Masters of Science

(Biotechnology)

(Two Year Full Time Degree Program)

SYLLABUS

M. Sc. (Biotechnology)

School of Biotechnology

Shri Mata Vaishno Devi University, Katra

(May 2018)

	ABBREVIATIONS / CODES / NOMENCLATURE
Course Code Convention	
SCTLBSC Example: BTL7234 BTE7413	Course Code for various Courses / Subjects SC: School Code T: Course Type Code (Lecture/Practical/Colloquium/Project,etc.) L: Course Level (1 & 2 for First and Second years) B: Broad Study Area S: Sub Area C: Course Specific Code Number
BT	School Code (SoBT)
L	Lecture
P	Practical
T	Tutorial
C	Colloquium
E	Elective
C	Colloquium
D	Project Based
NC	Non Credit
Teaching Scheme Convention	
L	Lecture
T	Tutorial
P	Practical
C	Course Credit
Evaluation Scheme Convention	
Minor	(Mid Term Exams / Tests) I & II
Major	Semester End Examination (Major)
FFCS	Fully Flexible Credit System
CBCS	Choice Based Credit System

M. Sc. (Biotechnology), Semester - I (Fall), FIRST Year														
			Teaching & Credit Scheme					Evaluation & Examination Scheme						
S. No.	Subject Code	Title of the Subject	L	T	P	Total Periods /week	C	Minor Duration (Hours)	Major Duration (Hours)	Internal Marks	Minor Marks (I + II)	Major Marks		Total Marks
												L	P	
1	BTL6021	Cell & Molecular Biology-I	3	1	0	4	4	1.5	3	10	40	50	-	100
2	BTL6043	Fundamentals of Biochemistry	3	1	3	7	5.5	1.5	3	10	40	50	100	200
3	BTL6072	Fundamentals of Microbiology	3	1	3	7	5.5	1.5	3	10	40	50	100	200
4	BTL6161	Biostatistics	2	0	0	2	2	1.5	3	10	40	50	-	100
5	BTL6173	Analytical Approaches in Biotechnology	3	0	0	3	3	1.5	3	10	40	50	-	100
6	CSL6014	Open Elective - I - Basics of Computers & IT	3	0	0	3	3	1.5	3	10	40	50	-	100
		SUBTOTAL	**17**	**3**	**6**	**26**	**23**	**-**	**-**	**60**	**240**	**300**	**200**	**800**
	NOTE	Marks for Lab courses shall be awarded on the student's work in the form of a written test along with experimental performance, viva voce and continuous evaluation methods which shall be evaluated by the concerned Course Coordinators and relevant credit weightage shall be calculated for the respective courses.												

M. Sc. (Biotechnology), Semester - III (Fall), SECOND Year														
			Teaching & Credit Scheme					Evaluation & Examination Scheme						
S. No.	Subject Code	Title of the Subject	L	T	P	Total Periods /week	C	Minor Duration (Hours)	Major Duration (Hours)	Internal Marks	Minor Marks (I + II)	Major Marks		Total Marks
												L	P	
1	BTL7222	Computational Biology & Bioinformatics	3	0	3	6	4.5	1.5	3	10	40	50	100	200
2	BTL7152	Genetic Engineering and Applications	3	0	3	6	4.5	1.5	3	10	40	50	100	200
3	BTL7234	Bioprocess Engineering and Technology	3	1	3	7	5.5	1.5	3	10	40	50	100	200
4	BTE7XXX	School Elective - I (4 choices)	3	0	0	3	3	1.5	3	10	40	50	-	100
5	BTE7XXX	School Elective - II (5 choices)	3	0	0	3	3	1.5	3	10	40	50	-	100
6	BTC7211	Colloquium				3	1.5	-	-	-	-	100	-	100
		SUBTOTAL	**15**	**1**	**9**	**28**	**22**	**-**	**-**	**50**	**200**	**350**	**300**	**900**
	NOTE	Marks for Lab courses shall be awarded on the student's work in the form of a written test along with experimental performance, viva voce and continuous evaluation methods which shall be evaluated by the concerned Course Coordinators and relevant credit weightage shall be calculated for the respective courses.												
		Marks for Colloquium course shall be awarded on the student's work in the form of a Reports/Presentations/Seminars/Viva voce methods or all of them for the Practical Training taken during the Summer Vacation after Semester II which shall be evaluated by the concerned Course Coordinator/s.												

LIST OF PROGRAM ELECTIVES (For School Elective - I Sem III)						
S. No.	Course Code	Course Title	L	T	P	C
1	BTE7413	Principles of Intellectual Property Rights and Biosafety	3	0	0	3
2	BTE7211	Applications of Plant Biotechnology	3	0	0	3
3	BTE7292	Food Science & Technology	3	0	0	3
4	BTE7081	Microbial Biotechnology	3	0	0	3
5	BTE7402	Drug Delivery and Pharmacokinetics	3	0	0	3
LIST OF PROGRAM ELECTIVES (For School Elective - II Sem III)						
1	BTE7122	Principles in Human Genetic Disorders	3	0	0	3
2	BTE7341	Radiation Biology	3	0	0	3
3	BTE7332	Genome stability Regulation and Drug Development	3	0	0	3
4	BTE7124	Introduction to Medical Genetics	3	0	0	3
5	BTE7352	Stem Cell Biology and Applications	3	0	0	3

NOTE:

Elective Courses shall be offered on the basis of the choice of the course given by the students, available faculty expertise and resources at that time subject to minimum 10 % students of a particular batch.

First Year

Ist Semester

BTL602			**Cell & Molecular Biology-I**				**Pre Requisites**		**Nil**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	0	4	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Cell Membrane and Intracellular organelles
Plasma membrane: Study of Structure and function through various proposed models. Regulation of intracellular transport. Structural organization and function of intracellular organelles.

Unit-II Genetic Material and Genome Replication
Historical development of molecular biology. DNA and RNA as genetic materials, Nucleic Acid - structure, forms and function, Replication mechanism, enzymes in replication, regulation of genome replication. Topology of nucleic acids.

Unit-III DNA Damage and Repair
Mutations, molecular mechanisms of mutagenesis, DNA Repair systems.

Unit-IV Genome Organization
Genome organization in eukaryotes- chromatin structure and function, genome packaging, chloroplast and mitochondrial genome.

