Rashtreeya Sikshana Samithi Trust

R.V. College of Engineering

(Autonomous Institution affiliated to VTU, Belagavi)

Department of Biotechnology

Master of Technology (M. Tech.)

Biotechnology

Scheme and Syllabus of Autonomous System w.e.f 2016

R.V. College of Engineering, Bengaluru – 59

(Autonomous Institution affiliated to VTU, Belagavi)

Department of Biotechnology

Vision:

A premier department in Biotechnology Education, Research and Innovation with a focus on sustainable technologies for the benefit of society and environment.

Mission:

- **Create state-of-the-art infrastructure for research and training in Biotechnology.**
- **Develop graduates who are ethical and socially concerned.**
- **Promoting collaboration with academia, industries and research organizations at National and International level.**
- **Contribute to socioeconomic development through sustainable and inclusive technologies.**

Program Educational Objectives (PEO)

M. Tech. in Biotechnology Post Graduates will

PEO1: Have an ability to solve Biotechnology and Engineering problems, communication skills and team work that prepare them for a successful career in Biotechnology and allied industries.

PEO2: Function at a technically competent level in formulating and solving problems in Biotechnology and develop an outlook for higher education and lifelong learning.

PEO3: Gain the ability to comprehend, analyze, design and develop biological processes and products, exhibit professionalism, ethical attitude to become an entrepreneur.

Program Specific Criteria (PSC)

Lead Society: American Society of Agricultural and Biological Engineers

PSC1: The curriculum of program consists of basics of Biotechnology, Chemical engineering and informatics knowledge for Biological processes. The curriculum prepares students to analyze and develop techniques or methods to solve problems encountered in applying Biotechnology.

PSC2: The curriculum of program includes advance core and electives courses together with laboratory, seminar, industry visit, assignment and tutorials emphasizing on production, processing, and management of biological, agricultural, food, health and natural resources.

PSC3: The curriculum of program also includes internship and project work which prepare students to apply biotechnological solutions and professional skills with focus on production, management and research.

Program Objectives (POs)

PO 1. **Scholarship of Knowledge:** Use knowledge of principles and applications of Biotechnology.

PO 2. **Critical Thinking:** Design and formulate the solutions for various biotechnological challenges.

PO 3. **Problem Solving:** Develop methodologies to solve the problems in the fields of health & pharma, bioprocess, and food & Agriculture.

PO 4. **Research Skill:** Possess skills appropriate to conduct research in life sciences with minimal supervision.

PO 5. **Usage of modern tools:** Apply advanced tools and techniques to the challenges of biotechnological sector.

PO 6. **Collaborative and Multidisciplinary work:** Collaborate with the confluence of various domains of Biotech from academic, industry and research institutes of national or international repute.

PO 7. **Project Management and Finance:** Design and develop projects related to biotechnological and allied branches keeping performance and cost constraints into consideration.

PO 8. **Communication:** Inculcate inter and intra personal skills for effective communication.

PO 9. **Life-long Learning:** Appreciate the breadth and depth of knowledge in biotech and the necessity for lifelong learning.

PO 10. **Ethical Practices and Social Responsibility:** Apply bio-engineering solutions to societal and ethical needs with focus on sustainability.

PO 11. **Independent and Reflective Learning:** Contemplate on real-time problems and develop independent interpretations.

Program Specific Outcomes (PSO)

PSO1: The post graduates of the program will be thorough with biotechnology, chemical engineering and statistics to deal with the Engineering problems related to Biotechnology and Bioinformatics.

PSO2: The post graduates of the program will be able to deal with chemical engineering and Biotechnology problems related to upstream and downstream process technology as well as will be ready to solve societal problems ethically.

PSO3: The post graduates of the program will be able to apply biotechnological tools in agriculture, health sector and fermentation industry with emphasis on production, management, entrepreneurship and research.

R. V. College of Engineering, Bengaluru – 59.
(An Autonomous Institution affiliated to VTU, Belagavi)

Department of Biotechnology

M. Tech. in Biotechnology

FIRST SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self Study S**	
1	16MEM11P	Project Management	IM	3	1	0	0	4
2	16MBT12	Advanced Biostatistics	BT	4	0	0	0	4
3	16MBT13	Recombinant DNA Technology (Theory and Practice)	BT	4	0	1	0	5
4	16MBT14	Computational Biology	BT	4	0	0	1	5
5	16MBT15X	Elective-1	BT	4	0	0	0	4
6	16HSS16	Professional Skill Development	BT	0	0	2	0	2
		Total		19	1	3	1	24

Elective -1			
16MBT151	Genomics, Proteomics and Microarray.	16MBT152	Enzyme Technology.

R. V. College of Engineering, Bengaluru – 59.
(An Autonomous Institution affiliated to VTU, Belagavi)

Department of Biotechnology

M. Tech. in Biotechnology

SECOND SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self Study S**	
1	16MEM21R	Research Methodology	IM	3	1	0	0	4
2	16MBT22	Upstream Processing (Theory and Practice)	BT	4	0	1	0	5
3	16MBT23X	Elective-2	BT	4	0	0	0	4
4	16MBT24X	Elective-3	BT	4	0	0	0	4
5	16MBT25X	Elective-4	BT	4	0	0	0	4
6	16MBT26	Minor Project	BT	0	0	5	0	5
		Total		19	1	6	0	26

Elective - 2			
16MBT231	Immunotechnology	16MBT232	Nanobiotechnology
Elective – 3			
16MBT241	Pharmaceutical Biotechnology	16MBT242	Agricultural Biotechnology
Elective – 4			
16MBT251	Applications of Recombinant DNA Technology	16MBT252	Bioreactor Engineering

