INTEGRAL UNIVERSITY, LUCKNOW

SYLLABUS

&

EVALUATION SCHEME

for

M.TECH. BIOTECHNOLOGY

2nd Year

(with effect from 2021-2022)

Integral University
M. Tech. Biotechnology
(with effect from Session 2021-2022)

2nd Year **3rd Semester**

S. No.	Course Category	Subject Code	Subject	Periods and Credits				Evaluation Scheme				Subject Total
								Sessional (CA)			ESE	
				L	T	P	C	CT	TA	Total		
1	DC	BE-601	Bioinformatics, Genomics and Proteomics	2	1	0	3	40	20	60	40	100
2	DC	BE-602	Immunotechnology	2	1	0	3	40	20	60	40	100
3	DE		Departmental Elective	2	1	0	3	40	20	60	40	100
4	DC	BE-699	M.Tech. Dissertation	0	0	8	4	40	20	60	40	100
5	DC	BE-603	Colloquium	0	0	4	2	40	20	60	40	100
6	DC	*BE-604	Advances in Molecular Techniques	2	1	0	0	40*	20*	60*	40*	100*
Total				**8**	**4**	**12**	**15**	**200**	**100**	**300**	**200**	**500**

* A zero-credit foundation course. Candidate has to pass the course by securing at least 50% marks.

Departmental Electives

1. Animal Cell Engineering (BE-605)
2. Biochemical Reaction Engineering (BE-606)
3. Environmental Biotechnology (BE-607)
4. Secondary Metabolism in Plants (BE-608)
5. Plant Developmental Biology (BE-609)
6. Biosensors: Design and Applications (BE-610)
7. IPR, Biosafety and Bioethics (BE-611)
8. Medical Biotechnology (BE-612)

BIOINFORMATICS, GENOMICS AND PROTEOMICS
BE-601

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The objective of the course is learning and understanding the detailed developments and applications of the field of Bioinformatics in varied area of biological research. The course generally focuses on genomics, proteomics and computational biology studies and their relevance on research platform.

UNIT I	**Bioinformatics & Sequence Analysis**	**8**
	Nucleic acid sequence data banks, GenBank; EMBL; Brief overview of Human Genome Project (HGP): goals and applications. Pair wise sequence alignment: Needleman and Wunsch; Smith Waterman algorithms; Database Similarity Searches: Basic Local Alignment Search Tool (BLAST) & FASTA methods.	
UNIT II	**Applied Bioinformatics**	**8**
	Drug Designing, Stages of Drug Designing, DNA microarrays and its applications, Determination of Secondary & Tertiary structure of proteins: Chou Fasman method, Homology Modeling and its applications; Gene prediction studies: Promoter and regulatory regions scanning.	
UNIT III	**Structural & Functional Genomics**	**8**
	Multiple sequence alignments: Strategies and applications in Phylogenetics. Structural genomics (SG): Basic principles and applications, approaches for target selection. Functional genomics: application of sequence based and structure-based approaches to assignment of gene functions e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification.	
UNIT IV	**Proteomics: Tools and Databases**	**8**
	Proteomics: an introduction; Study of transcriptome and proteome; Protein-protein interactions: databases such as DIP, PPI server and tools for analysis of protein protein interactions. Protein arrays: basic principles; bioinformatics-based tools for analysis of proteomics data, Tools available at ExPASy Proteomics server; Introduction to Protein Sequence Data Banks: UniProt, SwissProt.	

References Books:

1. Baxevanis AD, Ouelettte BFF; Bioinformatics: A practical Guide to the analysis of genes and proteins., Wiley 2004, ISBN: 978-0-471-47878-2
2. Stephen A., David K, Womble D; Introduction to Bioinformatics: A Theoretical and Practical Approach., 2003, Humana Press, ISBN-13: 978-1588292414
3. Harren Jhoti, Andrew R. Leach; Structure- based Drug Discovery, Springer, 2007, ISBN 1402044070
4. Andrew Leach; Molecular Modelling: Principles and Applications (2nd Edition), Prentice Hall, 2001, ISBN 13: 9780582382107
5. Cynthia Gibas, Per Jambeck; Developing Bioinformatics Computer Skills: An Introduction to Software Tools for Biological Applications, 2001, O'Reilly Media publishers.
6. Barry A. Bunin, Brian Siesel, Guillermo Morales, Jurgen Bajorath; Chemoinformatics: Theory, Practice, & Products, Springer Science & Business Media, 2006.