Unit-V Protein Synthesis
Transcription and translation, ribosome structure and function. Genetic code –nature and deciphering; Regulation of prokaryotic gene expression.

Recommended Books:-

1. Molecular Biology of the Cell, Alberts B, Johnson A, Lewis J, Raff M, Roberts K & Walter P, 4th Edition, New York & London, Garland Science, 2002.
2. Cell Biology (Eds. DeRobertis EDP, Francisco AS & DeRobertis EMF) 6th Edition, WB Saunders Co Ltd. 2005.
3. Molecular Biology of the Gene, James W, Richard L, Michael L, Alexander G, Tania B & Stephen B, 5th Edition, Benjamin-Cummings Publishing Company, 2003.
4. Molecular Cell Biology, Harvey L, Arnold B, Chris AK, Monty K, Matthew PS, Anthony B & Paul M, 8th Edition, WH Freeman & Co Ltd., 2016.
5. Cytology Genetics and Evolution, Gupta PK, Rastogi Publications, 2005.

Course Outcomes:-

After successful completion of the course the student will be able to:

1. Discuss the most significant discoveries and theories through the historical progress of biological scientific discoveries, and their impacts on the development of molecular biology.
2. Give an account of the structure and functions of the plasma membrane and the major organelles that occur in a cell.
3. Explain the fundamental structure, properties and processes in which nucleic acids play a part.
4. Associate the processes that unfold in individual cell compartments as preconditions for the functioning of the cell as a whole including various levels of genome organization, gene regulation and protein function.
5. Exhibit a knowledge base in cell and molecular biology.
6. Use general texts, reference books and a range of other resources to further develop knowledge of biological issues through continued independent learning.

I[st] Semester

BTL6043			**Fundamentals of Biochemistry**				**Pre Requisites**		**Nil**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	3	5.5	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Carbohydrates & Lipids: (12 Contact Periods)
Classification of carbohydrates, structures of mono, oilgo and polysaccharides, properties and functions of carbohydrates; Classification of lipids, structures, properties and functions of lipids. **[CO1 & CO2]**

Unit-II Proteins & Amino acids: (12 Contact Periods)
Classification of amino acids, chemical reactions and physical properties of amino acids, Proteins Classification, criteria of homogeneity, conformation of protein; primary, secondary, tertiary and quaternary structure, Disulphide bridges, Ramachandran plot; Protein folding, Protein stability. **[CO1 & CO2]**

Unit-III Enzymes and Nucleic Acids: (12 Contact Periods)
Nucleic Acids - structures of purines, pyrimidines, nucleosides and nucleotides. Stability and formation of phosphodiester bonds, Denaturation and renaturation of DNA-Melting Curves. Enzymes-Classification, mechanism of action and Kinetics. **[CO1, CO2 & CO3]**

Unit-IV Principles of Bioenergetics: (12 Contact Periods)
Study of metabolite pathways such as glycolysis, citric acid cycle, pentose phosphate pathway, gluconeogenesis, Electron transport and oxidative phosphorylation Biosynthesis of Carbohydrate, β-oxidation of Fatty acids, biosynthesis of Lipid; metabolism of amino-acids and related molecules**. [CO4]**

Unit-V Fundamentals of Biochemistry Lab (36 Contact Periods)

List of Experiments:- **[CO5]**

1. **Preparation of Buffers**
2. **Qualitative test of carbohydrates**
3. **Colorimetric and spectrophotometry**
   - Protein estimation by Lowry's method
   - Protein estimation by Bradford method
   - Estimation of sugars by Anthrone method
4. **Analysis of fats/oils**
   - Determination of acid value of a fat
   - Determination of saponification value of a fat
   - Determination of Iodine number of a fat
5. **Chromatographic Techniques**
   - Identification of sugars by paper chromatography
   - Separation of lipids by thin layer chromatography
   - Separation of amino acids by thin layer chromatography
6. **Electrophoresis Techniques**
   - Native polyacrylamide Gel Electrophoresis
   - SDS polyacrylamide Gel Electrophoresis

Recommended Books:-

1. Lehninger's Principles of Biochemistry, 5th Edition, David LN & Cox MM,WH Freeman & Co.
2. Principles of Biochemistry, 5th Edition, Robert AH, Laurence AM, David R, Gray S & Marc P, Kindle Edition.
3. Fundamentals of Biochemistry, 4th Edition, Donald V & Judith GV, John Wiley & Sons, NY.
4. Biochemistry, 5th edition, Garrett RH & Grisham CM, Brooks Cole Cengage Learning.
5. Biochemistry, 6th edition, Jeremy MB, John LT & Lubert S, WH Freeman & Co.

6. Biochemistry, 4th edition, Mathews CK, Vans Holde KE, Appling DR, Spencer J & Anthony C, Pearson.
7. Stereochemistry: Conformation and Mechanism, 6th Edition, Kalsi PS, New Age International (P) Ltd.
8. Harper's Illustrated Biochemistry, 30th Edition, Robert KM, Darryl KG, Peter AM & Victor WR.
9. Introduction to Practical Biochemistry, Plummer M & Plummer DT.
10. Introductory Practical Biochemistry, Sawhney SK.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Learn principles that govern the structures of macromolecules and their participation in living cells.
2. Demonstrate advanced knowledge and understanding of aspects of physical, chemical and biological properties of biomolecules.
3. Understand concepts of free energy & different types of chemical bonding, biocatalysts and molecular machinery of living cells.
4. Understand the various metabolic processes and how energy produced as well as utilized for various biological functions.
5. Apply appropriate biotechnological techniques, identify research problems, design experiments, analyse and interpret data.

I[st] Semester

BTL6072			**Fundamentals of Microbiology**				**Pre Requisites**		**Nil**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	3	5.5	1.5 Hrs	3 Hrs	10	20	20	150	200

Course Contents:-

Unit-I Introduction to Microbiology (20 Contact Hours)

General characters of microbes – Historical developments in microbial biotechnology, the concept of microbial origin of fermentation , Microscopy Techniques; Structure and general characteristics of Bacteria, Archea, Fungi and Algae; Identification methods of bacteria and other microorganisms, Fundamentals of classification of bacteria, fungi and algae. Recent trends in microbial taxonomy.