R. V. College of Engineering, Bengaluru – 59.
(An Autonomous Institution affiliated to VTU, Belagavi)
Department of Biotechnology

M. Tech. in Biotechnology

THIRD SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self Study S**	
1	16MBT31	Downstream Processing & Product Recovery (Theory and Practice)	BT	4	0	1	0	5
2	16MBT32X	Elective-5	BT	4	0	0	0	4
3	16MBT33X	Elective-6	BT	4	0	0	0	4
4	16MBT34X	Elective-7	BT	4	0	0	0	4
5	16MBT35	Internship / Industrial Training	BT	0	0	3	0	3
6	16MBT36	Technical Seminar	BT	0	0	2	0	2
		Total		16	0	6	0	22

Elective -5			
16MBT321	Stem Cell and Tissue Engineering	16MBT322	Food Technology
Elective – 6			
16MBT331	Human Diseases	16MBT332	Process modeling & Simulation
Elective-7			
16MBT341	Regulatory Affairs & Biobusiness	16MBT342	Medical Devices

R. V. College of Engineering, Bengaluru – 59

(An Autonomous Institution affiliated to VTU, Belagavi)

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Department of Biotechnology

M. Tech. in Biotechnology

FOURTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self Study S**	
1	16MBT41	Major Project	BT	0	0	26	0	26
2	16MBT42	Seminar	BT	0	0	2	0	2
		Total		0	0	28	0	28

THIRD SEMESTER

Downstream Processing & Product Recovery (Theory and Practice)						
Course Code	**:**	**16MBT31**		**CIE Marks**	**:**	**100+50**
Hrs/Week	**:**	**L:T:P:S**	**4:0:1:0**	**SEE Marks**	**:**	**100+50**
Credits	**:**	**5**		**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives (CLO):

Students are able to:

1) Learn about the different methods of cell separations and clarification of broth
2) Understand the basics of purification technology and its applications in Bioprocess industries
3) Know the new technologies adopted in industries
4) Understand different techniques of viral reduction in biological processes and explore case studies of current biological products.

Unit – I	08 Hrs

Introduction:

Introduction to downstream processing, biological processes, purification technologies, current scenario in the bioprocess industries. Process design criteria for low volume high value products and high volume low value products. Process economics: cost cutting strategies, costing for purification of a bioproduct.

Unit – II	10Hrs

Filtration and Purification:

Filtration, pre-filtration, depth filtration, mechanism of depth filtration, modules of depth filtration. Flow rates and pressure variations in depth filtration.

Broth clarification different types of broths and methods for cell removal, rheology of fermentation broth. Membrane filtration, microfiltration, ultrafiltration, Diafiltration, cross-flow filtration, transmembrane pressure and Flux calculations with numericals.

Unit – III	10Hrs

Chromatography:

Introduction to chromatography, types of chromatography, protein-A based Affinity chromatography, mechanism. Membrane chromatography, types of membranes used in bioprocess, compatibility of membranes, biofouling of membranes, concentration polarization and methods of control. Membrane chromatography modules and mechanism and scale-up techniques for purification of bio molecules. Capillary Electrochromatography and simulated moving bed chromatography.

Unit – IV	08Hrs

Final polishing methods: Drying curve, Batch and continuous dryers, Freeze drying, spray drying, crystallization.

Virus removal methods: Viral removal and deactivation methods, Viral filtration, uv-radiation, membrane filtration for virus removal. Methods of operation and scale-up activities for viral clearance

Unit – V	08Hrs

Case-Studies:

Purification Case studies on monoloclonal antibodies (mAbs), recombinant proteins, bacterial vaccines, traditional and cell culture based viral vaccines. Downstream processing of albumin and clotting factors.

PRACTICALS

1) Cell disruption of intracellular biomolecules (ex: yeast cells) and to assay the total protein or enzyme content
2) Calculation of terminal settling velocity of disrupted yeast cells & to design of thickener for batch sedimentation (under gravity) using Kynch's theory
3) Determination of clean water flux (CWF) and to calculate the flux and area of membrane required for the clarification of known cell broth (ex: yeast cells) in given time
4) Extraction of an antibiotic (ex: ceftriaxone and sulbatum) using different aqueous-organic solvent systems and determination of distribution coefficient and percentage extraction.
5) To carry out bulk precipitation of protein/enzyme from given suspension (ex; yeast cells) using ammonium sulfate and find the % cut of ammonium sulfate where the protein is highest precipitated
6) Determination of the partition coefficient and yield of total protein present in intracellular or extracellular compounds (such as yeast cells/pigments) using Polyethylene Glycol and salt system in single and/or multiple stages.
7) Identification of the unknown pigments such as (leaves of green leafy vegetables) by comparing its R_f value with R_f value of the standards using thin layer chromatography
8) Determination of the constants of Freundlich equation by adsorbing BSA on silica.
9) Determination of the rate of drying for the given sample in a vacuum tray drier or by osmotic dehydration (ex: vegetables such as potatoes)
10) Purification of biomolecules (ex: pigments) using gel chromatography or ion exchange chromatography

Expected Course Outcomes:

After going through this course the post graduates will be able to:

CO1: Summarize the current process involved in industrial purification of biological products
CO2: Acquire the knowledge on different filtration and purification techniques.
CO3: Understand the different types of chromatography and viral reduction, removal and its importance
CO4: Overview on case studies pertaining to bioproducts currently in market

REFERENCE BOOKS:

