetwork.org/resources
http://www.pss.co.jp/english/sc_bio/contents4.html
http://www.ncbi.nic

M.Sc. Biotechnology 2nd Year
SEMESTER-IV

ENVIRONMENTAL BIOTECHNOLOGY (STPB-401)

L	T	P
4	0	0

Course Name: Environmental Biotechnology
Course Code: STPB-401
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

The course provides the students with a conceptual and experimental background in the broad discipline of environmental biotechnology. The students will be introduced to the major groups of microorganisms and their diversity in structure and functions and microbial interactions. Emphasis has been laid on Microorganisms and their Habitats. The course also introduces the students to the scope of Biogeochemical Cycling, Waste Management and Microbial Bioremediation.

Course Description:

This course is mainly focused on the Environmental Microbiology which includes basic concept of patents, patent regime (in India and abroad) registration aspects and other details.

Course Contents:

Unit I: Introduction: Environmental components. Environmental pollution and its types. Non-renewable and renewable energy resources.

Unit II: Conventional fuels and their major impacts: Global warming and greenhouse effect. Global Ozone Problem. Acid rain. Eutrophication, Bio magnifications. Concept of clean fuel technology. Biomass energy and biofuels.

Unit III: Cleaning of Environment: Biodegradation and bioremediation of major pollutants, Biomineralisation, Use of microbial technology for mining.

Unit IV: Pollutant Treatment: Waste water treatment. Methods of water treatment.Treatment of municipal solid and liquid wastes. Environmental impact assessment and Environmental audit.

Unit V: Environmental Laws: Environmental laws. Policies and Practices. Protection of Environment. Bio-assessment of Environmental Quality. Bio fertilizers and Bio pesticides.

Course Learning Outcomes (CLOs):

CLO1. Understand the basic concept immune system and its importance.

CLO2. Discuss Structure, Functions and Properties of different type of Immune Cells and immune organs.
CLO3. Describe the Basic characteristics of an antigen and Structure, Types, Functions and Properties of antibodies.
CLO4. Explain the Major Histocompatibility Complex I & II molecules, basics of Components of the Complement system.
CLO5. Discuss the basic concept of Generation of Immune Response, in particular Generation of Humoral Immune and Cell Mediated Immune Response.

Text Books:

- Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) 2nd ed.
- Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) 4th ed.
- Bioinstrumentation by Joh G webster ISBN: 978-0-471-26327-2 August 2003

Reference Books:

- Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley InterScience (1989) 3rd ed.
- Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) 2nd ed.
- Webster, J.G., Medical Instrumentation Application and Design, John Wiley (2007) 3rd ed.
- Biophysical Techniques By Iain Campbell • 2012, 9780199642144, 0199642141, QUP Oxford.

Online links for study & reference materials:
https://microbenotes.com/category/instrumentation/
https://lecturenotes.in/download/material/18824-note-of-bioinstrumentation-by-nithya-biotech.
http://biomedikal.in/2009/12/lecture-notes-on-biomedical-instrumentation/

CLINICAL RESEARCH AND ENTREPRENEURSHIP (STPB-402)

L	T	P
4	0	0

Course Name: Clinical Research and Entrepreneurship
Course Code: STPB-402
Course Credit Hour: 4 hrs
Total Contact hour: 60 hrs

Course Objective:

To enrich the understanding of clinical data management procedure in clinical research which sponsor, CRO and Hospital use for clinical trials. To know the latest technology of clinical data management used in clinical trials.

Course Description:

This course provides students with insight into the issues, challenges and opportunities involved in the creation and management of a new venture over its full life cycle. Typically, entrepreneurs are consumed with their product or service and are not prepared to strategically nor tactically lead the venture.

Course Contents:

Unit I: Clinical Research: Basic conventional drug design approaches, Drug development process (Preclinical, clinical and toxicological studies). Past, Present and future Importance, Mile stones of regulations. FDA, US, Indian clinical research, global scenario of clinical research, Regulatory agency. Designing clinical trials- History, principles, scheme for conducting clinical trials, planning defining, objectives, variables, study populations, testable hypothesis.

Unit II: Ethical Issues in clinical research- Introduction, codes, declaration and guidelines, informed concent, special issues, Roles and responsibilities of IRBS, issues with ethics review

Unit III: Introduction of Entrepreneurship: definition, history and scope of Biotechnology Entrepreneurship. **Biotechnology Marketing & Companies:** Biotechnology in capital market; Initial Public Offering (IPO) in the capital market; examples of success and failure of biotechnology companies and the possible reasons. **Patenting, licensing and partnership in biotechnology industry:** Patents on biological inventions, licensing revenue, selection of right partner; negotiations of the terms of the terms of the deal.

Unit IV: Entrepreneurship Skills: Entrepreneurship Skills of bio-entrepreneur, bio-entrepreneurial training; research experience, creativity, communication skills and other attributes;

participation in conferences, training and educational courses; institutes offering entrepreneurship courses.

Course Learning Outcomes (CLOs):

After completion of the course the students will be able to:
CLO1. Learn how to build a business in healthcare based on their own research, demonstrate an understanding of the opportunities of health innovation and entrepreneurship for utilization of research.
CLO2. Apply scientific background and new knowledge of health innovation to address challenges and develop services and products within a clinical setting and a biopharma/medtech setting and use various business tools for ideation and feasibility studies; to develop, prototype and test solutions in response to user needs.
CLO3. Develop a business plan based upon a novel idea and communicate a business plan to people within the startup world and demonstrate an understanding of how Tech Transfer Offices and other innovation support actors can support the commercialization process.
CLO4. Discuss and argue for different types of intellectual property and intellectual assets, and understand different patent strategies and apply the basics in financing a startup company from private and governmental funding bodies.
CLO5. Discuss and argue for different types of intellectual property and intellectual assets, and establish patent strategies and assess their skills in health innovation and reflect on the exploitation of their own research combine being a scientist and a health innovator/entrepreneur.

Text Books:

- Richard K. Rondel, Sheila A. Varley, Colin F. Webb, Clinical Data Management, 2nd Edition ISBN No. 9780471983293, 0471983292
- Susanne Prokscha, Practical Guide to Clinical Data Management, Taylor & Francis, ISBN no. 9781439848296, 1439848297

Reference Books:

- Raymond G Hill, Drug Discovery and Development , 2nd Edition by, ISBN No. 9780443064203, 0443064202
- Hisrich, Robert D., Michael P. Peters, and Dean A. Shepherd. Entrepreneurship. McGraw-Hill Education, 2017, ISBN No. 9783319487014, 3319487019

Online links for study & reference materials:
https://www.khanacademy.org/
https://swayam.gov.in/
https://nptel.ac.in/

PROJECT (STPB-403)

L	T	P
0	0	8

Course Name: Research Project in Biotechnology
Course Code: STPB-403
Course Credit Hour: 8 hrs
Total Contact hour: 120 hrs

Course Objective:

Develop an ability to understand the basic requirement to conduct a research project. Student also develop skill of writing and presentation on the assigned research topics in the field of biotechnology.

Course Contents:

Every student will be required to undertake a research project based on any of the areas of biotechnology. The research project should have applied significance. The project report will be submitted in the form of dissertation duly certified by the supervisor of the Department of Biotechnology or at national institutes and Universities in India, by seeking the placement. The project will be presented for evaluation at the end of semester by external experiments.

Course Learning Outcomes (CLOs):

After completion of the course, students will understand about the Research in Biotechnology and develop presentation skill during the conduction of research, discussion and presentation. Additionally, Student will develop a drafting and writing skill.