Unit-II Microbial Nutrition, Growth, and Control (20 Contact Hours)

Microbial nutrition and growth - Nutrition in microorganisms and assimilation of nutrients, Nutritional groups of microorganisms and their importance in fermentation industry, Culturing of microorganisms in laboratory and industry,Microbial media and their application, Microbial growth and growth curve, influence of environmental factors on growth. Growth measurement techniques. Concept of pure culture and methods of pure culture development. Methods of preservations of microbial cultures of industrial applications; Concept of sterilization, Methods of sterilization and their application in industry.

Unit-III Microbial Metabolism and Microbial Pathogenecity (20 Contact Hours)

Energy transduction in microbial systems. Aerobic and anaerobic pathways. Sulfate reduction, Nitrogen metabolism - nitrate reduction, nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer. Role of microbial biota in natural environment .Microbial ecology; Microbial pathogenecity.

Unit-IV Introduction to Viruses (10 Contact Hours)

Virology - Ultrastructure, classification and replication mechanism in viruses and phages. Importance of viruses in biotechnology with reference to -Retroviruses, TMV, HIV, SV40, Prions-Kuru. Methods of cultivation of viruses.

Unit-V List of Experiments (15 Labs)

1. Preparation of culture media, glassware and sterilization
2. Isolation and purification of microorganisms from soil/water/air by streak plate method and serial dilution
3. To understand the construction and working of Light Microscopy - Principle, various parts, uses and care.
4. To determine Size measurement of the purified bacterial strain
5. To perform Gram staining of the purified bacterial culture
6. To perform the negative staining of the purified bacterial culture
7. To perform acid fast staining
8. To perform spore staining by the Schaeffer Fulton method
9. To perform capsule staining to distinguish between capsular material and bacterial cell
10. To test for the antibiotic sensitivity of the bacterial sample
11. To perform the MIC test for antibiotic sensitivity of a bacterial strain against a specific antibiotic
12. To perform IMVIC test for coliform bacteria
13. To study the motility of bacterial strain using the hanging drop technique
14. To perform standard growth curve of purified bacterial strain
15. Preservation of microbial strain.

Recommended Books:-

1. Prescott's Microbiology, 10th Edition, Willey J, Sherwood L & Woolverton CJ, Mc-Graw-Hill, 2017.
2. Microbiology: An Introduction, 12th Edition, Tortora GJ, Funke BR, Case CL, Pearson, 2016.
3. Microbiology, 5th Edition, Pelczar Jr., McGraw Hill Education, 2001.
4. Microbiology: A Laboratory Manual, 10th Edition, Cappuccino JG & Sherman N, Pearson Publishers, 2013.
5. Alcamo's Laboratory Fundamentals of Microbiology, 10th Edition, Pommerville JC, Jones and Bartlett Publishers, 2013.
6. Experiments in Microbiology, Plant Pathology and Biotechnology, 5th Edition, Aneja KR, New Age International Publishers, 2017.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Understand the importance of microorganisms and their application in Biotechnology.
2. Understand the structure, general characters of microbes and function of cells.
3. Understand the tools and techniques that are used to classify and identify microbes.
4. Understand the metabolism of microorganisms and how they grow/divide.
5. Understand how microbes can be pathogenic and what implications it can serve to human health.
6. Understand the structure and function of viruses and their role in diseases.
7. Isolate microorganisms and handle them in laboratory conditions.

Ist Semester

BTL6161			**Biostatistics**				**Pre Requisites**		**Nil**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
2	0	0	2	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Measures of central tendency and dispersion: **(7 Contact Periods)**
Basic terms, measures of central tendency and dispersion: Population, sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion: range, variance, standard deviation, coefficient of variation.**[CO1 & CO4]**

Unit-II Probability and distributions: (5 Contact Periods)
Probability and distributions: Sample space, events, equally likely events. Definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples bernoulli, binomial, poisson and normal distributions. **[CO1, CO2, CO3 & CO4]**

Unit-III Methods of sampling: (4 Contact Periods)
Methods of sampling: Use of random numbers to generate simple random samples with replacement and without replacement. Sampling distribution and standard deviation of sample mean. Stratified sampling and its advantages. **[CO2 & CO4]**

Unit-IV Hypothesis testing: (8 Contact Periods)
Hypothesis testing: Hypothesis, critical region, and error probabilities. Tests for proportion, equality of proportions, equality of means of normal populations when variance known and when variances are unknown. Chi-square test for independence. P-value of the statistic. Introduction to analysis of variance. **[CO1, CO3 & CO4]**

Recommended Books:-

1. Methods in Biostatistics: For Medical Students and Research Workers, 7th Edition, Mahajan BK.
2. Understanding Biostatistics, Kallen A, 2011.
3. Fundamentals of Biostatistics 7th Edition, Rosner B, 2010.

Course outcomes:-

After Successful Completion of this Course, students shall be able to:

1. Learn data collection, organization, summarization and analysis.
2. Demonstrate skills in drawing inferences about a body of data when only a part of the data is observed.
3. Demonstrate skills in interpreting and communicating the results of statistical analysis, orally and in writing.
4. Apply basic statistical concepts commonly used in Health and Medical Sciences.

I[st] Semester

BTL6173			**Analytical Approaches in Biotechnology**				**Pre Requisites**		**Nil**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hours	10	20	20	50	100

Course Contents:-

Unit-I Electrophoresis and viscosity (8 Contact Periods)
Electrophoretic techniques Principles of electrophoretic separation. Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, pulse field gel electrophoresis. Viscosity: Viscosity of macromolecules, relationship with conformational changes.

Unit-II Spectroscopic Techniques: (12 Contact Periods)
Spectroscopy Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lamberts law, Principles and applications of colorimetry; Optical rotatory dispersion, circular diachroism, Nuclear magnetic resonance spectroscopy.

Unit-III Chromatography and Centrifugation : (8 Contact Periods)
Chromatography Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC. Centrifugation: Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, sub cellular fractionation.

Unit-IV Electron Microscopy, radioactivity and X-ray: (8 Contact Periods)
Electron microscopy Transmission and scanning, freeze fracture techniques, specific staining of biological materials., Biosensors, X-ray diffraction, X-ray absorption, Basics of radioactivity and autoradiography, Safety aspects of radiation.