Research Publications:

1. Zhang W, Pei J, Lai L. Computational Multitarget Drug Design, J ChemInf Model, 2017. doi: 10.1021/acs.jcim.6b00491
2. Leelananda SP, Lindert S. Beilstein. Computational methods in drug discovery, J Org Chem,. 2016 Volume 12. Pg- 2694-2718.

Websites:

1. **Error! Hyperlink reference not valid.**simulation software: www.schrodinger.com
2. National Center for Biotechnology Information, www.ncbi.nlm.nih.gov/.
3. Auto Dock, autodock.scripps.edu

Online document/video/audio:

1. Computational chemistry in drug discovery. European Bioinformatics Institute - EMBL-EBIhttps://www.youtube.com/watch?v=9DESulCWbRQ.
2. Webinar recording: a sequel for beginners: ligand-based drug design — the basics https://www.youtube.com/watch?v=ef5EaooBYUU.

IMMUNOTECHNOLOGY
BE 602

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The objective of the course is to apprise the students about components associated with immune system and molecular mechanism of their working. The course also deals with implications of deregulation of basic regulatory networks that lead to immune system related disorders.

UNIT I	**Humoral and Cell Mediated Immunity**	**8**
	B-cell and T cell activation, Structure and function of MHC molecules. Exogenous and endogenous pathways of antigen processing and presentation. Antibodies and antibody based therapy: Production of Polyclonal antibodies with different types of antigens : antigen preparation and modification, adjuvant, dose and route of antigen administration, collection of sera, purification of antibodies; Inhibitors of tumor necrosis factor, targeting the IL2 receptor with antibodies or chimeric toxins, monoclonal antibodies to CD3.	
UNIT II	**Hybridoma Techniques and Monoclonal Antibody Production**	**8**
	Myeloma cell lines - fusion of myeloma cells with antibody producing B-cells-fusion methods - selection and screening methods for positive hybrids - cloning methods - production, purification and characterization of monoclonal antibodies. Application of monoclonal antibodies in biomedical research, in clinical diagnosis and treatment; Production of human monoclonal antibodies and their applications.	
UNIT III	**Immunotherapy for Allergic Diseases**	**8**
	Specific and nonspecific immunotherapy for Asthma and allergic diseases, Drug therapy in HIV: AIDS and other Immunodeficiencies; Vaccine and peptide therapy, newer methods of vaccine preparation, sub-unit vaccines, immuno-diagnosis of infectious diseases, serological techniques-ELISA, RIA and Immunoblotting.	
UNIT IV	**Transplantation**	**8**
	Graft rejection, evidence and mechanisms of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, Xenotransplantation. Drugs: Antimetabolites, corticosteroids, anti-inflammatory agents; Cytokines: Cytokines regulating immune inflammation: interleukin-4, interleukin-20, interleukin-12; The interferons: Basic biology and therapeutic potential.	

References Books:

1. "Cellular & Molecular Immunology" by Abbas AK, Lichtman AH, Abbas AK, Pober JS, Publisher: Elsevier;
   Year: 2012; Edition: 7th
1. "Immunology" by Kuby; Publisher: WH Freeman and Company, New York; Year: 2007; Edition: 6th.
2. "Elements of Immunology" by Fahim Halim Khan; Publisher: Pearson; Year: 2009; Edition: 1st
3. "Immunology" by Roitt, Publisher: Edinburg Mosby; Year: 2002; Edition: 6th.

ADVANCES IN MOLECULAR TECHNIQUES
BE-604

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	0

Objective: To demonstrate proficiency in advanced molecular biology techniques and to inculcate an understanding of advanced molecular techniques, including advanced background information and theory, applications, limitations, advantages and disadvantages, common problems and troubleshooting.

