Learning Outcomes based Curriculum Framework (LOCF)

For

Master of Technology
(Mechanical Engineering)
Two Year Regular Full-Time
Postgraduate Programme

Faculty of Engineering and Technology
Chaudhary Devi Lal University
Sirsa-125055
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1. Faculty of Engineering & Technology

The Faculty covers the professional and academic programmes/courses run in the university teaching department of computer science and engineering, university school of graduate studies, affiliated general degree colleges, institute of computer applications and engineering colleges. BTech and MTech programmes in major disciplines and MCA, MSc Data Science, BSc Data Science, BCA programmes are managed by the Faculty.

2. Learning Outcome based Curriculum Framework

The CBCS evolved into learning outcome based curriculum framework and provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enables the potential employers in assessing the performance of the candidate.

2.1 Objectives of the programme

After spending two years in their profession Master of Technology (Mechanical Engineering) regular full-time graduates are expected to:

- Create and maintain an environment for excellence in Instruction, Learning, and Applied Research in the area of Mechanical so as to equip the students with necessary knowledge and skills for higher education/employment and to meet the social demands.
- Combine excellence and research with service to society and provide students with a balance of intellectual and practical experiences.
- Cater the need of various industries particularly aerospace, defence and scientific industries.
- Create the centre of excellence in the field of Mechanical Engineering and ensure that the students after completion under this programme be capable enough to take over the challenges related to the design and manufacturing of the sophisticated components required in aerospace, auto industry, defence etc.
- Develop communication skills necessary to function productively in the given settings to achieve a successful professional/vocational career with academic and professional ethics and social obligations.
- Engage in lifelong learning, career enhancement and adapt to changing professional, societal, and environmental needs in a way confirming to his/her position in the profession/vocation.

2.2 Programme Outcomes (POs)

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyzecomplex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions for complex engineeringproblems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complexengineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as amember and leader in a team, to manage projects and in multidisciplinaryenvironments.
PO12	**Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

2.3 Programme Specific Outcomes (PSOs)

The graduates of the Master of Technology in Mechanical Engineering regular full-time programme will have/be:

PSO1	To impart knowledge to students in the latest technological topics on Mechanical Engineering and to provide them with opportunities in taking up advanced topics in the field of research.
PSO2	To create a congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary research
PSO3	To broaden and deepen their capabilities in analytical and experimental research methods, analysis of data, and drawing relevant conclusions for scholarly writing and presentation of their research work.
PSO4	To provide guidance to students for their choices in research and professional career outlook and to encourage students to take up research.
PSO5	To equip students with integrity and ethical values so that they become responsible technocrats

3. Programme Structure

Master of Technology (Mechanical Engineering) programme, a four-semester postgraduate programme is 80 credits weightage consisting of Core Courses (CC), Discipline Specific Elective Courses (DSC), Skill Enhancement Courses (SEC), Open Elective Courses (OEC);

Table 1: Master of Technology (Mechanical Engineering) Credit Scheme

Sem	Core Courses (CC)		Discipline Specific Elective Courses (DSC)		Skill Enhancement Courses (SEC)		Open Elective Courses (OEC)*		Grand Total Credits
	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
I	07	24	-	-	-	-	-	-	24
II	06	20	01	04	-	-	01	04	28
III	02	06	01	04	01	04	01	04	18
IV	-	-	-	-	01	10	-	-	10
Total	15	50	02	08	02	14	02	08	80
%age	-	62.5	-	10.0	-	17.5	-	10.0	100

* A total of 08 credits are to be earned from other Engineering Departments or from MOOCs.

Table 2: Detailed break-up of Courses' Type (Semester wise)

Sem	Core Courses	Discipline Specific Elective Courses	Skill Enhancement Courses	Open Elective Courses	Total Courses
I	CC1 CC2 CC3 CC4 CC5 CC6 CC7	-	-	-	7
II	CC8 CC9 CC10 CC11 CC12 CC13	DSC1	-	OEC1	8
III	CC14 CC15	DSC2	SEC1	OEC2	5
IV	-	-	SEC2	-	1