Recommended Books:-

1. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, Freifelder D.
2. Analytical Biotechnology-Methods and Tools in Biosciences and Medicine, Thomas GM & Schalkhammer.
3. Principles and Techniques of Biochemistry and Molecular Biology, Wilson K & Walker J.
4. Spectrophotometric Identification of Organic Compounds, Silverstein RM and Webstar FX, John Wiley and Sons.

Course outcomes:-

After Successful Completion of this Course, students shall be able to:
1. Learn data collection, organization, summarization and analysis.
2. Demonstrate skills in drawing inferences about a body of data when only a part of the data is observed.
3. Demonstrate skills in interpreting and communicating the results of statistical analysis, orally and in writing.
4. Apply basic statistical concepts commonly used in Health and Medical Sciences.

Second Year

III[rd] Semester

BTL7222			**Computational Biology & Bioinformatics**				**Pre Requisites**		• **Cell & Molecular Biology-I 6021** • **Cell & Molecular Biology-II BTL6022**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	3	4.5	1.5 Hrs	3 Hrs	10	20	20	150	200

Course Contents:-

Unit-I Introduction to Biological Data Bases: (9 Contact Periods)
Introduction to databases: Concepts, Sequence structure and Derived databases (Genebank, EMBL, Swiss prot and PDB). Database access and retrieval tools ENTREZ, SRS. Information system; NCBI, EBI, BTIs, Protein Data Bank (PDB) and the Nucleic Acid Data Bank (NDB). **[CO1 & CO6]**

Unit-II Sequence Alignment Methods: (9 Contact Periods)
Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, Needleman-Wunsch& Smith-Waterman algorithms. Analysis of computational complexities and the relative merits and demerits of each method.Theory of scoring matrices and their use for sequence comparison. **[CO2 & CO6]**

Unit-III Structural Bioinformatics and Genomics: (9 Contact Periods)
Experimental Methods for Molecular Structure Determination: Brief account of structure determination by X-ray crystallography and NMR spectroscopy.Introduction to genomics, functional and structural genomics, sequencing strategies for whole genome analysis, sequence data analysis, Comparative genomics, genome annotation. **[CO3, CO4 & CO5]**

Unit-IV Proteomics and its Applications: (CO3,C04,C06) (9 Contact Periods)
Strategies in proteomics, Structural/functional proteomics, Computational approach for studying protein–protein interactions, Proteomics methodologies, Proteomics applications: drug development, screening of diagnostic markers, identification and characterization of novel proteins, Global analysis of gene expression,Transcriptomics and microarray, Toxicogenomics, Pharmacogenomics.

Unit- V List of Experiments: (CO1, CO2, CO5 & CO6) (36 Contact Periods)

1. An introduction to the computing platforms.
2. Molecular databases and how they are organized and accessed.
3. Unknown DNA -- rational probe design and analysis.
4. DNA fragment contig assembly and restriction enzyme mapping.
5. Database similarity searching and the dynamic programming algorithm.
6. Gene finding strategies. How are coding sequences recognized in genomic DNA.
7. Multiple sequence alignment, expectation maximization, profiles, and Markov models.
8. Molecular evolutionary phylogenetic inference.
9. Estimating protein secondary structure and physical attributes.
10. Molecular modelling and visualization.

Recommended Books:-

1. Discovering Genomics, Proteomics, and Bioinformatics, 2nd Edition, Campbell AM & Heyer LJ, Pearson, 2007.
2. Bioinformatics: Sequence and Genome Analysis, 2nd Edition, Mount D, CSHL Press, 2004.
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, Baxevanis AD & Francis BF, Wiley, 2004.

4. A Bioinformatics Guide for Molecular Biologists, Aerni S & Sirota M, CSHL Press, 2014.
5. Genomes, 2nd Edition, Brown TA, Oxford, Wiley, 2002.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Know the usage of various biological databases.
2. Know about sequence comparison methods and their merits and demerits.
3. Understand the techniques used in genomics and proteomics.
4. Know the applications of genomics and proteomics.
5. Comprehend basis of protein structure determination.
6. Practical application of bioinformatics techniques.

III[rd] Semester

BTL7152			**Genetic Engineering and Applications**				**Pre Requisites**		**Cell & Molecular Biology-I BTL6021**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	3	4.5	1.5 Hrs	3 Hrs	10	20	20	150	200

Course Contents:-

Unit-I Tools in Genetic Engineering: (12 Contact Periods)
Isolation and purification of nucleic acids. Restriction enzymes- properties and uses in recombinant DNA technology. Gene cloning vectors: Plasmids, bacteriophages, phagemids, cosmids, binary vectors. Gene cloning vectors: artificial chromosomes: YAC, BAC, PAC, MAC, TAC and other commonly used vectors in microbes, plants and animals.

Unit-II Applications in Genetic Engineering 1: (8 Contact Periods)
cDNA synthesis, Gene Libraries, construction of recombinant DNA with plasmids. Concept and applications of PCR, RT-PCR, Q-PCR, RACE. Cloning in plasmids, construction of DNA libraries with phages, construction of genomic libraries in cosmid vectors. Screening of recombinants, use of selectable and scorable markers, characterization of recombinants.

Unit-III Applications in Genetic Engineering 2: (8 Contact Periods)
Radiolabelling of DNA, Nucleic acid hybridization, DNase-I footprinting, functional analysis of promoters, Sequencing of nucleic acids. Genetic transformation of eukaryotes – genetic transformation of plants and animal cells.

Unit-IV Genetic engineering for welfare: (8 Contact Periods)
Applications of genetic engineering: Transgenic animals, production of recombinant pharmaceuticals, gene therapy, disease diagnosis

Unit-V Genetic Engineering and Applications Lab Experiments: (12 Contact Periods)

1. Cloning of foreign DNA in plasmid.
2. Southern blotting and hybridization, Northern blotting of RNA gel
3. Various PCR techniques and applications, Nucleotide sequencing
4. Demonstration of promorter activity
5. *Agrobacterium tumefaciens* mediated plant transformation
6. Construction of genomic and cDNA library

Recommended Books:-

1. Genetic Engineering: Concepts, Tools and Techniques, Mann R, Syrawood Publishing House, USA, 2016.
2. An Introduction to Genetic Engineering, Nicholl DST, Cambridge University Press, 2008.
3. Molecular cloning 3rd Edition, A laboratory Manual, 1st edition, Maniatis T, Fritch EF& Sambrook L, Cold Spring Harbour Laboratory, New York, 2006.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Understand various principles and tools in genetic engineering.
2. Apply various techniques and methodologies for genetic manipulation.
3. Select and use of various genetic engineering applications for advanced development.
4. Comprehend perspectives for innovation and develop new methodologies.

