UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHEME OF EXAMINATIONS FOR
MASTER OF TECHNOLOGY IN
BIOTECHNOLOGY
(W. E. F. SESSION: 2018-19)

SEMESTER-I

S. No.	Course Code	SUBJECT	L	T	P	Total	Minor Test	Major Test	Practical	Cr.	Duration of Exam (Hrs.)
1	MTBT-101	Genomics and Proteomics	3	-	-	3	40	60		3	3
2	MTBT-103	Advances in Bioprocess Engineering	3	-	-	3	40	60		3	3
3	*	Program Elective –I	3	-	-	3	40	60		3	3
4	**	Program Elective-II	3	-	-	3	40	60		3	3
5	MTBT-117	Bio-analytical Techniques Lab	-	-	4	4	40		60	2	3
6	MTBT-119	Fermentation Technology Lab	-	-	4	4	40		60	2	3
7	MTRM-111	Research Methodology and IPR	2	-	-	2	40	60		2	3
8	***	Audit Course-I	2			2	100			0	3
		Total	16		8	24	280	300	120	18	
								700			

*Program Elective-I		**Program Elective -II	
Course No.	Subject	Course No.	Subject
MTBT-105	Phytomedicine	MTBT-111	Biomaterial Technology
MTBT-107	Microbial Diversity	MTBT-113	Biosensor Technology
MTBT-109	Fungal Biotechnology	MTBT-115	Protein Engineering

***Audit Course-I	
Course No.	Subject
MTAD-101	English for Research Paper Writing
MTAD-103	Disaster Management
MTAD-105	Sanskrit for Technical Knowledge
MTAD-107	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER- II

S. No.	Course Code	Subject	L	T	P	Total	Minor* Test	Major Test	Practical	Cr.	Duration of Exam (Hrs.)
1	MTBT-102	Drug Discovery and Development	3	-	-	3	40	60		3	3
2	MTBT-104	Medical Biotechnology	3	-	-	3	40	60		3	3
3	*	Program Elective-III	3	-	-	3	40	60		3	3
4	**	Program Elective-IV	3	-	-	3	40	60		3	3
5	MTBT-118	Molecular Techniques Lab		-	4	4	40		60	2	3
6	MTBT-120	Advanced Molecular Techniques. Lab	-	-	4	4	40		60	2	3
7	# MTBT-122	Mini Project	-	-	4	2	40	60		2	3
8	***	Audit Course-II	2			2	100			0	3
	Total		**14**		**12**	**24**	**280**	**300**	**120**	**18**	**3**
							700				

*Program Elective -III		**Program Elective -IV	
Course No.	**Subject**	**Course No.**	**Subject**
MTBT-106	Metabolic Engineering	MTBT-112	Biomedical Equipments
MTBT-108	Biofuel Technology	MTBT-114	Gene Therapy and Gene Editing
MTBT-110	Advanced Industrial Biotechnology	MTBT-116	Metagenomics

*** Audit Course - II	
MTAD-102	Constitution of India
MTAD-104	Pedagogy Studies
MTAD-106	Stress Management by Yoga
MTAD-108	Personality Development through Life Enlightenment Skills.

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. Students be encouraged to go to Industrial Training/Internship for at least 6-8 weeks during the summer break with a specific objective for Dissertation Part–I (MTBT-203). The industrial Training/Internship would be evaluated as the part of the Dissertation Part–I (with the marks distribution as 40 marks for Industrial Training/Internship and 60 marks for Dissertation work).

#4**. Mini project:** During this course the student will be able to understand the contemporary/emerging technologies for various processes and systems. During the semester, the students are required to search/gather the material/information on a specific topic, comprehend it and present/discuss the same in the class. He/she will be acquainted to share knowledge effectively in oral (seminar) and written form (formulate documents) in the form of report. The student will be evaluated on the basis of viva/ seminar (40 marks) and report (60 marks).

SEMESTER -III

S. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTBT-201	Advanced Food Biotechnology	3	-	-	3	40	60	3	3
2	*	Open Elective	3	-	-	3	40	60	3	3
3	MTBT-203	Dissertation Part-I	-	-	20	-	100	-	10	-
		Total	**6**		**20**	**6**	**180**	**120**	**16**	-
	Total						**300**			

*Open Elective		
1.	MTOE-201	Business Analytics
2.	MTOE-203	Industrial Safety
3.	MTOE-205	Operations Research
4.	MTOE-207	Cost Management of Engineering Projects
5.	MTOE-209	Composite Materials
6.	MTOE-211	Waste to Energy

SEMESTER-IV

Sr. No.	Course Code		L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTBT-202	Dissertation Part- II	-	-	32	-	100	200	16	3
	Total				**32**		**100**	**200**	**16**	-
							300		**16**	

Total credits of all four semesters – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

Note 2: Each admitted student is required to submit the report of his/her Dissertation Part-I as per the schedule mentioned in Academic calendar for the corresponding academic session otherwise the Dissertation Part-II cannot be continued at any level.

Note 3: Each admitted student is required to submit his/her final Dissertation Part-II as per the schedule mentioned in Academic calendar for the corresponding academic session only after the publication of two papers in a journal/International/National conference of repute like IEEE, Springer, Elsevier, ACM or equivalent etc.

Note 4: The course of program/open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

MTBT-101	GENOMICS AND PROTEOMICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enlighten the knowledge of the Students on different areas of genomics and proteomics						

Course Outcomes (CO)	
CO1	Students will be able to know structural organization and different tools used for analysis.
CO2	Students will be able to gain knowledge about Genome sequencing
CO3	Students will be able to know about techniques used in protein analysis.
CO4	Students will be able to study analysis of Genomic and Proteomics

Unit I

Introduction: Structural organization of genome in Prokaryotes and Eukaryotes; Organelle DNA-mitochondrial, chloroplast; DNA sequencing principles and translation to large scale projects; Next-Gen sequence technology and applications. Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis- RFLP, DNA fingerprinting, RAPD, PCR,. DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics.

Unit II

Genome sequencing projects: Human, microbes, plants and animals; Accessing and retrieving genome project information from web; Identification and classification using molecular markers-16SrRNAtyping/sequencing, EST and SNP's contigs; allele/gene mining; synteny and comparative genomics. Dart

Unit III

Proteomics: Protein analysis (includes measurement of concentration, amino acid composition, N-terminal sequencing);2 Delectrophoresis of proteins; Microscale solution isoelectric focusing; Peptide fingerprinting; Protein-protein interactions, Yeast two hybrid system. SAGE.

Unit IV

Genomic and Proteomic analysis: Metabolomics for elucidating metabolic pathways, Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein *insitu* arrays; Structural proteomics. Real Time PCR, Platform technologies for screening.

References:

1. Voet D, Voet JG & PrattCW, Fundamentals of Biochemistry, 2ndEdition.Wiley2006
2. Brown TA, Genomes, 3rd Edition. Garland Science2006
3. Campbell AM &Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition..
4. PrimroseS & TwymanR, Principles of Gene Manipulation and Genomics, 7thEdition, Blackwell,2006.
5. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rdEdition, ASM Press, 1998.
6. Specific journals and published references.