Table 3: Courses' codes, titles, and credits

Course Code	**Course Title**	**Contact Hours/Credit**			
	Semester I	L	T	P	Total
MTech/ME/1/CC1	Advanced Mechanics of Solids	4/4	-	-	4/4
MTech/ME/1/CC2	Advanced Engineering Materials	4/4	-	-	4/4
MTech/ME/1/CC3	Automation in Manufacturing	4/4	-	-	4/4
MTech/ME/1/CC4	CNC Technology and Programming	4/4	-	-	4/4
MTech/ME/1/CC5	Total Quality Management	4/4	-	-	4/4
MTech/ME/1/CC6	Advanced Mechanics of Solids Lab	-	-	4/2	4/2
MTech/ME/1/CC7	CNC Technology and Programming Lab	-	-	4/2	4/2
Semester II					
MTech/ME/2/CC8	Advanced Machine Design	4/4	-	-	4/4
MTech/ME/2/CC9	Computer Aided Design and Manufacturing	4/4	-	-	4/4
MTech/ME/2/CC10	Casting and Welding Technology	4/4	-	-	4/4
MTech/ME/2/CC11	Tool Engineering	4/4	-	-	4/4
MTech/ME/2/DSC1(i)	Modern Manufacturing Processes	4/4	-	-	4/4
MTech/ME/2/DSC1(ii)	Instrumentation and Measuring Systems				
MTech/ME/2/DSC1(iii)	Manufacturing Information Systems				
MTech/ME/2/CC12	Computer Aided Design and Manufacturing Lab	-	-	4/2	4/2

MTech/ME/2/CC13	Casting and Welding Technology Lab	-	-	4/2	4/2
MTech/ME/3/OEC1	Students shall complete a 4-credit open elective course offered by other Engineering Departments/MOOCs	4/4	-	-	4/4
Semester III					
MTech/ME/3/CC14	Tribology	4/4	-	-	4/4
MTech/ME/3/DSC2(i)	Smart Mobility and Intelligent Vehicles	4/4	-	-	4/4
MTech/ME/3/DSC2(ii)	Sustainable Manufacturing				
MTech/ME/3/DSC2(iii)	Flexible Manufacturing System				
MTech/ME/3/CC15	Tribology Lab	-	-	4/2	4/2
MTech/ME/3/SEC1	Dissertation Part-1 with Seminar	-	-	8/4	8/4
MTech/ME/3/OEC2	Students shall complete a 4-credit open elective course offered by other Engineering Departments/MOOCs	4/4	-	-	4/4
Semester IV					
MTech/ME /4/SEC2	Dissertation Part -II	-	-	20/10	20/10
	TOTAL	**56/56**	-	**48/24**	**104/80**

Table 4: M.Tech. Mechanical Engineering Regular Full Time Courses' List

Course Code	**Course Title**	**Credits**
	Core Courses	4
MTech/ME/1/CC1	Advanced Mechanics of Solids	4
MTech/ME/1/CC2	Advanced Engineering Materials	4
MTech/ME/1/CC3	Automation in Manufacturing	4
MTech/ME/1/CC4	CNC Technology and Programming	4
MTech/ME/1/CC5	Total Quality Management	4
MTech/ME/1/CC6	Advanced Mechanics of Solids Lab	2
MTech/ME/1/CC7	CNC Technology and Programming Lab	2
MTech/ME/2/CC8	Advanced Machine Design	4
MTech/ME/2/CC9	Computer Aided Design and Manufacturing	4
MTech/ME/2/CC10	Casting and Welding Technology	4
MTech/ME/2/CC11	Tool Engineering	4
MTech/ME/2/CC12	Computer Aided Design and Manufacturing Lab	2
MTech/ME/2/CC13	Casting and Welding Technology Lab	2
MTech/ME/3/CC14	Tribology	4
MTech/ME/3/CC15	Tribology Lab	2
Discipline Specific Elective Courses		
MTech/ME/2/DSC1(i)	Modern Manufacturing Processes	4
MTech/ME/2/DSC1(ii)	Instrumentation and Measuring Systems	
MTech/ME/2/DSC1(iii)	Manufacturing Information Systems	
MTech/ME/3/DSC2(i)	Smart Mobility and Intelligent Vehicles	4
MTech/ME/3/DSC2(ii)	Sustainable Manufacturing	
MTech/ME/3/DSC2(iii)	Flexible Manufacturing System	
Skill Enhancement Courses		

MTech/ME/3/SEC1	Dissertation Part-1 with Seminar	4
MTech/ME/4/SEC2	Dissertation Part-2	10
Open Elective Courses		
MTech/ME/2/OEC1	Students shall complete a 4-credit open elective course offered by other Engineering Departments/MOOCs	4
MTech/ME/3/OEC2	Students shall complete a 4-credit open elective course offered by other Engineering Departments/MOOCs	4
Open Electives Courses offered to the M.Tech. students of other Engineering Departments		
ME/OEC1	Supply Chain and Logistics Management	4
ME/OEC2	Entrepreneurship Development Skills	4
ME/OEC3	Quality and Reliability Engineering	4
ME/OEC4	Computer Integrated Manufacturing	4

SEMESTER – I

MTech/ME/1/CC1: Advanced Mechanics of Solids							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

To understand the concepts of stress and strain, strength and stiffness, deformation and displacement and energy theorems.