III[rd] Semester

BTL 7234			**Bioprocess Engineering and Technology**				**Pre Requisites**		**Fundamentals of Biochemistry BTL6043**	
Version R-01							Co-requisites		Fundamentals of Microbiology BTL6072	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	1	3	5.5	1.5 Hrs	3 Hrs	10	20	20	150	200

Course Contents:-

Unit-I Microbial Cell Growth and Death Kinetics: (12 Contact Periods)

Screening and Improvement of industrially important microorganisms, Microbial Growth and Death Kinetics, Media for Industrial Fermentation, Air and Media Sterilization. **[CO1]**

Unit-II Operation and Control of Bioreactors: (12 Contact Periods)

Types of Fermentation Processes: Analysis of batch, fed-batch and continuous bioreactors, stability of microbial bioreactors, analysis of mixed populations, specialized bioreactors-pulsed, fluidized, photo bioreactors, etc. Measurement and Control of bioprocess parameters. Downstream processing, Whole cell immobilization and their industrial applications. **[CO2, CO3 & CO4]**

Unit-III Fermentation Technology: (12 Contact Periods)

Industrial production of chemicals: Ethanol, Acids (citric, acetic and gluconic acid), Solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracyclin), Semi-synthetic antibiotics, Amino acids (lysine, glutamic acid), Single cell protein. **[CO5 & CO6]**

Unit-IV Applications of Bioprocess Engineering: (CO4, CO6) (12 Contact Periods)

Agitation and aeration: requirement in industrial processes, concept of volumetric oxygen transfer coefficient and its determination (K_{la}), Factors affecting K_{la} values; Uses of microbes in mineral beneficiation and oil recovery. Introduction to food technology; Elementary idea of canning and packaging, Sterilization and pasteurization of food products. **[CO4 & CO6]**

Unit- V List of Experiments: (CO7 & CO8) (12 Contact Periods)

1. To plot Microbial growth curve for shake flask culturing using turbidity method.
2. Prepare a standard curve of reducing sugar by 3,5-Dinitrosalicylic acid method
3. To produce invertase enzyme and find its activity from Baker's Yeast
4. Preparation of standard curve of Ethanol.
5. Quantitative estimation of ethanol produced during Yeast fermentation
6. Production of Penicillin and assaying its activity.
7. To get familiarized with the lab scale fermenter (bench top fermenter)
8. To determine dissolved oxygen concentration in tap and aerated water.
9. To determine the volumetric transfer coefficient (K_{la})
10. Estimation of BOD in a given waste water sample.
11. Centrifugation studies during settling of yeast cells.
12. Yeast cell disruption by mechanical methods.

Recommended Books:-

1. Bioprocess Engineering, Shular M & Kargi F, Prentice Hall
2. Biochemical Engineering Fundamentals, Bailey JE & Ollis DF
3. Bioprocess Engineering Principles, Doran, PM, Academic Press, California

4. Principles of Fermentation Technology, Stanbury PF, Whitaker A & Hall SJ
5. Biotechnology-A Textbook of Industrial Microbiology, Crueger W & Crueger A, Sinear Associates
6. Industrial Microbiology, Reed G, Prescott & Dunn's, CBS Publishers.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Present unit operations together with fundamental principles for basic methods in production techniques for biologically based products..
2. Select and design a bioreactor
3. Undertake bioprocess monitoring/control.
4. Describe equipment, materials and methods related to biotechnological processes
5. To give an account of important industrial biochemicals.
6. To perform competently in biotech industries
7. To gain ability to investigate, design and conduct experiments.
8. To analyze and interpret data to solve complex bioprocess engineering problems.

III[rd] Semester

BTE7413				**Principles of Intellectual Property Rights & Biosafety**			**Pre Requisites**		**Fundamentals of Microbiology BTL6072**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Introduction to Intellectual Property Rights: (9 Contact Periods)
Intellectual property, meaning, evolution, choice of intellectual property protection; Classification and forms; Rationale for protection of IPRs - Importance of IPRs in the fields of science and technology. **[CO1]**

Unit-II Types of IPR Rights: (9 Contact Periods)
Types of IPRs - Patents, Copyrights, Trademarks, Trade secrets, Geographical indicators, Traditional Knowledge Digital Library; Plant/Animal variety protection act, Plant breeders rights; International conventions, WTO, GATT, TRIPs. **[CO1 & CO2]**

Unit-III Patenting Processes: (9 Contact Periods)
Patent claims, requirements of patentability, patentable subject matter, patent litigation, recent developments in patent system and patentability of biotechnological inventions; special issues in biotechnology patents, disclosure requirements. **[CO2 & CO3]**

Unit-IV Biosafety Principles and Guidelines: (9 Contact Periods)
Biosafety concepts and issues: Rational vs subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biosafety levels, biosafety concerns at the level of individuals, institutions, society, region, country and the world; biosafety in the laboratory institution, laboratory associated infections and other hazards, prudent biosafety practices in the laboratory/institution; biosafety assessment procedures in India and abroad. **[CO4, CO5 & CO6]**

Recommended Books:-

1. Handbook of Indian Patent Law and Practice, Viswanathan S, Printers and Publishers Pvt. Ltd., 1998.
2. Intellectual Property Rights: Critical Concepts in Law, Vaver D, Taylor & Francis, 2006.
3. Intellectual Property: A Reference Handbook, Aaron Schwabach, ABC-CLIO, 2011.
4. IPR, Biosafety & Bioethics, Goel D & Parashar S, Pearson Publishers, 2013.
5. Introduction to Biotechnology, Pathak R, Atlantic Publishers & Distributors (P) Ltd., 2007.
6. Biological Safety Principles & Practices, 4th Edition, Fleming DO & Hunt DL, ASM Press, 2006.