MTBT-103	Advances in Bioprocess Engineering						
Lecture 3	**Tutorial** 0	**Practical** -	**Credit** 3	**Major** 60	**Minor** 40	**Total** 100	**Time** 3
PURPOSE	To sensitize the students about Advances in Bioprocess Engineering						
COUSE OUTCOMES							
CO 1	To sensitize students about basic concept of Bioprocess and its historical development.						
CO2	The students will be able to understand about ideal reactors for kinetic data measurement and industrial bioreactor.						
CO3	The students will be able to learn about techniques used for recovery of fermentation product.						
CO4	The students will be able to understand the basic concepts in process optimization.						

Unit I

Introduction to Bioprocess Engineering: **Historical development of bioprocessing technology**, processing and production of recombinant products. Batch and chemostat cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles. Transport phenomenon in bioprocess systems.

Unit II

Kinetics of substrate utilization and product formation. Ideal reactors for kinetics measurements. **High performing reactors and industrial reactors**. Kinetics of balanced growth.. Structured kinetic models. Product formation kinetics. Segregated kinetic models of growth and product formation.

Unit III

Recovery and purification of fermentation products: Liquid-liquid extraction, cell disruption and isolation of non- secreted products, Lyophilization and Spray drying. Membrane based affinity separations; two-phase affinity partitioning; use of reverse micelles in protein separation; chiral separations; molecular imprinting.

Unit IV

Fermentation Technology: Case studies on production of lactic acid, glutamic acid, penicillin, microbial lipase and protease, recombinant insulin. Case studies should deal with strain improvement, medium designs, and process optimization.

References-

1. Biochemical Engineering fundamentals" by J E Bailey and D F Ollis, 2nd ed, McGraw-Hill .
2. "Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press.
3. "Principles of Cell Energetics" : BIOTOL series, Butterworth - Heinemann.
4. "Bioprocess Technology - Kinetics & Reactors" by A Moser, Springer-Verlag.
5. "Biotechnology" Vol.4 Meanning Modeling and Control Ed. K.Schugerl, VCH (1991).
6 "Biotechnology" Vol.3 Bioprocessing Ed.G. Stephanopoulos, VCH (1991).
7. "Biochemical Engineering and Biotechnology Handbook" by B.Atkinson&F.Mavituna, 2nd Ed. Stockton Press (1991).
7. Specific journals and published references.

MTBT-105	Phytomedicine						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	Students will have knowledge about various strategies for the development of phytomedicine and mode of action of bioactive compound for the treatment of diseases						

Course Outcomes (CO)	
CO1	Students will learn about basics of Phytomedicine and quality issue associated with current medicine
CO2	Students will learn about selection of plant for medicine development and current status of phytomedicine in India
CO3	Students will have knowledge about various steps and strategies involved in phytomedicine development
CO4	Students will have knowledge about application of phytomedicine in treatment of severe diseases, mode of action of various biomolecules

Unit I

What is phytomedicine? History of phytomedicine. Taxonomy, Morphology and Ecology of Medicinal plants: a botanical perspective. Economic value of phytomedicne. Bioactive compounds in phytomedicine. Role of plant-derived compounds in drug development. Different classes of plant Secondary metabolites as a source of phytomedicine. Medicinal plant: molecular biology and Biotechnology approaches. Breeding and cultivation of medicinal plants, quality issues of current herbal medicines

Unit II

Selecting medicinal plants for development of phytomedicine and use in primary health care**;** bioactive phytocompounds and products traditionally used in India and Asia. Recent developments in drug discovery from plants. Examples of plant-derived compounds currently involved in clinical trials Phytomedicine: India's contribution.

Unit III

Development of phytomedicine; extraction, sample preparation, application of all available modern, high-tech methods to standardize phytomedicines before going for systematic pharmacological investigations and clinical studies. Quality control, screening, toxicity, and regulation of herbal drugs.

Unit IV

Application of phytomedicine in modern drug development. Molecular modes of action of some successful molecules used in phytomedicine, phyto-complexes versus single-entity drug, bioavailability issue. Drug delivery system for herbal-based therapeutics Methods for testing the anti-microbial, anti-cancer, anti-HIV, anti-diabetic, and neuroprotective activities of plant extracts. Reverse pharmacology approach for Phytomedicine development.

References:

1. Iqbal Ahmad, Farrukh Aqil, Mohammad Owais: Modern Phytomedicine: Turning Medicinal Plants into Drugs. (Wiley) 2006.
2. Leland J. Cseke; Ara Kirakosyan, Peter B. Kaufman, Sara Warber;James A. Duke; Harry L. Brielmann: Natural Products from Plants, 2ndedition; (CRC Press)2006.
3. Naturally Occurring Bioactive Compounds, 1st Edition (Advances in Phytomedicine vol 3). Edited by Rai & Carpinella. Publisher: ElsevierScience; 1 edition (December 2, 2006).
4. Stephen Neidle, Antony D Buss, Mark S Butler: Natural Product Chemistry for Drug Discovery; 1st Edition; (Royal Society ofChemistry).2009
5 Chemistry and Pharmacology of Naturally Occurring BioactiveCompounds. Editor, Goutam Brahmachari . Publisher: CRC Press; 1edition (February 20, 2013) 2013.

MTBT-107	MICROBIAL DIVERSITY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	**To familiarize the students with the diversity of microorganisms on the Earth and concept of metagenomics**						
Course Outcomes							
CO1	**Learner will know about microbial evolution and systematics and overview of bacterial diversity**						
CO2	**Students will be able to learn about diversity of Gram-positive bacteria**						
CO3	**This unit will enable the students to understand the archaeal diversity**						
CO4	**Students will be able to learn eukaryotic and viral diversity and will also learn the concept of metagenomics**						

UNIT I

Microbial Evolution and Systematics. Early Earth and the origin and diversification of life. Microbial evolution andsystematic. Bergey's Manual of Systematic Bacteriology. Archaea and Bacterial Domains.

Overview. Bacterial Diversity: The phylogeny of bacteria. Phototrophic, Chemolithotrophic and MethanotrophicProteobacteria. Aerobic and Facultatively Aerobic Chemoorganotrophic Proteobacteria. Morphologically unusual Proteobacteria. Delta and Epsilonproteobacteria.

UNIT II

Overview of Gram positive and other bacteria. Actinobacteria.Cyanobacteria and Prochlorophytes. Chlamydia. Planctomyces/ Pirellula. Verrucomicrobia. Flavobacteria. Cytophaga Group. Green Sulphur and Non-Sulphur Bacteria. Spirochetes. Dienococci. Hyperthermophilic Bacteria- Nitrospira and Deferribacter.

UNIT III

Archaeal Diversity. Phylogeny and general metabolism. Euryarchaeota. Crenarchaeota. Evolution and life at hightemperature.

UNIT-IV

Eukaryotic and Viral Diversity. Phylogeny of Eukarya. Protists, Fungi, Unicellular Red and Green Algae. ViralDiversity. Viruses of Bacteria and Archaea. RNA and DNA viruses of Eukaryotes. Retroviruses and Hepadnaviruses.

Culture independent studies of microorganisms – metagenomics: principles and applications – steps in construction of a metagenomes – examples of metagenomic studies – metagenomics as a tool to reveal the vast microbial diversity.