To design machine elements using theories of deformable bodies.

- To predict the behaviour of the solid bodies subjected to various types of loading.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Understand the concepts of stress and strain, strength and stiffness, deformation and displacement and energy theorems
CO2	Predict the behaviour of the solid bodies subjected to various types of loading.
CO3	Design machine elements using theories of deformable bodies.

CO-PO Mapping Matrix for Course MTech/ME/1/CC1

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	-	1	-	-	-	-	1
CO2	2	3	3	2	1	1	1	-	1	1	-	1
CO3	2	2	3	2	2	1	-	-	2	1	-	1
Average	2.33	2.66	2.33	1.66	1.33	0.66	0.66	-	1	0.66	-	1

Course Content
MTech/ME/1/CC1: Advanced Mechanics of Solids

Unit I	**3-D dimensional stress and strain**: Analysis of Stresses and Strains in rectangular and polar coordinates: Cauchy's formula, Principal stresses and principal strains, 3D Mohr's Circle, Octahedral Stresses, Hydrostatic and deviatoric stress, Differential equations of equilibrium, Plane stress and plane strain, compatibility conditions. Energy Theorems: Strain energy due to axial load, bending, shear and torsion, Maxwell's reciprocal theorem, Castigliano's theorem, analysis of helical springs by energy method.
Unit - II	**Unsymmetrical bending**: Shear centers for sections with one axis of symmetry, shear center for any unsymmetrical Section, stress and deflection of beams subjected to unsymmetrical bending. Axi-Symmetric Problems: Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.
Unit - III	**Buckling of columns**: Beam columns single concentrated load, number of concentrated loads, continuous lateral Load, end couple, couples at both ends triangular loads. Bending of plates: Basic definition, stress curvature and moment relations, differential equation of plate deflection, boundary conditions, simply supported rectangular plates, axis symmetric loaded Circular plates.

Unit - IV	**Beam on Elastic Foundations**: General theory, infinite, semi-infinite, finite beams classification of beams, Beam supported by equally spaced elastic elements. Stress concentration: Stress concentration in tension or compression members, Stresses in a plate with a circular hole, elliptical hole, small semi-circular grooves.

Text/Reference Books

1. Srinath L.S, "Advanced Mechanics of Solids", Tata McGraw-Hill Education, 2010.
2. Ryder G.H, "Strength of Material", Macmillan, India, 1961.
3. Sadhu Singh, "Strength of Materials", Khanna Publishers, India, 2012.
4. Muubeen A, "Mechanics of Solid", Pearson Publications, India, 2011.
5. Popov E.P, "Engineering Mechanics of Solids", Prentice Hall of India, 2006
6. Timoshenko S, "Strength of Materials Part-11", East-West Press Pvt. Ltd., New Delhi, 2012.

MTech/ME/1/CC2: Advanced Engineering Materials

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives:

- To understand significance of material science and its role in manufacturing.
- To analyze the importance of various engineering materials (metals, polymers, ceramics, composites, Semi-conductor).
- To recite ceramics and composites, their manufacturing techniques, properties and applications.

- To propose appropriate plastics and polymers for different applications.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Understand significance of material science and its role in manufacturing.
CO2	Analyze the importance of various engineering materials (metals, polymers, ceramics, composites, Semi-conductor).
CO 3	Recite ceramics and composites, their manufacturing techniques, properties and applications.
CO 4	Propose appropriate plastics and polymers for different applications.

CO-PO Mapping Matrix for Course MTech/ME/1/CC2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	1	-	1	-	-	-	-	2
CO2	3	3	1	2	3	1	2	-	-	1	1	1
CO3	3	3	1	1	2	-	2	-	-	1	1	1
CO4	2	2	3	2	1	1	3	1	1	1	1	1
Average	2.5	2.75	1.75	1.5	1.75	0.5	2	0.25	0.25	0.75	0.75	1.25