Course Outcomes:-

After successful completion of this course, students will be able to:
1. Describe the principles and choice for seeking various types of Intellectual Property Rights.
2. Identify the patentable and non-patentable materials.
3. Follow the correct procedures for filing of a patent.
4. Be aware of the principles and levels of Biosafety in Biotechnological research.
5. Be able to implement/design the proper containment facilities for a particular level of Biosafety in a given institution/industry.
6. Be aware about the various national and international guidelines of Biosafety.

III[rd] Semester

BTE7211				**Applications of Plant Biotechnology**			**Pre Requisites**		• **Cell & Molecular Biology –II BTL6022** • **Cell Culture BTL6202**	
Version R-01							Co-requisites		Genetic Engineering and Applications BTL7152	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Genetic Engineering for Biotic and Abiotic Stress Tolerance
Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance.

Unit-II Metabolic engineering for Crop improvement
Improvement in seed storage and other proteins; Carbohydrate and starch improvement, Nutraceuticals and other value addition compounds; post-harvest bioengineering.

Unit-III Transgenic plants for Molecular Farming
Concept of bio-factories; production of industrial enzymes, edible vaccines , vitamins ,antibiotics and other biomolecules; Cell cultures for secondary metabolite production, Production of pharmaceutically important compounds. Status of Genetically engineered plants and transgenic production in the world and country.

Recommended Books:-

1. Plant Biotechnology and Genetics: Principles, Techniques and Applications, C Neal Stewart Jr Wiley-Blackwell; Har/Cdr edition, 2008.
2. Applied Biotechnology and Plant Genetics, M Sudhir, Dominant Publishers & Distributors, 2016.
3. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops, Nigel Halford, Wiley-Blackwell, 2013.
4. Applied Biotechnology and Plant Genetics, Ashok Ganguli, Oxford Book Company, 2009.
5. Plant Biotechnology: The Genetic Manipulation of Plants by Slater Oxford, 2nd Edition, 2008.
6. Plant Biotechnology, P K Gupta, Rastogi Publications, 2010.
7. Plants, Genes and Crop Biotechnology, Chrispeels MJ & Sadava DE, Jones and Bartlett Publishers, Inc., 2nd Edition, 2002.

Course Outcomes:-

Course student will be able to:
1. Understand the aims and needs of industrial enterprises using plant biotechnology techniques to develop new products.
2. Understand the implications, current scope and limits of modern methods of genetic modification for plants.
3. Competently discuss and present the recent ongoing technologies and research for applications in plant biotechnology.
4. Have an appreciation of the issues associated with growing and using transgenic plants.

III[rd] Semester

BTE7292				**Food Science and Technology**			**Pre Requisites**		**Fundamentals of Microbiology BTL6072**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Objectives:-

1. The course intends to introduce the students to the basic principles of food science, basic constitution of food, effect of microbes on the food.
2. The knowledge of techniques used in food processing and preservation to be learnt.
3. The processes used in manufacture of important food materials to be learnt.

Course Contents:-

Unit-I Food Chemistry: (9 Contact Periods)
Food quality characteristics; Composition and nutritive value of common foods, Structure, properties and metabolic function of food constituents. **[CO1 & CO5]**

Unit-II Food Microbiology: (9 Contact Periods)
Growth and inactivation kinetics; Harmful and beneficial effects of microbes, microbes in food industry; Food spoilage, poisoning and intoxication. **[CO2, CO5 & CO6]**

Unit-III Food Process Principles: (9 Contact Periods)
Basic principles of food preservation and processing; Preservation of food by removal or supply of heat, dehydration, irradiation, addition of chemicals and fermentation. **[CO3, CO5 & CO6]**

Unit-IV Food Technology: (9 Contact Periods)
Technological processes for industrial manufacture of selected foods of commercial importance from plants and animal sources. Laws and Standards: Food additives; Food packaging; Quality control in food industry. **[CO4, CO5 & CO6]**

Recommended Books:-

1. Food Chemistry, 4th Edition, Belitz HD, Grosch W & Schieberle P, Springer, 2009.
2. Introduction to Food Engineering, 4th Edition, Singh RP & Heldman DR, Academic Press, 2008.
3. Food Microbiology, Frazier WC, Westhoff DC & Vanitha NM, McGraw Hill, 2013.
4. Modern Food Microbiology, 1st Edition, Aneja KR, Meditech, 2017.
5. Food Processing Technology Principles and Practice, 4th Edition, Fellows PJ, Elsevier, 2016.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Know about the basic constituents of food and their role in metabolism.
2. Have knowledge effects of microorganisms on food and their use in fermented foods.
3. Have understanding about food preservation and processing.
4. Know about the processes of producing some commercially important foods.
5. Know the nutritive value of foods, importance of fermented foods, preservation, laws governing food production.
6. Know about food spoilage, processing of foods, additives in food.

III[rd] Semester

BTE7402				**Drug Delivery and Pharmacokinetics**			**Pre Requisites**		**Fundamentals of Biochemistry BTL 6043**	
Version							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Basics of Drug Delivery and Pharmacacokinetics: (9 Contact Periods)
Basics of Drug delivery, Routes of drug delivery, Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development

Unit-II Modes of Drug Absorption and Kinetics: (9 Contact Periods)
Study of the different modes of drug absorption and Passage of drug across biological barrier, Pharmacokinetics of drug absorption (zero order, 1[st] order), Factors influencing absorption of drugs.

Unit-III Models of Drug Distribution, Elimination and Pharmacokinetic Principles: (9 Contact Periods)
Various theories of Drug distribution in the body, Compartment and non-compartment models, plasma protein binding, Volume of distribution and distribution coefficient. Pharmacokinetic principles, Bioavailability and Bioequivalence. Termination of drug action, Excretion, Biotransformation, Tissue redistribution.

Unit-IV Bioavailability and Drug Dose Calculation: (9 Contact Periods)
Measures of bioavailability, Pharmacokinetic parameters from plasma and urine data, C-max, and Area under curve (AUC), Calculation of LD50 & ED50, Therapeutic index and its role in dose adjustment.

Recommended Books:-

1. Text Book of Biopharmaceutics & Clinical Pharmacokinetics, Niazi S, Appleton-Century-Crofts (ACC), New York.
2. Pharmacokinetics and Metabolism in Drug Design, Smith DA, Waterbeemd HV & Walker DK, Wiley VCH.