1) Uwe Gottschalk, Process Scale Purification Of Antibodies, John Wiley & Sons, 2nd edition, 2017, ISBN: 978-1-119-12691-1
2) Harrison R.G. Todd P. Rudge S.R. and D.P. Petrides, Bioseparations Science and Engineering, Oxford University Press, 2nd edition, 2015, ISBN: 9780195391817
3) Mokesh Doble, Principles of Downstream Processing in Biological and Chemical Processes. CRC Press, Taylor & Francis group, 1st edition, 2015, ISBN 9781771881401
4) Nooralabettu Krishna Prasad, Downstream Process Technology: A New Horizon in Biotechnology, PHI Learning Publications, 1st edition, 2010, New Delhi. ISBN: 978-81-203-4040-4

Scheme of Continuous Internal Evaluation (CIE):

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE):

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Lab:

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Evaluation (SEE) for Lab:

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of COs with POs

	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	L	L	L	L	--	--	L	--	L
CO2	M	L	M	M	M	M	--	--	M	--	M
CO3	M	L	M	L	M	M	--	--	M	--	M
CO4	M	L	M	L	L	L	--	--	M	--	L

Mapping of COs with PSOs

	PSO1	PSO2	PSO3
CO1	L	L	L
CO2	M	M	M
CO3	M	M	M
CO4	L	L	L

STEM CELL AND TISSUE ENGINEERING (Elective-5)						
Course Code	**:**	**16MBT321**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**L:T:P:S**	4:0:0:0	**SEE Marks**	**:**	100
Credits	**:**	**4**		**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives (CLO):

Students are able to:

1. Know the types and applications of stem cells.
2. Learn techniques involved in isolation, selection and maintenance of stem cells.
3. Study the techniques used in growth and differentiation of tissues.
4. Acquire the methods for repairing of various kinds of tissues.

Unit – I	**9 Hrs**

Stem Cells: Concepts and Types of Stem cells: Embryonic, Adult and Induced stem cells. Embryonic stem cells: Pluripotent, Totipotent and Multipotent cells. Adult stem cells: Hematopoietic, Neural stem cells, Epidermal and Epithelial stem cell.

Unit – II	**9 Hrs**

Growth and applications of stem cells: Cell culture methods, Cell isolation, selection, maintenance of primary and early passage cultures. Clinical potential of stem cells: Organ and tissue regeneration, cardiovascular treatment, Cell deficiency therapy, treatment of any brain related defects.

Unit – III	**9 Hrs**

Introduction to Tissue Engineering: History and scope of tissue engineering. The isolation and handling of human and animal tissue. The major methods of preparing a primary culture. Introduction to cell adhesion: cell–cell adhesion, cell–matrix adhesion and signalling, cell proliferation, and differentiation.

Unit – IV	**9 Hrs**

Basic growth and Differentiation of Tissues: Morphogenesis and tissue engineering-gene expression, cell determination and differentiation. In vitro control of tissue development: In vitro culture parameters, growth factors, mechanobiology, tissue development and organ engineering. In vivo synthesis of Tissue and Organs.

Unit – V	**9 Hrs**

Tissue engineering for tissue regeneration: using bone marrow mesenchymal stem cells (MSCs) and adipose derived stem cells (ASCs). Therapeutic strategy for repairing the injured spinal cord using stem cells. Wound and Disc repair using stem cells. Engineering of tissues: cartilage, bone and skin. Biomaterials in tissue engineering.

Expected Course Outcomes:

After going through this course the post graduates will be able to:

CO1: Explain the importance of stem cell, characteristics and tissue functions for specialized applications

CO2: Compare various kinds of stem cells and tissues used for regeneration purpose.

CO3: Interpret the methods used in organ regeneration.
CO4: Apply techniques for growth of stem cells, and repairing various kinds of tissues.

Scheme of Continuous Internal Evaluation (CIE):

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE):

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Reference Books

1. Song Li, Nicolas L' Heureux and Jennifer Elisseeff,; Stem cell and Tissue Engineering, world scientific publications, 2014, ISBN: 13978-981-4317-05-04
2. R Lanza, Langer R and Vacanti J: Principles of Tissue Engineering. Elsevier. 2013. ISBN: 978-0-12-398358-9
3. John P. Fisher, A G Mikos and Joseph D Bronzino; Tissue Engineering. CRC Press. 2007. ISBN: 0849390265
4. JD Bronzino; Tissue Engineering and Artificial organs, Taylor and Francis, 4th edition 2006, ISBN: 0849321239.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	L	L	L	L	_	_	L	L	L	_
CO2	M	L	M	L	H	_	_	M	L	L	_
CO3	M	M	H	M	H	_	_	L	L	L	_
CO4	M	L	L	L	L	_	_	L	L	L	_

Mapping of COs with PSOs

	PSO1	PSO2	PSO3
CO1	L	M	L
CO2	L	M	M
CO3	L	M	M
CO4	L	M	L

FOOD TECHNOLOGY
(Elective-5)

Course Code	**:**	**16MBT322**	**CIE Marks**	**:**	100
Hrs/Week L:T:P:S	**:**	4:0:0:0	**SEE Marks**	**:**	100
Credits	**:**	**4**	**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives (CLO):

Students are able to:

1.Understand the components of food, principles of food spoilage and techniques for food processing.
2.Illustrate the application of food preservation and food production with improved nutritional benefits
3.Analyze various modern tools and techniques for food processing and packaging.
4.Evaluate various food adjuvants needed in processing along with regulatory norms.