References:

1. Madigan. M. T. 2008. Brock: Biology of Microorganisms. 12th Edition. Benjamin Cummings. California, USA.
2. Prescott, L. M., Harley, J. P. and Klein, D. A. 2007. Microbiology. 7th Edition. McGraw Hill, USA.
3. Atlas, R. M. and Bartha, R. 1997. Microbial Ecology: Fundamentals and Applications. Benjamin Cummings, California, USA.
4. Specific Journals and Published References

MTBT-109	FUNGAL BIOTECHNOLOGY						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3.0	60	40	100	3 Hrs.
Purpose	To familiarize the students with the concepts of Fungal Biotechnology						
Course Outcomes							
CO1	Learner will know about basics of fungal biotechnology and fungal diversity						
CO2	Students will be able to understand the diversity of protozoal fungi						
CO3	This unit will enable the students to understand applications of fungi in various sectors						
CO4	Students will be able to learn about keratonophilic and endophytic fungi						

UNIT-I

Fungal biotechnology : Fungi and Fungus-like Organisms—Introduction and Classification. Historical Development of Mycology.

Fungal Diversity—Kingdom Fungi. Phylum *Chytridiomycota* Phylum *Zygomycota* Phylum *Zygomycota* Class *Trichomycetes.* Phylum *Ascomycota* Introduction. Phylum *Basidiomycota* Introduction. Anamorphic Fungi (Deuteromycetes). Fungi as symbionts-Lichens.

UNIT-II

Fungal Diversity- Kingdom *Straminipila* (Heterokont Zoosporic Organisms). Phylum *Oomycota, Hyphochytriomycota, Labyrinthulomycota* (Net Slime Molds). *Plasmodiophoromycota* (Endoparasitic Slime Molds), *Dictyosteliomycota.* (Dictyostelid Cellular Slime Molds, *Acrasiomycota* (Acrasid Cellular Slime Molds). *Myxomycota* (Plasmodial or True Slime Molds).

UNIT-III

Fungi as Saprotrophs and their Role in Nutrient Cycling and Bioremediation**.** Fungal Biotechnology–Introduction and Applications in agriculture, food, medicine and industry.

Opportunities of fungal applications in pulp and paper manufacturing. Role of fungi in bioremediation. Fungi in bioremediation of toxic metals from waste water. Recycling of agro-wastes for protein production through mushroom cultivation. *Curvularia lunata* : A versatile organism for biotransformation of organic compounds

UNIT-IV

Fungi in enzyme industries. Starch hydrolysing enzymes of thermophilic moulds. Production and application of fungal Xylanases.

Keratinophilic fungi : Diversity and sensitivity to some medicinal plants Current trends in aeromycological research

Endophytic Fungal Biology- Present Status and Future prospective in Biotechnology.

References:

1. Rai, M. K. and Deshmukh S. K. Fungi: Diversity and Biotechnology. Scientific Publishers.
2. Aneja, K. R. and Mehrotra, R.S. Fungal Diversity and Biotechnology

MTBT-111	BIOMATERIAL TECHNOLOGY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to understand the role of gene therapy in treatment of severe diseases.						
Course Outcomes (CO)							
CO1	Students will learn about basics of Biomaterials, need of biomaterials, types of biomaterials, techniques for characterization of biomaterialas and their potential applications						
CO2	Students will learn about biomaterial degradation, cell interaction with biomaterial and process to improve biocompatibility						
CO3	Students will have knowledge about Biomaterial implantation, imuune and infalammatory response to biomaterial, tests for hemocompatibility						
CO4	Students will have learn about the risk of Infection, tumorigenesis and calcification Associated with biomaterials						

UNIT I

Introduction to biomaterials: Definition of biomaterials, History and current status of the field, Types of biomaterials, Important properties of biomaterials. Characterization techniques (X-ray diffraction, UV-VIS, IR and NMR Spectroscopy, Mass spectrometry, HPLC- Size exclusion chromatography).

UNIT II

Biomaterial degradation in Biological environment; Biodegadable materials: Ceramics and polymers; Processing to improve biocompatibility: sterilization and fixation. Cell interactions with biomaterials: Introduction: Cell-surface interactions and cellular functions. Techniques: Assays to determine effects of cell-material interactions: Cytotoxicity assays, DNA and RNA assays and Protein production assays- Immunostaining.

UNIT III

Biomaterial implantation and Immune response to biomaterials. Undesired immune responses to biomaterials: innate vs. acquired responses to biomaterials and hypersensitivity reactions. Clinical signs of acute inflammation against biomaterials. In vitro assays for inflammatory response. Biomaterials and thrombosis: Tests for hemocompatability.

UNIT IV

Infection, tumorigenesis and calcification of biomaterials. Overview of potential problems with biomaterial implantation, steps to infection, techniques for infection experiments. Biomaterial related tumorigenesis, In vitro and in vivo models for tumorigenesis experiments, pathologic calcification of biomaterials and techniques for pathologic calcification experiments.

Text/References:

1. Temenoff, I.S. and Mikos, A.G. Biomaterials: The Intersection of Biology and Material Science. Pearson Education, India. 2009 Indian ed.
2. Ratledge C and Kristiansen B, Basic Biotechnology, Cambridge University Press, 2nd Edition, 2001.
3. J B Park, Biomaterials - Science and Engineering, Plenum Press, 1984.
4. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
5. C.P.Sharma & M.Szycher, Blood compatible materials and devices, Technomic Publishing Co. Ltd., 1991.
6. Piskin and A S Hoffmann, Polymeric Biomaterials (Eds), Martinus Nijhoff Publishers. (Dordrecht. 1986)
7. Eugene D. Goldbera, Biomedical Ploymers. 8. Specific journals and published references.

MTBT-113	BIOSENSOR						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective	To enable students to formulate project, set up a business in field of biotechnology and will be able to understand ethical issue associated it.						

Course Outcomes (CO)	
CO1	To familiarize with basic concepts of general properties of transducers and other analytical instruments
CO2	Students will come to know about bioassay design and implementation and basic concepts of automation and robotics
CO3	This unit will enable the students to learn about data retrieval, handling and integration of databases and basics of human cardiac and vascular system
CO4	Students will be able to know the basic concepts and applications of various types of biosensors

UNIT-I

Introduction: Electrical quantities and units, functional elements of an instrumentation system, static and dynamic characteristics, principle of analog and digital meters, CRO, energy meters, time and frequency meters, multimeters.

Transducers: Classification, resistive strain gauges, RTD, LVDT, Piezoelectric transducers, Electromagnetic transducers, Optical transducers, Transducers for biomedical science and their applications.

Analytical Instruments: pH meters, radiometric devices, fluorescence spectrophotometers, chromatology (chromatographic techniques- GC and HPLC), electrophoresis, lab on a chip – related instrumentation, Validation, commissioning and maintenance of the above equipments.

UNIT II

Assay Technologies and Detection methods: Introduction, bioassay design and implementation, radiometric assay, scintillation proximity assay, fluorescence methodology to cover all types of fluorescence measurements and instrumentation, Reporter gene assay applications. Bio-analytical applications.