Course Outcomes:-

After successful completion of this course, students shall be able to:

1. Understand the basics of drug delivery and different routes of drug delivery.
2. Learn about the role of the Biopharmaceutics and Pharmacokinetics and their role in formulation development.
3. Understand different rate of drug absorption and their kinetics.
4. Understand various phenomenon involved in drug absorption, distribution and elimination from the body.
5. Calculate various kinetic parameters required in dose calculation and adjustments.

III[rd] Semester

BTE7122			**Principles in Human Genetic Disorders**				**Pre Requisites**		**Molecular Genetics BTL6091**	
Version R-01							Co-requisites		Cell & Molecular Biology –II BTL6022	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Principles in Human Genetics: (10 Contact Periods)

Human genomic sequence and annotations, Comparative homologies of human genomic sequence, evolutionary changes and SNPs. Genetic variations and molecular evolution, functional characterizations of mutant alleles, Genotype-phenotype correlations. Non-recurrent and recurrent mutation, Mutation pressure, Genetic load, Heterozygous advantages, Equilibrium between mutation and selection.

Unit-II Human Population Genetics: (8 Contact Periods)

Application and subdivisions of human population genetics, Hardy-Weinberg law and its application for autosomal locus, Genetic drift, Founder effect, Bottleneck effect,Consanguinity and inbreeding, Biological consequences of inbreeding, Admixture.

Unit-III Understanding Human Genetic Diseases: (8 Contact Periods)

Human gene and mutation nomenclature, Mutations and their clinical consequences. Basic concepts of inheritance — Mendelian inheritance, Sex- linked inheritance, Multifactorial traits. Spectrum of genetic diseases (single gene, chromosomal, multifactorial, mitochondrial, somatic cell genetic diseases). Pedigree Analysis and patterns of their inheritance.

Unit-IV Application of Human Genetics: (10 Contact Periods)

Human genetic variations and use of polymorphisms in medical genetics. Twin studies, Linkage Studies, Candidate Gene Association Studies, Congenital anomalies and birth defects. Genetic Counseling, Impact of disease on the patient and family, Introduction to treatment and management of genetic diseases. The Human Genome Project, Human genetic variations, and human Evolution, Human Genographic project, Hapmap Project, 1000 genomes Project, ENOCDE project.

Recommended Books:-

1. Human Molecular Genetics, 4th revised Edition Strachan T & Read A, Garland Science, USA, 2010.
2. Human Evolutionary Genetics, 2nd revised Edition Jobling M, Hollox Ed, Hurles M, Kivisild T & Smith CT, Garland Science, USA, 2013.
3. Genetics and Genomics in Medicine, Strachan T, Goodship J & Chinnery P, Garland Science, USA, 2014.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Understand principles in human genetics
2. Comprehend population genetics and understand genetic structure of present world population.
3. Understand role of genetics in human health and social implications
4. Understand preventive measures to reduce genetic diseases load.

III[rd] Semester

BTE7341			**Radiation Biology**				**Pre Requisites**		**Nil**	
							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3.0	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Introduction to Radiation Biology: (12 Contact Periods)
Introduction to principles and concepts underlying the biological effects of ionizing radiation at the molecular, cellular and whole-tissue level.Biological effects of radiation and risks on cellular level to humans, factors that affect the dose-effect relationship. **[CO1, CO3 & CO5]**

Unit-II Deeper Understanding of Cell and Radiation Biology (12 Contact Periods)
A deeper knowledge on radiation protection for ionizing and non-ionizing radiation and its protection technology. Selected aspects of microdosimetry, radiation damage to DNA, DNA repair mechanisms, cell-cycle kinetics (repopulation effects), cell death mechanisms and clonogenic survival, apoptosis, acute effects of whole body irradiation.radiation carcinogenesis, hereditary effects of radiation, clinical responses of normal tissues to radiation, cancer biology. **[CO2 & CO3]**

Unit-III Interdisciplinary Approach of Physics, Chemistry and Mathematics to Radiation Biology: (12 Contact Periods)
The tumor control probability (TCP), and biological indicators of treatment effectiveness, such as biologically equivalent dose (BED) and equivalent uniform dose (EUD) concepts.Linear Energy Transfer (LET) effects and relative biological effectiveness (RBE). **[CO3, CO4 & CO6],**

Unit-IV Law, Society and Ethical Considerations: (12 Contact Periods)
Indian radiation protection legislation and regulations for ionizing, ultraviolet, laser and electromagnetic fields. It also includes methods for personal dosimetry, radiation protection instruments and handling of radioactive substances. Ethical and social issues. **[CO1, CO2 & CO7]**

Recommended Books:-

1. Radiobiology for the Radiologist, 6th Edition, Hall EJ & Giaccia AJ, Lippincott Williams & Wilkins, 2006.
2. An Introduction to Radiobiology, Second Edition, Nias AHW, John Wiley and Sons, 1998 (reprinted in 2000).
3. Molecular Biology of the Cell, 4th Edition, Alberts B, Johnson A, Lewis J, Raff M, Roberts K & Walter P, Garland Science, Taylor & Francis Group, New York, 2002.

Course Outcomes:-
After successful completion of this course, students will be able to:

1. Explain the basics of ionizing radiation biological effects and risks from cellular to human.
2. Summarize the factors that affect the dose-effect relationship.
3. Summarize acute and late effects from ionizing radiation.
4. Plan and implement radiation protection education of health professionals, such as nurses and medical technicians.
5. Explain the principles of radiation protection for both ionizing and non-ionizing radiation.
6. Understanding the dose-response curves.
7. Applying Radiation Protection Act and the relevant radiation protection regulations.

III[rd] Semester

BTE7332				**Genome Stability Regulation and Drug Development**			**Pre Requisites**		**Fundamentals of Microbiology BTL6072**	
Version R-01							Co-requisites		Cell & Molecular Biology –II BTL6022	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Introduction to Model Organisms: (9 Contact Periods)
Model Organisms, Structure of DNA, Nucleotide Metabolism, Cell cycle regulation in Eukaryotes, Fundamentals of DNA Transaction.

Unit-II Genome Stability Mechanisms: (9 Contact Periods)
Mechanisms of Genome Stability regulation, Unit of replication, Enzymes involved, Replication Origin and Replication Fork, Fidelity of Replication, Extra-Chromosomal Replicons.