Unit – I	**08 Hrs**

Basic constituents, nutritive value and metabolic function of food, Food quality characteristics, engineering properties of foods, colloidal systems in food, rheological properties-viscosity and texture, aerodynamics and hydrodynamic characteristics, pneumatic handling Food Microbiology: Microbial growth and contaminants of food, mechanism of food spoilage. Biochemical changes caused by microorganism, food borne intoxicants and mycotoxins.

Unit – II	**09 Hrs**

Principles and objectives of Food Processing Technology, impact of food processing on food constituents. Principle behind Post-harvest processing technology, processing of coffee, tea, cocoa and spices. Food preservation by high and ultra-high temperatures, food dehydration: fixed tray, cabinet drying, tunnel drying. Preservation by freezing. Freeze dehydration and storage, Food preservation by irradiation treatment. Frozen foods. Food freezing equipment: Air blast, plate and immersion freezers. Bacteriocins. Fermented food products: yoghurt, pro and prebiotics, Soya foods, dietary foods, nutritional food supplements, edible films.

Unit – III	**09 Hrs**

Food additives-definition and classification, acidulants, preservatives, emulsifiers and gums, Humectants, conditioners and enhancers, Nutritional additives, Sweeteners–Natural and synthetic, Chelating agents, anti-browning agents, antinutritional factors in foods, nutrition value and nutritional labeling, functional foods. Food safety levels as per the specifications, determination of acute and chronic toxicity-NOEL, ADI, PFA regulations in India, Codex, US FDA, FSSAI and GRAS.

Unit – IV	**09 Hrs**

Introduction to Food packaging, Packaging materials and their physico-chemical characteristics. quality of packaging materials; metal cans, glass containers, plastic containers and pouches, paper and paperboard, environmental factors in packaging, Shelf Life estimation, Vacuum Packaging, packaging materials for newer techniques like radiation processing, microwave and radiowave processing, high pressure processing, thermal processing as retortable pouches, active packaging, CO_2 and oxygen scavenging, modified atmosphere packaging, cushioning materials, Biodegradable packaging. Concept of personalized nutrition, Concept of nutraceuticals and nutrigenomics.

Unit – V	**09 Hrs**

EMERGING PROCESSING TECHNOLOGIES Principles of radiation processing, applications like disinfestation, pasteurization and sterilization, advantages and limitations; ionizing radiations, mechanisms of action, High Pressure Processing – principles, mechanism of action, advantages and

disadvantages over conventional processing; Equipment and applications in food industry; Equipment and applications in food industry. Ohmic heating of foods - principles, mechanism of action, advantages and disadvantages over conventional processing. Retort processing, UHT, Extrusion - hot and cold.

Expected Course Outcomes:

After going through this course the post graduates will be able to:

CO1: Understand the components of food and principles of food spoilage and techniques for food preservation.

CO2: Know the application of biotechnology for food preservation and food production with improved nutritional benefits.

CO3: Acquire and apply various food processing techniques to increase the nutritional content and shelf life of food.

CO4: Comprehend the knowledge of modern tools and applications in food technology with emphasis on safety norms.

Reference Books:

1. James M, Jay. Food Biotechnology, CBS Publishers, 2nd Edition, 2005.

2. Kalidas Shetty. Food Biotechnology, CRC Press, 1st Edition, 2006.

3. Byong H. Lee Fundamentals of Food Biotechnology 2nd , Kindle Edition,Wiley-Blackwell 2014

4. Smith, P.G. "Introduction to Food Process Engineering", Springer, 2005.

Scheme of Continuous Internal Evaluation (CIE):

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE):

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	M	L	L	M	_	_	L	L	L	_
CO2	M	H	M	L	H	_	_	L	L	L	_
CO3	M	H	M	L	H	_	_	L	L	L	_
CO5	M	H	M	L	H	_	_	L	L	L	_

Mapping of COs with PSOs

	PSO1	PSO2	PSO3
CO1	L	L	L
CO2	M	M	L
CO3	M	H	M
CO4	M	M	L

HUMAN DISEASES
(Elective-6)

Course Code	:	**16MBT331**		**CIE Marks**	:	**100**
Hrs/Week	:	**L: T: P: S**	**4:0:0:0**	**SEE Marks**	:	**100**
Credits	:	**4**		**SEE Duration**	:	**3 hrs**

Course Learning Objectives (CLO):
Students are able to:
1. Describe the processes that underlie the development of various diseases.
2. Explain the characteristics of and describe the basic mechanisms of pathogenesis
3. Understand the techniques involved in diagnostics of various types of disease
4. Understand the causes and therapeutics of various diseases

Unit – I **10 Hrs**

Introduction to human diseases:
Communicable disease and non-communicable disease. Genetic and congenital disease: sickle-cell anemia, hemophilia, colorblindness, down's syndrome. Deficiency disease: vitamin, hormone and mineral. Common screening methods for disease diagnosis.

Unit – II **10 Hrs**

Infectious Diseases:
Overview of infectious diseases. Causes, diagnosis and therapeutics of infectious diseases: **Bacterial disease**: pneumonia, typhoid, tuberculosis, leprosy and cholera. **Viral disease**: influenza, dengue, chickenpox, human immunodeficiency virus. **Protozoan disease**: malaria and leishmaniasis. **Fungal disease**: ringworm and athlete's foot.

Unit –III **08 Hrs**

Diabetes Mellitus:
Normal glucose and fat metabolism. Type I and type II diabetes: genetic and environmental predisposition, metabolic disturbances, symptoms, diagnosis and management. Gestational diabetes. Complications of diabetes- diabetic ketoacidosis, hypoglycemia, diabetic retinopathy and diabetic nephropathy.