Automation and Robotics: Introduction: management and services issues of a centralized robotics HTS (high throughput screening) core, flexible use of people and machines, Bar-code technology and a centralized database, factors for the successful integration of assays, equipment, robotics and software. Perspectives on scheduling.

UNIT III

Data retrival, handling and integration: Database systems, systems integration, data management and tracking

Cardiac and Vascular system: Overview of cardiovascular system, types of blood pressure sensors, Lumped parameters modeling of a catheter- sensor/system, heart sounds, cardiac catheterization, indirect measurement of blood pressure, measuring blood flow rate, measuring blood volume, pacemakers, defibrillators, cardiac-assist devices and heart valves- related instrumentation of equipments and involved sensors.

Respiratory system: Modeling the respiratory system, measuring gas flow rate and lung volume, tests of respiratory mechanics, measuring gas concentration, tests of gas transport, ventilators, anesthesia machines- related instrumentation of equipments and involved sensors.

UNIT IV

Biosensors: Introduction to biosensors: concepts and applications, biosensors for personal diabetes management, micro fabricated sensors and the commercial development of biosensors, electrochemical sensors, chemical fibrosensors, Ion-selective FETs, noninvasive blood-gas monitoring, blood-glucose sensors. Noninvasive biosensors in clinical analysis, Applications of biosensors based instruments to the bioprocess industry. Applications of biosensors to the environmental samples, Introduction to biochips and their application to genomics, BIA core- an optical biosensors

Text Books:

1. Introduction to Bio-analytical Sensors by Alice J Cunningham New York, John Wiley, 1998.
2. Applied Biosensors by DolandL.Wise, 1989
3. Advances in Laboratory Automation – Robotics, Eds. J.R.Strimataitis and J.N. Little, Zymark Corporation, Hopkinton, MA 1991.

Reference Books-

1. Instrument methods of analysis by H W Willard, L LMerrit, J A Dean and F A Sttle. VI edition, East- West publishers. 1992.
2. Biosensors and their applications by C Yang Victor &TNgo That, Plenum Press NY, 2000.
3. Biosensors- An Introduction by R.Eggins Brain.
4. Automation technologies for genome characterization, edited by Tony J Beugelsdijk, John Wiley & Sons, Inc.2002.
5. Transducers and instrumentation by D V S Murthy, Prentice Hall, 1995.
6. Commercial sensors by Graham Ramasay, John Wiley & Son, INC, 1998.
7. Biosensors by Jon Cooper and Tony Cass, Oxford university Press, 2004.

MTBT-115	PROTEIN ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The course aims at imparting knowledge on protein structure characterization, structure prediction and strategies to design the novel protein of industrial importance						

Course Outcomes (CO)	
CO1	Students will learn about basics of protein engineering and various characterization techniques
CO2	Students will be able to predict and design novel protein structure
CO3	Students will learn about various protein engineering strategies
CO4	Students will have idea about applications of novel engineered protein

UNIT I

Protein Structure Characterization: Introduction to protein engineering, structure and properties of amino acids, primary, secondary, tertiary and quaternary structure of proteins, analysis of protein structure by CD spectroscopy, NMR, X ray diffraction crystallography,

UNIT II

Protein Structure Prediction: Protein prediction of protein structure using bioinformatics approach, protein sequence and structure relationship, predicting the conformation of proteins from sequence data Protein Folding – Molecular Energy and Forces,
Strategies for design of novel proteins-strategies for the design of structure and function, computer methods in protein modeling, mutations and their effects on protein folding,

UNIT III

Protein Engineering Strategies and Techniques: protein engineering - methodology, application and interpretation, Directed evolution and Rational design (Computer modeling).
Protein Evolution - Cell surface and phage display technologies, Cell-free protein engineering technologies

UNIT IV

Engineering the Proteins and Their Application: Effect of amino acids on structure of proteins, prediction of structure function relations of enzymes and other proteins, gene shuffling methods such as RACHITT, ITCHY, SCRATCHY

Examples of engineered proteins:, Engineering fluorescent proteins/molecular probes, Engineering multi-functional proteins, Antibody engineering

Text Books: 1. Cleland JL and Craik CS, Protein Engineering: Principles and Practice, WileyLiss. (1996).
2. Lutz S and Bornscheuer U T, Protein Engineering Handbook, Wiley-VCH (2009)
3. Paul R. Carey , Protein engineering and design, academic press, 1996, 361 pages.

Reference Books: 1. Primrose SB and Twyman RM, Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006).

MTBT-117	BIOANALYTICAL TECHNIQUES LAB						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
-	-	4	2	60	40	100	3 Hrs.
Program Objective (PO)	To familiarize the students with various biophysical and bioanalytical techniques and their applications in Biotechnology						
Course Outcomes							
CO1	Learner will know about concept of pH, preparation of buffers and measurement of pH.						
CO2	Students will be able to learn about concept of centrifugation and various kinds of chromatographic techniques						
CO3	Students will understand the concept of electrophoresis and Immunochemical techniques						
CO4	Students will be able to learn about spectroscopy and biosensors						

LIST OF EXPERIMENTS

1. Concept of pH, preparation of buffers, measurement of pH.

2. Centrifugation: Principle and technique.

3. Chromatographic techniques: TLC, Gel Filtration Chromatography, Ion exchange Chromatography, Affinity Chromatography.

4. Electrophoretic techniques - Agarose and PAGE (nucleic acids and proteins).

5. Immunochemical techniques – general principles and applications of immunodiffusion, immunoelectrophoresis, radioimmunoassay, enzyme linked immunosorbent assay, fluorescence immunoassay.

6. Spectroscopy Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lamberts law, Principles and applications of colorimetry.

7. Biosensors and their applications.

Text/ References-

1. Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols inMolecular Biology*. John Wiley.
2. Sambrook J, Russel DW & Maniatis T. 2001. *Molecular Cloning: A Laboratory Manual*. Cold Spring Harbour Laboratory Press.

MTBT-119	FERMENTATION TECHNOLOGY LAB						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
-	-	4	2	60	40	100	3 Hrs.
Program Objective (PO)	**To familiarize the students with various experiments on microbial fermentation processes**						
Course Outcomes							
CO1	**Learner will know about concept of bioreactor and its operation.**						
CO2	**Students will be able to learn about techniques of isolation and screening of bacteria, actinomycetes and fungi for secondary metabolite production.**						
CO3	**To understand the effect of pH, temperature, Carbon and Nitrogen Sources on secondary metabolite production.**						
CO4	**Students will be able to learn the use of statistical tools in fermentation technology**						

LIST OF EXPERIMENTS

1. Study of bioreactor and its operations.
2. Isolation and screening of bacteria, actinomycetes and fungi for secondary metabolite production such as antimicrobial metabolites and enzymes.
3. Studying the effect of pH, temperature, C and N Sources on secondary metabolite production by microorganisms.
4. Partial Purification of secondary metabolite production by microorganisms.
5. Studying the statistical analysis of fermentation experiments by using various tools.
6. Isolation of genomic DNA of bacteria, fungi and actinomycetes.