Unit-III DNA Damage Repair and System Biology: (9 Contact Periods)
DNA Damage and Repair Mechanisms Homologous and Site-Specific Recombination, System Biology.

Unit-IV Synthetic Lethality and Drug Development: (9 Contact Periods)
Genetic Networks, Protein Degradation Mechanisms and Drug Targeting, Emerging Pathogen and Drug Targets.

Recommended Books:-

1. Genes IX, Lewin B, 2007.
2. Genetics: From Genes to Genomes, 3rd Edition, Hartwell L, Hood L, Goldberg M & Reynolds A, McGraw-Hill Higher Education, 2008.
3. Eukaryotic DNA Replication, Phamphilis MD, CSHL Press, 2006.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Learn role of model organism in experimental research
2. Explain the role of Genome instability in disease causation
3. Explain the role of biological processes in Genome stability
4. Understand the concept of synthetic lethality
5. Design strategies for genetic network, synthetic interaction & drug development

III[rd] Semester

BTE7124			**Introduction to Medical Genetics**				**Pre Requisites**		**Nil**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5 Hrs	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I Human genome, Patterns of Inheritance (18 Contact Periods)

The basis of heredity; Mutation, Human Genome analysis; Usual patterns of inheritance: Mendelian diseases; Unusual patterns of inheritance; Complex diseases and genetics. **[CO1 & CO2]**

Unit-II Population genetics, Epigenetics (CO1, CO3) (9 Contact Periods)

Basics of population genetics; Environmental modification; Tools of human molecular genetics. **[CO1 & CO3]**

Unit-III Genetic Association Studies, Clinical Genetics (CO3, CO4) (9 Contact Periods)

Mapping and Linkage in complex diseases; Therapy of Genetic Disease; clinical genetics: prenatal Diagnosis and Counseling. **[CO3 & CO4]**

Recommended Books:-

1. Medical Genetics, 5th Edition, Carey JC, Jorde L & Bamshad MJ, 2015.
2. Principles of Genetics, 8th Edition, Gardner, Simmons & Snustad, 2005.
3. Genetics-A Molecular Approach, Russell P, Pearson Benjamin Cummings.
4. Genetics-Analysis of Genes and Genomes, Hartl & Jones, Jones and Bartlett.

Course outcomes:-

After Successful Completion of this Course, students shall be able to:

1. Understand the structure of the human genome and impact of genetic variations (mutations) as well as environmental modifications on development of genetic diseases.
2. Solve Mendelian and non-Mendelian patterns of inheritance.
3. Understand the basics of population genetics and association studies in complex disorders.
4. Understand the importance of genetics in disease diagnosis and get familiar with the practice of genetic counseling.

III[rd] Semester

BTE 7352				**Stem Cell Biology and Applications**			**Pre Requisites**		**Animal Cell Culture BTL6191**	
Version R-01							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major Marks	Total Marks
3	0	0	3	1.5	3 Hrs	10	20	20	50	100

Course Contents:-

Unit-I: **Types of stem cells** (9 Contact Periods)

Early events in development; Introduction to stem cells and basis of stemness; Embryonic stem cells, embryonal carcinoma cells, embryonic germ cells, adult stem cells, hematopoietic stem cells, mesenchymal stem cells, cancer stem cells, induced pluripotent stem cells. **[CO1]**

Unit-II: **Stem cells isolation and culture** (5 Contact Periods)

Isolation, characterization and maintenance of embryonic stem cell isolated from: Mouse and Human. Serum and feeder free culture of human embryonic stem cells, evolution of xeno-free culture systems. **[CO2]**

Unit-III: **Basic Biology/Mechanisms of Stem Cells** (10 Contact Periods)

Molecular basis of pluripotency, stem cell niche, cell cycle regulators in stem cells, mechanisms of stem cell self-renewal. **[CO3]**

Unit-IV: **Applications of stem cells** (12 Contact Periods)

Neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedic applications, eye diseases, stem cells and gene therapy. Ethical and regulatory issues in the use of stem cells. **[CO4 & CO5]**

Recommended Books:-

1. Handbook of Stem Cells, 2nd Edition, Atala A & Lanza R, Academic Press, 2012.
2. Essential of Stem Cell Biology, 3rd Edition, Lanza R, et al, Elsevier Academic Press, 2013.
3. Translational Approaches in Tissue Engineering & Regenerative Medicine, Mao JJ, et al, Artech House, 2007.
4. Stem Cell Repair and Regeneration, Volume-2, Habib NA, Levièar NY, Gordon M, Jiao L & Fisk N, Imperial College Press, 2007.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Describe the characteristics of stem cells and the different types of stem cells
2. Understand the isolation process and cultivation of embryonic stem cells.
3. Understand basic biology/mechanisms of pluripotency, self-renewal of stem cells, stem cell niche in regulating stem cell fate, role cell cycle regulators in stem cells.
4. Describe the applications of stem cells in diseases, injury and gene therapy
5. Appreciate the ethical and regulatory issues associated with use of stem cells.

III[rd] Semester

BTC7211			**Colloquium**				**Pre Requisites**		Fifty (50) working days or 400 hours of practical training in an industry at the end of one year of study	
							Co-requisites		Nil	
L	T	P	C	Minor Duration	Major Duration	Internal Marks	Minor-I Marks	Minor-II Marks	Major* Marks	Total Marks
			1.5						100	100

*Marks for Colloquium course shall be awarded on the student's work in the form of a Reports/Presentations/Seminars/Viva voce methods or all of them for the Practical Training taken during the Summer Vacation after Semester II which shall be evaluated by the concerned Course Coordinator/s.

Course Contents:-

Unit-I Report Submission and Presentation: (12 Contact Periods)
Students shall submit the Project Report and deliver a Power Point Presentation batch-wise based on their work done during the summer training.

Unit-II Report Submission and Presentation: (contd.) (12 Contact Periods)
Students shall submit the Project Report and deliver a Power Point Presentation batch-wise based on their work done during the summer training.

Unit-III Viva Voce and Group Discussion: (12 Contact Periods)
The presentations and work done shall be reviewed for the whole class together during the group discussion.

Course Outcomes:-

After successful completion of this course, students will be able to:

1. Use correct form of scientific language.
2. Analyze and present appropriate research data generated by them.
3. Acquire hands-on training on ongoing fields of research.