UNIT I	**PCR-based Techniques** Principle and applications of PCR; RACE; DD-RTPCR; Degenerate PCR, TA cloning, Realtime PCR, Scorpion probes, Site directed mutagenesis, PCR-based mutagenesis, Error-prone PCR	**8**
UNIT II	**Gene Silencing** Antisense RNA technique, Sense co-supression in plants and animals, RNAi, Gene silencing, Ribozymes	**8**
UNIT III	**Sequencing Techniques** Rapid DNA and RNA sequencing techniques, Sanger method, Maxam and Gilbert procedure, Automated DNA sequencing, Pyrosequencing, Genomics: High throughput, Shot gun, Clone contig, Microarray, Protein microarray	**8**
UNIT IV	**Molecular Markers and other Molecular Techniques** Molecular markers, RFLP, RAPD, AFLP, SCAR, STS, Microsatellites, SSCP, Yeast two-hybrid system, DNase foot printing	**8**

References Books:

1. Molecular Cloning; Sambrook and Russel, Cold Spring Harbor Laboratory
2. Gene Cloning and DNA Analysis: An Introduction, T.A. Brown; Blackwell Publications
3. Principles of Gene manipulation and genomics; Primrose and Twyman; Wiley Publishing

ANIMAL CELL ENGINEERING
BE 605

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The course will help students to understand mechanisms of gene manipulation of animal cells, stem cell therapeutics and other frontier areas associated with molecular medicine.

UNIT I	**Animal Cell Culture** Animal Biotechnology and its scope, Principles of sterile techniques and cell propagation, Cell culture media: Physicochemical Properties, Chemically defined and Serum free media. Culture Environment, Cell Adhesion. Types of culture system: monolayer culture, Roller bottle, Suspension culture, static suspension culture, agar culture, agitated micro carrier suspension culture, hollow fiber systems, Scaling up factors. Strategies of medium optimization, Organotypic cultures, Animal Tissue Engineering, Bioartificial Organs, Scaffolds and Biomaterials used in Tissue Engineering.	**8**
UNIT II	**Primary Culture** Isolation of Tissue, isolation of cells from explants by enzymatic disaggregation, mechanical disaggregation, EDTA treatment. Steps involved in primary cell culture, Cell line characterization: Morphology, Chromosome Analysis, Antigenic Markers, Transformation, Immortalization, Cell counting, Rates of Synthesis, Generation Time. Measurement of cell growth and viability, cell synchronization, cell transformation, maintenance of cell culture through sub-culturing and cloning, cryo-preservation, application of cell cultures. Types of microbial contamination and Eradication of Contamination	**8**
UNIT III	**Mammalian Cell Lines** Mammalian cell expression system, gene transfer techniques in Mammalian cells, Stem cell culture: principles for identification, purifications, assessment of proliferation heterogeneity, long-term maintenance and characterization, Embryonic and adult stem cells and their applications. Genetically modified stem cells in gene therapy, Markers for stem cell identification, characterization of differentiated cell types, Applications of stem cells.	**8**
UNIT IV	**Transgenic Animals** Animal virus vectors; Shuttle vectors. Cloning in mammalian cells, Integration of DNA into mammalian genome, Methods of transformation: (Microinjection, Electroporation, Microprojectile bombardment, Liposomal packaging),Animal as bioreactors, problems after developing transgenic animals. Applications of transgenic animals, In vitro-fertilization, Gene Therapy: *Ex-vivo* gene therapy, *In vivo* gene therapy, Prodrug activation therapy, Nucleic acid therapeutic agents.	**8**

	Protein production by genetically engineered mammalian cell lines, Manipulation of Growth hormone: somatotropic hormone, Thyroid horomone; Probiotics as growth promoters, Ideal characteristics probiotics, uses of probiotics.	

References Books:

1. "Gene Cloning and DNA Analysis" by TA Brown, Publisher: Oxford Balckwell Science, Year: 2008, 2011, Edition: 4^{th}, 5^{th}.
2. Old & Primrose "Principles of Gene Manipulation", Publisher: Balckwell; Year: 2014, Edition: 7^{th}
3. "Methods of Tissue Engineering" Anthony Atala, Robert P. Lanza; Publisher: Elsevier; Year: 2005,
4. "Animal Cell Biotechnology: Methods and Protocols" by Nigel Jenkins; Publisher: New Jersey: Humana Press; Year: 2005.

BIOCHEMICAL REACTION ENGINEERING
BE-606

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The course will help students to understand mechanisms of gene manipulation of animal cells, stem cell therapeutics and other frontier areas associated with molecular medicine.