Text/Reference Books-

1. Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
2. Demain L. Manual of Industrial Microbiology and Biotechnology. ASM Press

MTRM-111	Research Methodology and IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to Research Methodology and IPR for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.*						
Course Outcomes (CO)							
CO1	Understand research problem formulation.						
CO2	Analyze research related information						
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.						

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. C.R. Kothari, "Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

MTBT-102	DRUG DISCOVERY AND DEVELOPMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	-	-	3	60	40	100	3 Hrs.
Program Objective (PO)	To familiarize the students with the concept of drug discovery and development						
Course Outcomes							
CO1	To understand the mechanism of action of drugs and lead optimization strategies						
CO2	To understand the concept of rational drug design						
CO3	To learn the concept of clinical research						
CO4	Students will be able to learn about assisted reproductive technologies.						

UNIT I

Introduction to Drug Discovery and Development. Lead Optimization and validation strategies.
Mechanism of Drug Actions: Inter and intramolecular interactions: Weak interactions in drug molecules; Chirality and drug action; Covalent, ion, ion-dipole, hydrogen bonding, C-H hydrogen bonding, dihydrogen bonding, van der waals interactions and the associated energies. Cation-and OH- interactions. Drug-receptor interactions: Occupancy theory, rate theory, induced fit theory, macromolecular perturbation theory, activation-aggregation theory. Topological and stereochemical consideration.

UNIT II

Rational Drug Design: Structure activity relationships in drug design, Molecular modeling, Molecular docking and dynamics, Electronic structure methods and quantum chemical methods, De novo drug design techniques and Informatics methods in drug design. Optmization of ADME characteristics and physicochemical properties. Xenobiotic Drug Metabolism.

UNIT III

Clinical Research- definition and basic concept. Pharmacological Screening and Assays : General principles of screening, correlations between various animal models and human situations. Pharmacological screening models for therapeutic areas. Correlation between in-vitro and in-vivo screens; Special emphasis on cell-based assays, high through put screening, specific use of reference drugs and interpretation of results. Clinical trials and their regulations.

UNIT IV

Concept of Assisted Reproductive Technologies (Artificial Insemination, *In Vitro*Fertilziation, Gamete Intrafallopian Transfer and Zygote Intrafallopian Transfer), Gene Therapy- Concept and Applications. Concept of Eugenics.

Texts/References-

1. Hill, R. (2012). Drug Discovery and Development- Technology in Transition. 2nd Edition. Churchill Livingstone, London, UK.
2. Hinchliffe, A.(2003). Molecular Modelling for Beginners. John Wiley & Sons
3. Leach, AR (1996). Molecular Modelling: Principles and Applications. Longman.

MTBT-104	Medical Biotechnology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enlighten the knowledge of the Students on different areas of Medical Biotechnology. To train the Students in a hospital based setup and familiarize them with the clinical diagnostics of diseases.						

Course Outcomes (CO)	
CO1	Students will be able to explain insights about genetic diseases and also about the molecular aspects related to human disease
CO2	Students will be able to gain new insights into molecular mechanisms of nucleic acid and gene therapy
CO3	Students will be able to gain knowledge about therapeutic recombinant proteins and immunotherapy
CO4	Students will be able to study processes of treatment of Biomedical waste

Unit 1

Introduction: Classification of genetic diseases: Chromosomal disorders – Chromosomal instability syndromes. Gene controlled diseases – Autosomal and X-linked disorders, Mitochondrial disorders. Molecular basis of human diseases: - Pathogenic mutations Gain of function mutations: Oncogenes, Huntingtons Disease, Pittsburg variant of alpha 1 antitrypsin. Loss of function - Tumour Suppressor. Genomic. Dynamic Mutations - Fragile- X syndrome, Myotonic dystrophy. Mitochondrial diseases

Unit 2

Gene therapy: Ex-vivo, In vivo, In situ gene therapy, Strategies of gene therapy: gene augmentation Vectors used in gene therapy Biological vectors – retrovirus, adenoviruses, Herpes Synthetic vectors– liposomes, receptor mediated gene transfer. Gene therapy trials – Familial Hypercholesterolemia, ADA, AIDS, Cystic Fibrosis, Solid tumors. Artificial organs and biocompatibility-Overview ,design consideration and evaluation process.

Unit 3

Recombinant & Immunotherapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors, Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Immunosupressors in organ transplants; Role of cytokine therapy in cancers; Clinical management and Metabolic syndrome: – PKU, Familial Hypercholesterolemia, Rickets, ADA, Congenital hypothyroidism.

Unit 4

Hazards of biomedical waste-Need for disposal specifically communicable diseases, Disease Epidemiology and mode of transmission of disease. Environment pollution by waste-CAUSES, Consequences, Mitigation and remedies. Treatment-Mechanical and chemical disinfection, Conventional treatments-Incineration, Microwave technology, Autoclave tech, Hydroclave system, Electro thermal reactivation- Pyrolysis/gasification WHO guidelines on management and disposal of biomedical waste from hospitals.

Text books 1. Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T. George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2000)
2. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl Amazon
Reference Book 1 Human Molecular Genetics by T. Strachan, Andrew

MTBT-106	METABOLIC ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to describe the improvement of primary and secondary metabolites production with various application of metabolic engineering						

Course Outcomes (CO)	
CO1	Students will learn about the Basic concepts of Metabolic engineering and synthesis of primary metabolites
CO2	Students will learn about synthesis of secondary metabolites and bioconversion
CO3	Students will learn about Regulation of Enzyme Production and Metabolic flux
CO4	Students will learn about Metabolic engineering with Bioinformatics and Applications of Metabolic Engineering

UNIT I

Introduction: Identification of metabolic regulation. Basic concepts of Metabolic Engineering – Overview of cellular metabolism – Different models for cellular reactions, induction – Jacob Monod model and its regulation, Feedback regulation. Synthesis of Primary metabolites. Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feedback regulation, Limiting accumulation of end products.

UNIT II

Biosynthesis of Secondary Metabolites. Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, Catabolite regulation by passing control of secondary metabolism, producers and applications of secondary metabolites.
Bioconversions: Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Cometabolism, Mixed or sequential bioconversions, Conversion of insoluble substances.

UNIT III

Regulation of Enzyme Production. Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, the modification of existing - or the introduction of entirely new metabolic pathways
Metabolic flux. Integration of anabolism and catabolism, metabolic flux analysis and its applications, Experimental determination method of flux distribution,

UNIT IV

Metabolic engineering with Bioinformatics. Metabolic pathway modeling, Analysis of metabolic control and the structure metabolic networks,
Applications of Metabolic Engineering. Application in pharmaceuticals, chemical bioprocess, food technology, agriculture, bioremediation and biomass conversion.

Text/References-

1. Wang.D.I.C Cooney C.L., Demain A.L., Dunnil.P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, John Wiley and sons 1980.
2.Stanbury P.F.,andWhitakerA.,Principles of Ferment Technology, Pergamon Press1984.
3. Specific journals and published references.