Unit –IV **08 Hrs**

Cardiovascular diseases:
Physiology of cardio vascular system. Causes, symptoms, diagnosis and therapeutics for ischaemic heart disease (IHD), hypertension, cerebrovascular disease (stroke), coronary artery disease, atherosclerosis, rheumatic heart disease and congenital heart disease.

Unit – V **08 Hrs**

Cancer:
Genome instability and mutation, regulation of cell growth/proliferation, oncogenes, tumor suppressor genes, metastasis and complications. Cancer biomarkers. Diagnosis and therapeutics for cancer. Role of Virus in cancer.

Expected Course Outcomes:
After going through this course the post graduates will be able to:

CO1: Explain the etiological factors of diseases
CO2: Explain the causative factors of diseases
CO3: Illustrate techniques of diagnosis for various human diseases.
CO4: Discuss the causes and therapeutics of various diseases.

Reference Books:

1. Davidson's "principles and practice of medicine" 22nd edition, 2014, Main Edition ISBN-13: 978-0-7020-5035-0, International Edition ISBN-13: 978-0-7020-5047-3, eBook ISBN-13: 978-0-7020-5103-6
2. Mahajan & Gupta, "Textbook of Preventive and Social Medicine", 5th Edition, 2013, ISBN: 978-93-5090-187-8.
3. Harsh Mohan, "Textbook of Pathology", Jaypee Brothers Medical Publishers., 6th Edition, 2013, ISBN 978-81-8448-702-2.
4. David A. Warrell, Timothy M. Cox, John D. Firth, Edward J., J R., M.D. Benz, "Oxford Textbook of Medicine" Oxford Press, 6th Edition, 2014, ISBN: 9812-53-121-1.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	L	M	L	H	M	L	M	M	M	L
CO2		H	-	M	M	L	-	H	L	M	H
CO3	-	L	H	H	-	M	H	-	H	-	M
CO4	M	-	M	M	M	L	M	H	M	-	H

Mapping of COs with PSOs

	PSO1	PSO2	PSO3
CO1	-	M	-
CO2	M	-	H
CO3	-	H	M
CO4	M	M	-

PROCESS MODELING & SIMULATION (Elective-6)						
Course Code	**:**	**16MBT332**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S 4:0:0:0**		**SEE Marks**	**:**	**100**
Credits	**:**	**4**		**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives (CLO):

Students are able to:

1) Understand the levels and procedure of optimization of a process
2) Learn desirable and undesirable features in the formulation of an optimization problem
3) Understand and solve the mathematical models using different numerical techniques
4) Get an insight of simulation models and their applications to reactors

Unit – I	**08 Hrs**
Introduction- Scope and hierarchy of optimization, examples of applications of optimization, the essential features and general procedure of solving optimization problems, obstacles to optimization. Classification of models, selecting functions to fit empirical data, the method of least squares, factorial experimental designs, fitting a model to data subject to constraints.	
Unit – II	**08 Hrs**
Basic concepts of optimization: Continuity of functions, Nonlinear Program (NLP) statement. Unimodal versus Multimodel functions. Convex and Concave functions and their determination, Necessary and sufficient conditions for an extremism of an unconstrained function one-dimensional search quadratic approximation.	
Unit – III	**10Hrs**
Numerical methods, function of one variable, scanning and bracketing procedures, Newton's, Quasi-Newton's and Secant methods of uni-dimensional search, region elimination methods, polynomial approximation methods, multivariable optimization: Direct methods and indirect methods, types.	
Unit – IV	**10Hrs**
Solution of General form of dynamic models, dimensionless models. General form of linear systems of equations, nonlinear function. General state-space form. Solving homogeneous, linear ODEs with distinct and repeated Eigen values. Solving non-homogeneous equation, equation with time varying parameters. Introduction to systems and modeling - discrete and continuous system - Limitations of simulation, areas of application - Monte Carlo Simulation.	
Unit – V	**08 Hrs**
Analysis of simulation data - Input modeling – verification and validation of simulation models – output analysis for a single model related to linear regression and generalization of linear regression technique. Stirred tank heaters: model equations, Isothermal continuous stirred tank chemical reactors, Biochemical reactors: model equations, linearization. Case studies.	

Expected Course Outcomes:

After going through this course the post graduates will be able to:

CO 1. Develop the strategy for selecting functions to fit empirical data

CO 2. Develop the governing equation for systems and solve them using numerical techniques

CO 3. Analyze and solve homogeneous and non-homogeneous equation with time varying parameters

CO 4. Analyze the simulation data and model the reactor

Reference Books:

1) Edgar, T.F., Himmelblau DM and Leon S Lasdon, Optimization of chemical processes by Mc-Graw. Hill.2001 ISBN-0-07-0393591
2) Wayne Bequette B., Process Control: Modeling, Design and Simulation, Prentice Hall, Upper Saddle River, NJ, 2003, ISBN-13: 978-0133536409
3) Jenson, V. G. and Jeffreys, F. V., Mathematical methods in Chemical Engineering,2nd edition, Academic press, Elsevier, India, 2012, ISBN 13: 9780123844569
4) Jana, Aimya K., Chemical Process Modeling and Computer Simulation, 2nd edition, PHI Learning Private Limited, New Delhi, India, 2011, ISBN978-81-203-4477-8

Scheme of Continuous Internal Evaluation (CIE):

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE):

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	L	L	--	--	L	--	L
CO2	M	H	M	M	L	M	--	--	L	--	L
CO3	M	H	M	M	L	M	--	--	L	--	L
CO4	M	H	M	M	M	M	--	--	M	--	M