UNIT I	**Reaction Basics**	**8**
	Rate of reaction, reaction order and rate laws, Rate-limiting step. Chain reactions. Pyrolysis reactions. Steady state ideal reactors: completely mixed and plug flow.	
UNIT II	**Reactors**	**8**
	Reactor size comparisons for PFR and CSTR. Reactors in series and in parallel. How choice of reactor affects selectivity vs. conversion. Theory of the continuous and semi-continuous fermentor operation.	
UNIT III	**Reactor Engineering I**	**8**
	Non-ideal reactor mixing patterns, Residence time distribution, Tanks in series model. Combinations of ideal reactors. Non isothermal reactors. Equilibrium limitations, stability. Derivation of energy balances for ideal reactors; equilibrium conversion, adiabatic and nonadiabatic reactor operation.	
UNIT IV	**Reactor Engineering II**	**8**
	Oxygen transfer in fermentors. Applications of gas-liquid transport with reaction. Reaction and diffusion in porous catalysts. Combined internal and external transport resistances.	

References Books:

1. Fogler H.S. Elements of chemical reaction Engineering. 4th edition, Prentice- Hall of India Pvt Ltd, 2006.
2. Levenspiel O., Chemical Reaction Engineering. 3rd edition, Wiley New York. 1992.
3. Rao D.G., Introduction to Biochemical Engineering, McGraw-Hill, 2005.
4. Villadsen, J., Nielsen, J., & Lidén, G. Bioreaction engineering principles. 3rd edition Springer. 2011
5. Smith J.M., Chemical Engineering Kinetics. 3rd edition. New York, McGraw-Hill, 1981.
6. Steinfeld, J. I., Francisco J. S., & Hase W. L. Chemical Kinetics and Dynamics. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1999.
7. Holland, C. D., & Anthony, R. G. Fundamentals of Chemical Reaction Engineering, John Wiley and Sons, 1990.

ENVIRONMENTAL BIOTECHNOLOGY
BE-607

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The main objective of this course is to impart students an understanding of pollution of environment by air, water and soil responsible for degradation of natural resources and degradation of biodiversity. It also familiarizes them with various remediation techniques, non polluting technologies viz. bioenergy and biomining**.**

UNIT I	**Title of the Unit Introduction to Ecosystem & Environmental Pollution** Source of air, water and solid wastes, Ecosystem, Ecosystem Management, Renewable resources, Role of biotechnology in environmental protection,. Air, water and soil pollution: cause and control measures. Treatment technologies, Biofilters and Bioscrubbers for treatment of industrial waste.	**8**
UNIT II	**Bioreactors & Rural Biotechnology** Biocompositing, Biofertilizers; Vermiculture; Organic farming; Biomineralization; Biofuels; Bioethanol and Biohydrogen; Energy management and safety.	**8**
UNIT III	**Water Quality Modeling For Streams** Characterization of effluents, effluent standards, Waste water collection; control and management; waste water treatment, sewage treatment through chemical, microbial and biotech techniques, Treatment of waste water from dairy, tannery, sugar and antibiotic industries. Waste recovery system. Primary methods; setting, pH control, chemical treatment. Secondary methods; Biological treatment, Tertiary treatments; like ozonization, disinfection, etc.	**8**
UNIT IV	**Environmental Regulations and Technology** Regulatory Concerns, Technology; Laws, regulations and permits, Air, Water, Solid Waste, Environmental Auditing, National Environmental Policy act, Occupational Safety and Health Act (OSHA), Storm Water Regulations; Technology (waste water); Recycling of Industrial wastes: paper, plastics, leather and chemicals.	**8**

References Books:

1. E.P. Odum "Fundamentals of Ecology" V.B. Saunders and Co. 1974.
2. W.J. Weber "Physics-Chemical Process for water quality control, Wiley-international Ed.
3. L.L. Gaccio water and water population Handbook Marcel Dekkar, New York.
4. Pradipta Kumar Mohapatra "Textbook of Evironmental Biotechnology" I.K. International Publishing House Pvt. Ltd., New Delhi.
5. Allan Scagg "Environmental Biotechnology" Oxford University Press, Canada. 2004.
6. Environmental Biotechnology by Prof. Jogdand, Himalayan publishing House, 2010.

SECONDARY METABOLISM IN PLANTS AND MICROBES
BE-608

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The main objective of this course is to impart students an understanding of biologically active compounds accumulated in plants especially as secondary metabolites that have been used as a source of major, essential oils, anti-oxidants and phytopharmaceutical ranging from anti-cancer activity to HIV. There has been an exclusive demand for herbal plants and extracts which can be used to improve human health and well being.