MTBT-108	Biofuel Technology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to describe the role of biotechnology in biofuel technology						

Course Outcomes (CO)	
CO1	Student will learn about Historical Development of Bioethanol and Chemistry of Lignocelluloses
CO2	Student will learn about the degradation of lignocelluloses by enzymes
CO3	Student will learn about Biochemical Engineering and Bioprocess Management for biofuel and their downstream processing.
CO4	Student will learn about the improvement of biofuel production by genetic manipulations

Unit 1

Historical Development of Bioethanol as a Fuel, Starch as a Carbon Substrate for Bioethanol Production, The Promise of Lignocellulosic Biomass, Thermodynamic and Environmental Aspects of Ethanol as a Biofuel, Effects on emissions of greenhouse gases and other pollutants, Ethanol as a First-Generation Biofuel: Present Status and Future Prospects. Lignocellulosic Biomass, Biomass as an Energy Source: Chemistry of Lignocellulosic Biomass, Lignocellulose as a chemical resource, Physical and chemical pretreatment of lignocellulosic biomass, Biological pretreatments, Acid hydrolysis to saccharify pretreated lignocellulosic biomass

Unit II

Enzymology of cellulose degradation, Cellulases in lignocellulosic feedstock processing, biotechnology of cellulase production, Hemicellulases and Lignin-Degrading Commercial Choices of Lignocellulosic Feedstocks for Bioethanol Production. Biotechnology of Bioethanol Production, Traditional Ethanologenic Microbes, Yeasts, Bacteria, Metabolic Engineering of Novel Ethanologens

Comparison of industrial and laboratory yeast strains for ethanol production, Improved ethanol production by naturally pentose-utilizing yeasts, Assembling Gene Arrays in Bacteria for Ethanol Production, Genetic and metabolic engineering of bacteria for bioethanol production, Candidate bacterial strains for commercial ethanol production, Trends for Research with Yeasts and Bacteria for Bioethanol Production, “Traditional” microbial ethanologens, “Designer” cells and synthetic organisms

UNIT III

Biochemical Engineering and Bioprocess Management for Fuel Ethanol, Biomass Substrate Provision and Pretreatment, Wheat straw — new approaches to complete saccharification, Switchgrass, Corn stover, Softwoods, Sugarcane bagasse, Other large-scale agricultural and forestry, Fermentation Media, Highly concentrated media developed for alcohol fermentations, Fermentor Design and Novel Fermentor Technologies, Continuous fermentations for ethanol production, Fed-batch fermentations, Immobilized yeast and bacterial cell production designs, Contamination events and buildup in fuel ethanol plants, Simultaneous Saccharification and Fermentation and Direct Microbial Conversion, Downstream Processing and By-Products, Ethanol recovery from fermented broths, Solid by-products from ethanol fermentations

UNIT IV

Genetic Manipulation of Plants for Bioethanol Production, Engineering resistance traits for biotic and abiotic stresses, Bioengineering increased crop yield, Optimizing traits for energy crops intended for biofuel production. Vegetable oils and chemically processed biofuels, Biodiesel composition and production processes, Biodiesel economics, Energetics of biodiesel production, Issues of ecotoxicity and sustainability with expanding biodiesel production, Biodiesel from Microalgae and Microbes, Biohydrogen, The hydrogen economy and fuel cell technologies, Bioproduction of gases, Microbial Fuel Cells

References:

1. David M. Mousdale, Biofuel-Biotechnology, Chemistry, and sustainable Development, 1st Ed., CRC Press Taylor & Francis Group, 2008.
2. Ayhan Demirbas, Green Energy and Technology, Biofuels, Securing the Planet’s Future Energy Needs, 1st edition, Springer, 2009.

MTBT-110	ADVANCED INDUSTRIAL BIOTECHNOLOGY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to describe the various advance industrial application for the benefit of human life						

Course Outcomes (CO)	
CO1	Students will learn about microbial diversity and screening of microbes
CO2	Students will learn about the fermentation and its improvement
CO3	Students will learn about genetic analysis by using tools of recombinant DNA technology and various applications
CO4	Students will learn about Novel industrial applications, tracking of microbes and monitor their gene expression

UNIT I

Microbial diversity and strategies for its recovery. Bioprospecting for novel compounds. Screening of microbial isolates for bioactivity. Cultivation of hyperthermophilic and extremely thermo acidophilic microorganisms. Instrumentation and monitoring of bioreactors. Culture and analysis using gel microdrops.

UNIT II

Experimental design for improvement in fermentation processes. Software applications in fermentation processes. Methods for biocatalysis. Downstream processing. Introduction to bioprocess simulation. Quality assurance and quality control. Concepts of anaerobic fermentation and contract fermentations.

UNIT III

Introduction to genetic analysis of *Streptomyces* and *Bacillus* spp. using tools of recombinant DNA technology. Applications of rDNA technology in thermophiles. Design and assembly of polycistronic operons in *Escherichiacoli. In vivo* folding of recombinant proteins in *E. coli.* Expression of G protein coupled receptors inmicroorganisms. Selection of suitable hosts for *E. coli* optimized for expression of proteins. Mechanism of mRNA degradation in bacteria and their implication for stabilization of heterologous transcripts. Filamentous fungi in industrial biotechnology. Genetics and genomics of *Saccharomyces cerevisiae*.

UNIT IV

Methods for optimizing industrial enzymes. Cloning and analysis of genes for the biosynthesis of microbial secondary metabolites. Antibiotic resistance mechanisms of bacterial pathogens. Genetics of bacteriocins produced by Lactic acid bacteria and their use in novel industrial applications. Biomarkers and bioreporters to track microbes and monitor their gene expression. Biofilms. Future perspectives in industrial microbial technology.

Textbooks and Reference Books

1. Industrial Microbiology. Casida Jr. , L.E . (1968) New Age International (P)Ltd. New D elhi .
2. Prescott & Dunn's Industrial Microbiology. Ed. E. G. Reed (1987). CBS Publishers, New Delhi .
3. Biotechnology: A Textbook of Industrial Microbiology 2nd Edition. Crueger, W. and Crueger, A. (2000) Panima Publishing Corporation, New Delhi.
4. Demain, A.L. and Davies, 1.E. Manual ofIndustrial Microbiology and Biotechnology 2nd Ed. ASM Press, Washington DC.

MTBT-112	Biomedical Equipments						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enlighten student's knowledge about biomedical equipments and techniques involved						

Course Outcomes (CO)	
CO1	Students will learn about basics of bioelectric signals and electrodes
CO2	Students will learn about various equipments involved in diagnostic
CO3	Students will be able to understand the working principle of various therapeutic equipments
CO4	Students will have learn calibration and testing of equipments

UNIT I

Bioelectric Signals and Electrodes: Bio-potentials and their origin: ECG, EEG, EMG, ENG, ERG, EOG, MEG. Bio-potential electrodes, generalized medical instrumentation system-Man machine interface.

UNIT II

Diagnostic Equipments: ECG: normal and abnormal waveform, diagnosis interpretation, ECG leads connections, Einthoven triangle, Plethysmography, Blood pressure measurement: direct and indirect methods, Cardiac output measurements, Respiratory volume measurement, Impedance pneumograph, Spirometers, Pneumotachometers. EEG: signal amplitudes and frequency bands, EEG machine. Blood cell counter, Endoscopes, Laparoscopes and Camera pill.