Mapping of COs with PSOs

	PSO1	PSO2	PSO3
CO1	L	L	L
CO2	L	L	L
CO3	L	L	L
CO4	M	M	M

REGULATORY AFFAIRS & BIOBUSINESS (Elective-7)					
Course Code	**:**	**16MBT341**	**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S:: 4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**4**	**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

Students are able to:

1. Understand the basic concept of regulatory affairs.
2. Address the safety and quality requirement related to biotechnology and other allied domains.
3. Apply the knowledge for addressing the legal intricacies in product development and commercialization
4. Design the business model for the reproducible and justiciable bio enterprise

Unit – I	**8 Hrs**

Regulatory framework: USFDA: history, regulatory organization, regulated products: biologics, drugs, medical devices, combinations & others, overview of regulatory operations for FDA applications. Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007),

Unit – II	**10 Hrs**

Regulatory compliance: Quality System Regulations (QSR), Good Manufacturing Practice (GMP), Good Laboratory Practices (GLP), Good Clinical Practice (GCP), and FDA inspections and enforcement, product liability, compliance with non-FDA regulations.

Quality systems: Evolution of quality concepts & practices, quality system planning: objectives, quality manual and quality plans. Elements of quality system, Unique approaches to quality management: Risk based approach, ISO, TQM and six sigma, quality systems for research.

Quality control: Development of Product & process specifications, selection of analytical test methods, reference standards/materials, method validation, control of products, process, raw materials & manufacturing environment,

Unit – III	**10 Hrs**

Nonclinical studies: nonclinical studies & risk assessment, biopharmaceutical delivery, pharmacokinetics, pharmacodynamics, applications of pharmacokinetics & pharmacodynamics in biopharmaceutical development, Safety assessment of biopharmaceuticals: toxicology, Design of a safety assessment program: *in vitro* screens, *in vivo* tests on animal models, test product formulation, route of delivery, and dosing design, elements of nonclinical study design, quality of nonclinical studies & GLP and its elements..

Clinical studies: Introduction, organization of clinical research: phases of clinical trials, science of clinical research, quality in clinical research & GCP, Infrastructure for a clinical trial: individuals, documents & protocols, collection of clinical data & reporting results (CDM). Clinical trial operations: Phase 1 Clinical Trials – Frist time in man, Phase 2 Clinical Trials – Proof of Concept, Phase 3 Clinical Trials – Therapeutic Confirmatory, Phase 4 Clinical Study & REMS, Clinical Trials for New populations and Global clinical trials. Quality Systems for clinical trials: GCP and its elements.

Unit – IV	8 Hrs

Biomanufacturing: Overview of biomanufacturing requirements, Design in biomanufacture, technical considerations for biomanufacturing, biomanufacturing life cycle, Quality in biomanufacturing & GMP, biomanufacturing process and products, analysis & testing (GLP & NABL), labeling, biomanufacturing facilities, utilities & equipment and their qualification,

Commercialization of Biotech products & Processes: Basic regulatory framework with respect to Regulated and Non-regulated market practices and procedures. Nature of bioscience enterprises, Strategies in bio enterprises: startups, spinoffs & makeovers, Factors for promotion of bio entrepreneurship: Role of science parks, Universities, Finance, Government, public support and industries,

Unit – V	8 Hrs

Bioenterprises: Business plans, Business models, funding of biotech business: Financing alternatives, Angel funding, Venture Capital funding, funding for biotech in India, Exit strategy, licensing strategies and valuation. Business laws applied to Biotech industries in India. Organizations supporting biotech growth, areas of scope, funding agencies in India and biotech policy initiatives. Bio entrepreneurship in rural areas. Support mechanisms for entrepreneurship: Bio entrepreneurship efforts in India,

History of pioneer biotech companies: Alembic, Shanta Biotech & Biocon,

Expected Course Outcomes:

After going through this course the post graduates will be able to:

CO 1. Comprehend the concept and knowledge of regulatory affairs and bio-business

CO 2. Plan for quality control & quality assurance of a biotech products

CO 3. Analyze the factors influencing the bioenterprises.

CO 4. Develop the business and regulatory approval model for biotechnological domains

REFERENCE BOOKS:

1. Michael J Roy; Biotechnology Operations: Principles and Practices; CRC Press, 2011, ISBN 1439830282, 9781439830284,
2. D. Hyne & John Kapeleris; Innovation and entrepreneurship in biotechnology an International Perspective: Concepts, theories & cases; Edward Elgar, 2006, ISBN 1843765845, 9781843765844
3. The Business of Biotechnology: From the Bench of the Street: By Richard Dana Ono Published Butterworth- Heinemann, 2011.
4. Regulatory Framework for GMOs in India (2012) Ministry of Environment and Forest, Government of India, New Delhi

Scheme of Continuous Internal Evaluation (CIE):

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE):

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	L	M	L	H	M	L	M	M	M	L
CO2		H	-	M	M	L	-	H	L	M	H
CO3	-	L	H	H	-	M	H	-	H	-	M

CO4	M	-	M	M	M	L	M	H	M	-	H

Mapping of COs with PSOs

	PSO1	PSO2	PSO3
CO1	H	L	L
CO2	H	H	L
CO3	L	H	L
CO4	M	M	L

MEDICAL DEVICES
(Elective-7)

Course Code	**:**	**16MBT342**	**CIE Marks**	**:**	100
Hrs/Week L:T:P:S	**:**	4:0:0:0	**SEE Marks**	**:**	100
Credits	**:**	**4**	**SEE Duration**	**:**	**3 hrs**

Course Learning Objectives (CLO):

Students are able to:

1. Understand the principles, applications and purpose of using medical devices.
2. Gain the knowledge of biological phenomenon that help in the design of engineering devices
3. Acquire knowledge on use of medical devices in healthcare sectors.
4. Appreciate the use of engineered devices that mimics biological system.