UNIT I	**Types of Secondary Metabolites and their Synthesis** Introduction to primary & secondary metabolism: structure, biosynthesis and metabolism of important secondary products; Glycosides, isoprenoids, cardenolides, alkaloids, phenylpropanoids and antibiotics.	**8**
UNIT II	**Enzymes involved in Secondary Metabolism** Important groups of secondary metabolic enzymes; Significance of secondary metabolism and products for the producer organism.	**8**
UNIT III	**Regulation of Secondary Metabolism** Regulation and expression of secondary metabolism; regulation of enzyme activity; regulation of enzyme amount; integration with differentiation and development; action of inducers; coordinated enzyme expression and sequential gene expression.	**8**
UNIT IV	**Culture Systems and Biotransformation** Metabolic products produced by *in vitro* culturing of plant cells, selection of plant cells/tissues for the production of a specific product, Culture system in secondary plant product biosynthesis-batch continuous cultures and immobilized plant cells, Biotransformation of precursors by cell culturing. Metabolic pathway engineering for production of secondary metabolites.	**8**

Books:

1. Slater A, Scott NW, Fowler MR "Plant Biotechnology: The Genetic Manipulation of Plants".
2. Mantell SH, Matthews JA, McKee RA, "Principles of Plant Biotechnology: An
3. Introduction to Genetic Engineering in Plants".
4. Brown TA, "Gene cloning: An Introduction".
5. Old, Primrose, "Principles of Gene Manipulation".
6. Buchanan, "Plant Biochemistry & Molecular Biology".

PLANT DEVELOPMENTAL BIOLOGY
BE-609

Pre-requisite	Co-requisite	L	T	P	C
BE-513		2	1	0	3

Objective: To make the students aware of the plant differentiation and development. The students will also knowledge about the plant aging and senescence.

UNIT I	**Basics of Differentiation** Concept of totipotency and differentiation, Mechanisms of differentiation: cellular differentiation, induction, asymmetric division, morphogens.	**6**
UNIT II	**Seed and Embryo Development** Seed Germination, Hormonal control of seed germination, Embryo development, Signalling and cell development, Plant cell division, Meristem development and patterning.	**8**
UNIT III	**Organ Development in Plants** Root development, shoot development, Flower development, Stomata development and patterning, Homeotic genes and its role in development, Developmental plasticity.	**8**
UNIT IV	**Aging and Regulation of Development** Aging & Senescence, Environmental regulation and development, the problem with Rubisco and photorespiration: the physiological, ecological and evolutionary aspects of photosynthesis in C4 plants.	**8**

References:

1. Raghavan, V. Developmental Biology of Flowering Plants, Springer publications, 2000.
2. Claudia Köhler and Lars Hennig. Plant Developmental Biology: Methods and Protocols, Springer publications, 2010.
3. **Cutler**, Sean, **Bonetta**, Dario (Eds.). Plant Hormones Methods and Protocols, Springer publications, 2009.
4. L. D. Noodén, Aldo Carl Leopold, Senescence and aging in plants, Academic Press, 1988.

BIOSENSORS: DESIGN AND APPLICATIONS
BE-610

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The course will give an overview of biosensors, their fabrication and other details.

UNIT I	**Biosensors : An overview** Overview of biosensors and bio-electronic devices, History, concepts and applications. Fundamental elements of biosensor devices and design considerations, calibration, dynamic range, signal to noise, sensitivity. Fundamentals of surfaces and interfaces, modifications of sensor surface. Bio-electrochemistry, Electrochemistry for biosensors, Principles of potentiometry and potentiometric biosensors; amperometry and amperometric biosensors; Conductimetric and Impedimetric Biosensors.	**8**
UNIT II	**Molecular Recognition Elements** Molecular recognition elements: Enzymes, Antibodies and DNA. Kinetics and thermodynamics of bio-recognition reactions. Enzyme sensors and affinity sensors: immune sensors, oligo-nucleotides sensors, SPR, FRET, Membrane protein sensors: ion channels, receptors, whole cell sensors – bacteria, yeast, mammalian cells, non-biological and bio-mimicry: molecularly imprinted polymers, non-biological organic molecules.	**8**
UNIT III	**Basic Fabrication of Biosensors** Immobilization: adsorption, encapsulation - (hydro-gel, sol-gel glass, etc.), covalent attachment, diffusion issues. Optical Biosensor, Microlithography for biosensors, FETS and Bio-FETS, MEMS and Bio-MEMS. Lab-on-a-chip: TAS and m-TAS devices, Sensors based on Fiber Optic. Electro-chemiluminescence, pH sensors, artificial receptors.	**8**
UNIT IV	**Application** Physical sensors: piezoelectric, resistive, bridge, displacement measurement, blood pressure measurement, quartz crystal microbalance. Applications of biosensors in Agriculture, food safety, food processing, Biomedical: Point-Of-Care system, Noninvasive Biosensors in Clinical Analysis. Biosensor-based instruments; Blood chemistry sensors, sensors for Genetic testing. Applications of biosensors in Bio-security, environmental.	**8**