UNIT III

Therapeutic Equipments: Heart lung machine, Dialyzers: basic principle of dialysis, different types of dialyzer, membranes, portable type. Cardiac pacemakers: external and Implantable pacemaker. Cardiac defibrillator: DC defibrillator, implantable defibrillator and defibrillator analyzer. Ventilators, Anesthesia machine, Short wave diathermy, microwave diathermy, ultrasonic therapy unit, electrotherapy

UNIT IV

Patient Safety: Electric shock hazards, leakage currents, electrical safety analyzer, testing of biomedical equipments. Calibration and testing of biomedical equipments. Modern biomedical equipments and systems: Market scenario.

Books Recommended:

1. John G. Webster, "Medical Instrumentation Application and Design" 4th Ed, Wiley, 2011.
2. Joseph J Carr, John M Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, NewDelhi, 2011.
3. L. J. Street, "Introduction to Biomedical Engineering Technology", 2 nd Ed, CRC Press, 2011
4. Khandpur R S, "Medical Instrumentation: Application and Design", 3Rd Ed, John Wiley & Sons, 2009.

MTBT-114	GENE THERAPY AND GENE EDITING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to understand the role of gene therapy in treatment of severe diseases.						
Course Outcomes (CO)							
CO1	Students will learn about basics of gene therapy						
CO2	Students will learn about viral vectors used in gene therapy						
CO3	Students will have knowledge about role of gene therapy in curing of diseases treatment						
CO4	Students will have learn about gene editing and its application						

UNIT I

Introduction: Basic concept of gene therapy. Somatic and germ line gene therapy. Gene replacement and gene addition. In vivo, ex vivo and in vitro gene therapy. Transgenic animal models. Vichels for gene transferviral vectors, reterovirus, adenovirus and adenoassociated virus.

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UNIT II

Viral Vectors: Lentivirus, Recombinant SV40 Virus, Non viral vectors, Naked DNA and Transposons., RNADNA chimera, Gene therapies for Crigler Najjar syndrome.

UNIT III

Gene Therapy and disease: Cystic fibrosis, Duchmne muscular dystrophy, Bleeding disorder, Tryosenemia. Cancer gene therapy

UNIT IV

Genome and Gene Editing: Introduction to Genome and Gene Editing, History of CRISPR, Components of CRISPR/CAS9 system, Editing with homology directed repair, Genome-wide Screening and Regulation of Gene Expression usıng Crispr/Cas9, CRISPR Purification, and Multiplexible Crispr Expression Systems

Text Books:

1. Gene therapy: TwentyFirst Century Medicine. Annu. Rev. Biochem. 2005. 74:71138
2. Gene therapy: Promises and Problems. Annu. Rev. Genomics Hum. Genet. 2001. 2:177211

Reference Books:

1. Primrose SB and Twyman RM, Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006).
Reference Books:
2. Friedman T. 1999. *The Development of Human Gene Therapy* . Cold Spring Harbor,NY: Cold Spring Harbor Lab. Press.
3. Knipe DM, Howley PM, eds. 2001. *Fields Virology.* Philadelphia, PA: Lippincott Williams & Wilkins.
4. Hackett NR, Crystal RG. 2000. Adenovirus vectors for gene therapy. In *Gene Therapy* , ed. NS Templeton, DD Lasic, pp.1739. New York: Marcel Dekker
5. http://www.liebertpub.com/hum .
6. www.nature.com/gt/index.html

MTBT-116	METAGENOMICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The purpose of this course is to provide knowledge about how the metabolic functions, taxonomic distribution, diversity, evenness and species richness of microbial communities varies across environment.						

Course Outcomes (CO)	
CO1	Students will learn about basics of metagenomics and different approaches to metagenomics
CO2	Students will learn about probing of biomarkers and oligonucleotide microarrays
CO3	Students will learn about construction and analysis of metagenomic libraries
CO4	Students will learn about industrial application of metagenomics with case studies

UNIT -I

Environmental Metagenomics – Introduction; Pure culture and in consortium ; Cultivable and Non-cultivable microbial analysis; Molecular fingerprinting techniques (RFLP, T-RFLP, ARISA, DGGE, rDNA library, and FISH); Stable isotope probing (SIP); Suppressive subtractive hybridization (SSH); Differential expression analysis (DEA); Microarrays & Metagenome sequencing; Next-generation sequencing approaches to metagenomics

UNIT II

Stable isotope probing and oligonucleotide microarrays: Direct linking of microbial populations to specific biodegradation and biotransformation processes by stable isotope probing of biomarkers- PhyloChip & GeoChip-Detection of xenobiotic-degrading bacteria by using oligonucleotide microarrays.

UNIT III

Library construction and analysis of metagenomic Libraries: Library Cataloging microbes: phylogenetic tree and construction - Construction of a metagenomic library; Analysis of Metagenomic Libraries; Sequence-based Metagenomics Analysis; Function based Metagenomics Analysis; Phylogenetic analysis and Comparative genomics Softwares & Tools

Unit IV

Metagenomics case studies: Metagenomic analysis of soil microbial communities; marine microbial communities; Microbial Community in Acid Mine Drainage; Bacteriophage; Archaeal Metagenomics: Bioprospecting Novel Genes and Exploring New Concepts; Metagenomics and Its Applications to the Study of the Human Microbiome; Applications of Metagenomics for Industrial Bioproducts

References

1. Diana Marco Universidad Nacional de Cordoba, Argentina, “Metagenomics: Theory, Methods and Applications”, Caister Academic Press, 2010.
2. Diana Marco Universidad Nacional de Cordoba,Argentina “Metagenomics: Current Innovations and Future Trends”, Caister Academic Press, 2011.
3. Joanna R. Freeland, Heather Kirk, Stephen Petersen, “Molecular Ecology”, Mc Graw Hill, 2nd Edition “2012.
4. Beebee T.J.C., D G. Rowe,” An Introduction to Molecular Ecology”, Mc Graw Hill, 2004.

MTBT-118	Molecular Technique Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
-	**-**	4	4	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To provide hands on training on basic techniques.						
Course Outcomes (CO)							
CO1	Student will learn the basic techniques used in molecular biology						
CO2	Student will learn PCR and detection of food borne pathogenic organisms						

Note: A college must offer 4 of the below listed experiments. The remaining 2 experiments may be Modified by College according to facilities available.

Practical Exercises

1. Extraction of DNA from clinical samples followed by agarose gel electrophoresis.
2. Extraction of double stranded genomic RNA from viral samples.
3. Polyacrylamide gel electrophoresis (PAGE) for detection of segmented genomic RNA.
4. Polymerase chain reaction for detection of pathogens in blood/and other clinical samples.
5. RT-PCR for detection of RNA.
6. Detection of food borne pathogenic organisms from food samples using PCR technology.

Text/ References-

1. Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
2. Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
3. Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.
4. Specific journals and published references.

MTBT-120	Advance Molecular Technique Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
-	**0**	**4**	4	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To provide hands on training on advanced techniques.						
Course Outcomes (CO)							
CO1	Student will learn the advance techniques used in molecular biology						
CO2	Student will learn the hybridization and microarray						

Note: A college must offer 5 of the below listed experiments. The remaining 2 experiments may be modified by College according to facilities available.