Unit – I	**08 Hrs**

Introduction and Oral implants: Introduction to medical implants and prosthetics used to mimic natural body organs or parts. The requirement of implants and various materials used to make implants.

The implants related to oral problems: The jaw replacement, artificial single tooth or full denture, palate replacement.

Unit – II	**08 Hrs**

Orthopedic implants: The Implant to correct the problems related to bones, various types of material used to make artificial bone for natural bone replacement. The limbs bones and support implant or full bone replacement methods. The knee replacement, types of material to make artificial knee and surgical method to implant. The partial or full hip bone replacement.

Unit – III	**10 Hrs**

Cardiovascular implants: The common problems related to cardiovascular system which are being routinely corrected using artificial implants. The various types of "Stents" used for arterial blockages. The implant of pace maker for heart to monitor and form the correct pace for heart breathing. The heart valves to replace damaged or incorrect valves in heart. The complete artificial heart device in case of total failure of heart functioning.

Unit – IV	**08 Hrs**

Optical and Auditory implants:

Auditory implants: hearing aids, external ear for the cosmetic purpose, the middle ear and cochlea implant to correct the sense of hearing.

Vision implants: related For the correction of vision related to focal length the lenses and contact lenses. The replacement of opaque lens due to cataract by artificial lens. The recent advances in retina replacement

Unit – V	**10 Hrs**

Non invasive Wearable Medical devices: Explain purpose, design, signal, data storage, data integration into information technology and work flow related to following devices: Overall health record, Stay Fit and Energetic, Continuous Glucose Monitors (CGM) to gather with release of Insulin, Cardiac Monitoring Device

Expected Course Outcomes:

After going through this course the post graduates will be able to:

CO1: Explain the principle of sensing of various bio-devices.
CO2: Apply the bio-devices in the field of healthcare, agriculture, military and environmental sectors.
CO3: evaluate the principles of biological systems as applied to the design of engineering devices
CO4: Assess the potentials and limitations of various biosensors to a given problem.

Reference Books:

1. Yoseph Bar-Cohen, Biomimetics: Biologically Inspired technologies, 2005, CRC press, ISBN: 9780849331633
2. Yoseph Bar-Cohen, Biomimetics-Nature Based Innovation, 2011, CRC press, ISBN: 9781439834763
3. Jenkins, C.H. Bioinspired Engineering, NY: Momentum press, 2012 ISBN: 97816066502259
4. C.C.Chatterjee, Human Physiology Volume 1 (11th Edition), 2016, ISBN 10: 8123928726 / ISBN 13: 9788123928722.

Scheme of Continuous Internal Evaluation (CIE):

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE):

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks

.**Mapping of COs with POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	L	L	M	_	_	L	L	L	_
CO2	M	M	M	M	H	_	_	M	L	L	L
CO3	M	M	M	M	H	_	_	M	L	M	L
CO5	M	M	M	L	M	_	_	M	L	M	_

Mapping of COs with PSOs

	PSO1	PSO2	PSO3
CO1	L	L	L
CO2	L	M	M
CO3	L	M	M
CO4	L	M	M

INTERNSHIP / INDUSTRIAL TRAINING						
Course Code	**:**	**16MBT35**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**0:0:6:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**3**		**SEE Duration**	**:**	**30 min**

GUIDELINES FOR INTERNSHIP

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the process of applying engineering knowledge to produce product and provide services.

(2) Explain the importance of management and resource utilization

(3) Comprehend the importance of team work, protection of environment and sustainable solutions.

(4) Imbibe values, professional ethics for life long learning.

1) The duration of the internship shall be for a period of 8 weeks on full time basis between II semester final exams and beginning of III semester.

2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.

3) Internship must be related to the field of specialization or the M.Tech program in which the student has enrolled.

4) Students undergoing internship training are advised to use ICT tools such as skype to report their progress and submission of periodic progress reports to the faculty members.

5) Every student has to write and submit his/her own internship report to the designated faculty.

6) Students have to make a presentation on their internship activities in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the internship final report. However interim or periodic reports and reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.

7) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.

8) The broad format of the internship final report shall be as follows

- Cover Page
- Certificate from College
- Certificate from Industry / Organization
- Acknowledgement
- Synopsis
- Table of Contents
- Chapter 1 - Profile of the Organization – Organizational structure, Products, Services,

Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,

- Chapter 2 - Activities of the Department -
- Chapter 3 – Tasks Performed – summaries the tasks performed during 8 week period
- Chapter 4 – Reflections – Highlight specific technical and soft skills that you acquired during internship
- References & Annexure

Course Outcomes:

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of the Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries 35%

(2) Ability to comprehend the functioning of the organization/ departments 20%

(3) Importance of resource management, environment and sustainability 25%

(4) Presentation Skills and Report 20%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		M	H	M		M				L	
CO2				H	M	M		L			
CO3					L		M	H	H		
CO4					L		H			M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	
CO2	L	L
CO3		M
CO4	M	H

GUIDELINES FOR INDUSTRIAL TRAINING

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the process of applying engineering knowledge to industrial products & processes

(2) Explain the importance of skilling, training and resource management.

(3) Comprehend the importance of team work, communication and sustainable solutions.