References Books:

1. Handbook of Chemical and Biological Sensors", Richard F Taylor; IOP Publishing Ltd; Edition Year: 1996
2. "Handbook of Biosensors and Biosensor Kinetics"; Ajit Sadana & Neeti Sadana, Elsevier; Edition Year: 2011
3. "Biosensors"; Jonathan M. Cooper; Oxford University Press; Edition Year: 2003

Websites:

1. http://www.sciencedirect.com/science/journal/09565663
2. http://www.nature.com/subjects/biosensors
3. http://www1.lsbu.ac.uk/water/enztech/biosensors.html

IPR, BIOSAFETY AND BIOETHICS
BE-611

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The knowledge of IPR, Bio-safety and Bioethics recognizes the need for the possibility to exchange views and ideas of the students in the form of patent in the field of science and technology development. The basic knowledge of this subject paper is very useful and for student in term of how they save and protect their invention or intellectual property in proper ways.

UNIT I	**History Of IPR**	**8**
	Jurisprudential definitions and concepts of property, rights, duties and their correlation; History and evolution of IPR like patent, design and copyright. Significance of IPR; Requirement of a patentable novelty; Issues related to IPR protection of software and database; IPR protection of life forms; International convention in IPR; Geographical indication; Distinction among various forms of IPR; Rights / protection, infringement or violation, remedies against infringement: civil and criminal.	
UNIT II	**Patent Process**	**8**
	Obtaining patent; Invention step and prior art and state of art procedure; Detailed information on patenting biological products and biodiversity; Appropriate case studies; Indian Patent Act 1970 (amendment 2000); Major changes in Indian patent system as post TRIPS effects; Budapest treaty	
UNIT III	**Biosafety Levels**	**8**
	Biosafety Levels : Safety guidelines for rDNA research and infectious agents ; Containment facilities and its disposal; Radiation hazards; Safety concerns about transgenics: Environmental, Health, Economic. Safety concerns related to Animal Models.	
UNIT IV	**Bioethics**	**8**
	Bioethics: Introduction, necessity and limitation; Ethical conflicts in Biotechnology; Different paradigms of bioethics: National and International guidelines; Bioethics of genes; Bioethics in health care: Bioethical dilemmas in medical and surgical treatment; Legal implications in bioethics.	

Books:

1. Old and Primrose “Principles of Gene Manipulation”.
2. Keru M “Ethical Biotechnology”, Global Vision Publishing House.
3. Huxley TH “Evolution and ethics”, Princeton University Press.
4. Arya R “Bioethics”.
5. Erbisch FH and Maredia KM “Intellectual Property Rights”, Universities Press.
6. Glick and Pasternak “Molecular Biotechnology”.
7. Knight ‘Patent strategy for researches and research managers’, Wiley Publications

MEDICAL BIOTECHNOLOGY
BE 612

Pre-requisite	Co-requisite	L	T	P	C
None	None	2	1	0	3

Objective: The course will acquaint the students with pathogenesis and management of different diseases.