Practical Exercises

1. Restriction endonuclease profile analysis.
2. Isolation of plasmid DNA from bacteria.
3. Cloning of PCR products followed by nucleic acid sequencing.
4. Analysis of sequenced data.
5. RFLP and RAPD.
6. Southern hybridization/ Northern hybridization.
7. Microarray.

Text/ References-

1. Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
2. Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
3. Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.
4. Specific journals and published references.

MTBT-201	Advanced Food Biotechnology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	-	-	3	60	40	100	3 Hrs.
Objective	To acquaint with the fundamentals and application of biotechnology in relation to raw materials for food processing, nutrition, food fermentations, waste utilization						
Course outcomes							
CO1	To acquaint with principles of different techniques used in processing and preservation of food						
CO2	To acquaint the students with packaging methods, packaging materials, modern packaging techniques						
CO3	To acquaint with food quality parameters and control systems, food standards, regulations, specifications						
CO4	To develop an understanding of enzymes useful in food product technology and food processing						

UNIT I

Preservation and Processing : Scope of food processing; historical developments; principles of food processing and preservation. Processing and preservation by drying, concentration and evaporation-types of dryers and their suitability for different food products; ultra- filtration, reverse osmosis, convectional and adiabatic drying. Fruit powders using spray drying..

Processing and preservation by non-thermal methods, irradiation, high pressure, pulsed electric field, hurdle technology. Use and application of enzymes and microorganisms in processing and preservation of foods; food fermentations, pickling, smoking etc.

UNIT II

Food packaging systems: Different forms of packaging such as rigid, semirigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods.

UNIT III

Quality management : Concept of quality, instrumental methods for testing quality.Concepts of quality management: Objectives, importance and functions of quality control; Quality management systems in India; Sampling procedures and plans; Food adulteration. Food Safety and Standards Act, 2006; Domestic regulations; Global Food safety Initiative; Indian & International quality systems and standards like ISO and Food Codex. Various organizations dealing with inspection, traceability and authentication, certification and quality assurance (PFA, FPO, MMPO, MPO, AGMARK, BIS); Labeling issues.International scenario, International food standards. Quality assurance.

UNIT IV

Enzymes as processing aids: Role of enzymes in cheese making and whey processing; fruit juices (cell wall degrading enzymes for liquefaction,clarification, peeling, debittering, decolourization of very dark coloured juices such as anthocyanases); baking (fungal α-amylase for bread making; maltogenic α-amylases for anti-staling; xylanses and pentosanases as dough conditioners; lipases or dough conditioning; oxidases as replacers of chemical oxidants; synergistic effect of enzymes).

Text & References:

1. Microbiology 5th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A.(2003) McGraw Hill, USA
2. Food Microbiology: Fundamentals and Frontier 2nd Eds. Ed. Beuchat, Doyle & Montville. (2001). Blackwell Synergy.
3. Food Microbiology. Frazier, W.C. and Westhoff, D.C. (2010) Tata Mc-Graw Hill, New Delhi.
4. Modern Food Microbiology. Jay, J.M. (1996) CBS Publishers and Distributors, New Delhi.
5. Foods: Facts and Principles. (2012) N. Shakuntala Manay and M. Swami. New Age International (P) Ltd, Publishers
6. Biotechnology: Food Fermentation Vol. I & II. Eds. Joshi, V.K. & Pandey, A. (1999) Educational Publishers, Kerala.
7. Biotechnological Strategies in Agroprocessing. Eds. Marwaha S.S & Arora, J.K. (2003)
8. Ray, Bibek (1996). Fundamental Food Microbiology .CRC Press.
9. Food Microbiology 2nd ed, Adam, M. R. and Moss (2003) Panima Pub., New Delhi.

MTOE-201	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes (CO)							
CO1	*Able to have knowledge of various business analysis techniques.*						
CO2	*Learn the requirement specification and transforming the requirement into different models.*						
CO3	*Learn the requirement representation and managing requirement assests.*						
CO4	*Learn the Recent Trends in Embedded and collaborative business*						

Unit 1

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit 2

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 3

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.
Managing Requirements Assets: Change Control, Requirements Tools

Unit 4

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

References:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

MTOE-203	Industrial Safety						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the industrial safety.*						
Course Outcomes (CO)							
CO1	*Understand the industrial safety.*						
CO2	*Analyze fundamental of maintenance engineering.*						
CO3	*Understand the wear and corrosion and fault tracing.*						
CO4	*Understanding that when to do periodic inceptions and apply the preventing maintenance.*						

Unit-1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-2

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-3

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-4

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MTOE-205	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it.						
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it.*						

Unit -1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit -2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit- 3

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit -4

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MTOE-207	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the strategic cost management process.*						
CO2	*Students should able to types of project and project team types*						
CO3	*Students should able to carry out Cost Behavior and Profit Planning analysis.*						
CO4	*Student should able to learn the quantitative techniques for cost management.*						

Unit-1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-4

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MTOE-209	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT–1:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT – 2

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–3

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – 4

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MTOE-211	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit-1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-2

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-3

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-4

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

MTAD-101	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

MTAD-103	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

Unit 1

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit 2

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

MTAD-105	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit –1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit – 2

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit –3

Technical concepts of Engineering: Electrical, Mechanical

Unit –4

Technical concepts of Engineering: Architecture, Mathematics

References

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTAD-107	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit 1

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Unit 2

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature,Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit 4

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1.Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

MTAD-102	Constitution of India						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive , President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

MTAD-104	Pedagogy Studies						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.*						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit 1

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit 2

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 3

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit 4

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

MTAD-106	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yog asan*						
CO4	*Learn the pranayama*						

Unit – 1

Definitions of Eight parts of yog (Ashtanga).

Unit- 2

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit- 3

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit- 4

Regularization of breathing techniques and its effects-Types of pranayam.

References

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

MTAD-108	Personality Development through Life Enlightenment Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit – 1

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don's); Verses: 71, 73, 75, 78 (do's).

Unit – 2

Approach to day to day work and duties; Shrimad Bhagwad Geeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit - 3

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit – 4

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Dissertation Part – I and Dissertation Part - II

	Dissertation Part-I (MTBT-207) and Dissertation Part-II (MTBT-202)
	Course Outcomes (CO)
CO1	Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
CO2	Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
CO3	Ability to present the findings of their technical solution in a written report.
CO4	Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.
The dissertation should have the following:
Relevance to social needs of society
Relevance to value addition to existing facilities in the institute
Relevance to industry need
Problems of national importance
Research and development in various domain

The student should complete the following:

Literature survey Problem Definition
Motivation for study and Objectives
Preliminary design / feasibility / modular approaches
Implementation and Verification
Report and presentation
The dissertation part- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:
Experimental verification / Proof of concept.
The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Part – I and Dissertation Part - II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two parts i.e. Part– I: July to December and Part– II: January to June.
The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.
The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing Engineering and any other related domain. In case of Industry sponsored projects, the relevant application notes, white papers, product catalogues should be referred and reported.
Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
Part–I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper, proof of concept/functionality, part results, and record of continuous progress.
Part–I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Part-I work.
During Part– II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
Part–II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, and record of continuous progress.
Part-II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the Part-I work.

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