(4) Imbibe values, professional ethics for life long learning.

1) The duration of industrial training must be for a minimum of 1 week and maximum of 8 weeks on full time basis.

2) Industrial Training in which students pays a fee to the organization / industry will not be considered.

3) He/she can undergo training in one or more industry /organization.

4) The student must submit letters from the industry clearly specifying his / her name and the

duration of the training provided by the company with authorized signatures.

5) Industrial training must be related to the field of specialization or the M.Tech program in which the student has enrolled.

6) Students undergoing industrial training are advised to use ICT tools such as skype to report their progress and submission of periodic progress reports to the faculty members.

7) Every student has to write and submit his/her own industrial training report to the designated faculty.

8) Students have to make a presentation on their industrial training in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.

9) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.

10) The broad format of the industrial training report shall be as follows

- Cover Page
- Certificate from College
- Training Certificate from Industry / Organization
- Acknowledgement
- Executive Summary
- Table of Contents
- Chapter 1 - Profile of the Organization –Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices
- Chapter 2 – Details of the Training Modules
- Chapter 3 – Reflections – Highlight specific technical and soft skills that you acquired

References & Annexure

Course Outcomes:

After going through the industrial training the student will be able to:

CO1: Understand the process of applying engineering knowledge to solve industrial problems

CO2: Develop skills through training relevant to industrial requirement

CO3: Communicate effectively and work in teams

CO4: Imbibe ethical practices and develop it as life skill.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation on the application of engineering knowledge 25%

(2) Ability to comprehend the importance of skilling and training 25%

(3) Importance of communication, professional ethics, sustainability 20%

(4) Oral Presentation and Report 30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		M	H	M		M				L	
CO2				H	M	M		L			
CO3					L		M	H	H		
CO4					L		H			M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	
CO2	L	L
CO3		M
CO4	M	H

GUIDELINES FOR INDUSTRIAL VISITS

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the role of industries and service organization in meeting the demands of the society.

(2) Explain the working of different industries and organizations with an engineering perspective

(3) Comprehend the importance of team work, communication and sustainable solutions.

(4) Imbibe values, professional ethics for life long learning.

1) Student must visit a minimum of THREE organizations/industry. The duration of the visit per organization must be for ONE full day, during which he/she must comprehend the importance of organization structure, function of various departments, application of engineering knowledge, resource management, importance to environment and safety, professional ethics.

2) It is mandatory to visit ONE private multi-national company or public sector industry /

organization, ONE medium-small enterprise and ONE rural based or NG organization.

3) The student must submit letter from the industry clearly specifying his / her name and the date of visit to the industry with authorized signatures.

4) Industrial visit must be related to the field of specialization or the M.Tech program in which the student has enrolled.

5) Every student has to write and submit his/her own report on each industrial visit and submit the report to the designated faculty advisor for evaluation.

6) A photograph outside the industry with the name and logo of the industry in the background along with the students and faculty members could be included in the report.

7) Students have to make a presentation on their industrial visit in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.

8) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.

9) The broad format of the industrial visit report shall be as follows

- Cover Page
- Certificate from College
- Acknowledgement
- Synopsis / Executive Summary
- Table of Contents
- Chapter 1 - Profile of the PSU or MNC – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
- Chapter 2 – Profile of the SME – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
- Chapter 3 - Profile of the NGO – must include Organizational structure, services, Manpower, Societal Concerns, Professional Practices
- Chapter 4 – Comparative Analysis of PSU/MNC – SME – NGO
- References & Annexure (Permission letters from the organizations for the visit & photographs)

Course Outcomes:

After going through this course the student will be able to:

CO1: Classify the role of different industries and organization in addressing the needs of the society.

CO2: Explain the process of applying engineering knowledge in industries and organizations.

CO3: Describe the importance of communication and team work

CO4: Recognize the importance of practicing professional ethics and need for life skills.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):
The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries 25%

(2) Ability to comprehend the functioning of the organization/ departments 30%

(3) Importance of resource management, environment and sustainability 20%

(4) Presentation Skills and Report 25%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		M	H	M		M				L	
CO2				H	M	M		L			
CO3					L		M	H	H		
CO4					L		H			M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	
CO2	L	L
CO3		M
CO4	M	H

TECHNICAL SEMINAR						
Course Code	**:**	16MBT36		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L:T:P:S**	**0:0:4:0**	**SEE Marks**		**50**
Credits	**:**	**2**		**SEE Duration**		**30 min**

Course Learning Objectives (CLO):
The students shall be able to:

(1) Understand the technological developments in their chosen field of interest

(2) Explain the scope of work and challenges in the domain area

(3) Analyze these engineering developments in the context of sustainability and societal concerns.

(4) Improve his/her presentation skills and technical report writing skills

GUIDELINES

1) The presentation will have to be done by individual students.
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
3) The topic could be an extension or complementary to the project
4) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation.

Course Outcomes:
After going through this course the student will be able to:
CO1:Identify topics that are relevant to the present context of the world
CO2: Perform survey and review relevant information to the field of study.
CO3: Enhance presentation skills and report writing skills.
CO4: Develop alternative solutions which are sustainable

Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):
The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

Rubrics for Evaluation:

1) Topic – Technical Relevance, Sustainability and Societal Concerns 15%
2) Review of literature 25%
3) Presentation Skills 35%
4) Report 25%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		H	M	M	L	H	H	--	---	---	M
CO2	L	M								H	
CO3							L	M	H		
CO4		L	M		H	H					H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	L
CO2	M	H
CO3	M	L
CO4	H	L