UNIT I	**Genetic Disorders**	**8**
	General, systemic and specific syndromes. Classification of genetic diseases. Chromosomal abberations–Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, Genetic diseases–Autosomal, X-linked and Y-linked disorders and Mitochondrial disorders.	
UNIT II	**Molecular Basis of Human Diseases**	**8**
	Pathogenic mutations and Dynamic Mutations - Fragile- X syndrome, Myotonic dystrophy. Prevention and treatment of human diseases Avoiding exposure to pathogen Antibiotics and chemotherapeutic agents - drug resistance and antibiotic policy Using body's immune responses Alternative systems - Chinese, European and Indian (Siddha, Ayurveda, Naturopathy, etc.) Gene therapy; Chemotherapy and radiotherapy of tumors; Stem cell therapy.	
UNIT III	**Pathogenesis of Different Diseases**	**8**
	Pathogen, pathogenesis, clinical condition, laboratory diagnosis, epidemiology, chemotherapy and prevention of the following diseases. Viral - influenza, measles, hepatitis, Bacterial - pneumonia, tuberculosis, Typhoid, Fungal-histoplasmosis, Protozoan - Amoebic dysentery. AIDS. Nosocomial infections, Factors that influence hospital infection, hospital pathogens, route of transmission, investigation, prevention and control.	
UNIT IV	**Techniques in Laboratory Diagnosis**	**8**
	Haematology, biochemistry, microbiology, serology, radiology and other special methods. Prenatal diagnosis–Amniocentesis, Chorionic Villi Sampling (CVS), Non-invasive techniques-Ultrasonography, X-ray, Diagnosis using protein and enzyme markers, monoclonal antibodies. Microarray technology- genomic and cDNA arrays, application to diseases. Biosignalanalyzer, CT scan and Magnetic Resonance Imaging assisting the heart and kidney.	

Books:

1. Mackie and McCartney; Practical Medical Microbiology; Elsevier; Edition: 14th; Year: 2012.
2. Pratibha Nallari and V. Venugopal Rao; Medical Biotechnology; Oxford University Press; Edition: 2nd; 2012.
   a. Name of the authors: Jochen Decker (Editor), Udo Reischl (Editor)
   b. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicin; Humana Press; 2003.

M.TECH. DISSERTATION
BE-699

Pre-requisite	Co-requisite	L	T	P	C
None	None	0	0	8	4

Objective: To acquaint the student with the various techniques used in contemporary research in biotechnology that will be useful in successful completion of their project work in the fourth semester.

1. Biological Databases (e.g.; sequence databases, structure databases and specialized databases) and their retrieval tools and methods.
2. Sequence similarity searching (e.g.; BLAST and FASTA).
3. Protein sequence analysis using ExPASy Bioinformatics resource portal and multiple sequence alignment using Clustal W tool.
4. 3-D structure prediction of protein through homology modeling and their visualization by PyMol/DS Visualizer/RasMol.
5. Media preparation and sterilization for plant and animal tissue culture.
6. Induction of callus and suspension culture.
7. Multiple shooting and organogenesis from buds.
8. Plant regeneration by micropropagation.
9. Preparation of media for the given animal cell culture.
10. Maintenance of established cell lines.
11. Cell counting & viability by vital staining.
12. Staining of animal cells.

Books:

1. Bioinformatics: A Practical Approach by K Mani and N Vijayaraj, Aparna Publications, Coimbatore.
2. Bioinformatics: Sequence, Structure and Databanks- A Practical Approach by Des Heggins and Willie Taylor, Oxford University Press.
3. Debra Davis “Animal Biotechnology: Science-Based Concerns”
4. Nigel Jenkins “Animal Cell Biotechnology: Methods and Protocols
5. Chawla HS, “Plant Biotechnology: A Practical Approach”.
6. Slater A, Scott NW, Fowler MR “Plant Biotechnology: The Genetic Manipulation of Plants”.

Integral University
M. Tech. Biotechnology
(with effect from Session 2021-2022)

2nd Year **4th Semester**

S. No	Course Category	Subject code	Name of the Subject	Periods and Credits				Evaluation Scheme				Subject Total
				L	T	P	C	Sessional (CA)			ESE	
								CT	TA	Total		
1.	DC	BE-699	M.Tech. Dissertation	0	0	0	4	40	20	60	40	100
2.	DC	BE-699	M.Tech. Dissertation	0	0	0	4	40	20	60	40	100
3.	DC	BE-699	M.Tech. Dissertation	0	0	0	4	40	20	60	40	100
4.	DC	BE-699	M.Tech. Dissertation	0	0	0	4	40	20	60	40	100
Total				**0**	**0**	**0**	**16**	**160**	**80**	**240**	**160**	**400**

L: Lecture **T**: Tutorial **P**: Practical **C**: Credit **CA**: Continuous Assessment

CT: Class Test **TA**: Teacher's Assessment **ESE**: End Semester Examination

DC: Departmental Core