Course Content
MTech/ME/1/CC2: Advanced Engineering Materials

Unit I	**Non-Ferrous Materials:** Copper and its Alloys, Aluminium and its Alloys, Nickel and its Alloys, Zinc and its Alloys, Titanium and its Alloys, Magnesium and its Alloys, Cobalt and its Alloys, Lead and its Alloys.
Unit - II	**Ferrous Materials**: Production of Iron and Steel, Cast Irons, Low Alloy and High Alloy Steels, Tool Steels, Stainless Steels, Iron Carbon System, Time Temperature Transformation Relations, Heat Treatment of Plain Carbon Steels, Selective and Surface-Hardening.
Unit - III	**Polymers, Composites and Ceramics**: Polymer Materials (Introduction), Polymer Structure, Thermoplastics, Thermosets, Elastomers, Types and Applications of Ceramics, Properties of Ceramics Materials, Glass, Cements, Refractories and Advanced Ceramics, Structure of Composites, Metal Matrix Composites, Ceramic Matrix Composites, Polymer Matrix Composites, Fiberglass, Carbon Fiber Reinforced Polymer Composites, Properties of Composites.
Unit - IV	**Miscellaneous Materials**: Smart Materials, Shape Memory Phenomenon and Alloys, Hydrogen Storage Alloys, Functionally gradient material, Adhesives, Metals for Nuclear energy, Sound Insulating Materials.

Text/Reference Books

1. William F. Smith, Havad Hashemi and Ravi Prakash, "Material Science and Engineeing", Tata McGraw Hill Education (P) Ltd, 2013.
2. William D. Callister, Jr. and Balasubramaniam, R., "Callister's Material Science and Engineering" Wiley India (P) Ltd, 2009.
3. Gandhi and Thompson, "Smart Materials and Structures", Chapman and Hall, 1992.
4. Gladius Lewis, "Selection of Engineering Materials" Prentice-Hall, 1989.
5. Rama Rao, "Advances in Materials and their applications", Wiley Eastern Ltd, 1993.

MTech/ME/1/CC3: Automation In Manufacturing							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: To inculcate the ability to design of hydraulic, pneumatic and electro-pneumatic logic circuits for automating processes in manufacturing, demonstrate problem-solving skills in automation and safely use the machines in the industries. Also, to explore the use of different sensors, control valves, controllers and actuators for electro-pneumatic & hydraulic circuits.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Understand the concepts of automation theory and its applications in various fields of manufacturing.
CO2	Understand principles, methods, and hardware/software tools used in modern computerized design and manufacturing of discrete parts
CO3	Understand the main principles and components involved in optimizing production system design and operations.

CO-PO Mapping Matrix for Course MTech/ME/1/CC3

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	2	2	1	1	-	-	-
CO2	3	2	2	2	3	2	-	-	-	-	1	-
CO3	3	2	3	2	3	2	1	-	-	-	-	-
Average	3	2	2.66	2	3	2	1	0.33	0.33	-	0.33	-

Course Content
MTech/ME/1/CC3: Automation In Manufacturing

Unit I	**Introduction to Factory Automation and Integration**: Basic Concepts, Types of automation, Automation. Modern developments in automation in manufacturing and its effect on global competitiveness, Need and implications of automation in Manufacturing.
Unit - II	Introduction to Hydraulics/Pneumatics Electro-pneumatic controls and devices, Basic elements hydraulics/pneumatics, Electro-pneumatic systems, Fluid power control elements and standard graphical symbols for them, Construction and performance of fluid power generators, Hydraulic & pneumatic cylinders - construction, design and mounting, Hydraulic & pneumatic valves for pressure, Flow & direction control, Servo valves and simple servo systems with mechanical feedback, Solenoid, Different sensors for electro-pneumatic system, hydraulic, pneumatic & electro-pneumatic circuits.

Unit - III	Introduction to rapid prototyping (RP), Basic Principles of RP, Steps in RP, Advantages of RP, Classifications of Different RP Techniques. Materials for RP: Plastics, Ceramics, Resins, Metals, Selection criterions for materials for different processes, the advantages and limitations of different types of materials.
Unit - IV	**Automatic transfer machines**: Classifications, Analysis of automated transfer lines, without and with buffer storage, Group technology and flexible manufacturing system. Assembly automation: Types of assembly systems, Assembly line balancing, Performance and economics of assembly system.

Text/Reference Books

1. Groover, M. P., "Automation, Production systems and Computer Integrated Manufacturing", 2nd Ed., Prentice Hall, 2005.
2. Boothroyd, G., "Assembly Automation and Product Design", 2nd Ed., Marcel Dekker, 1992.
3. Boothroyd, G., Dewhurst, P. and Knight, W., "Product Design for Manufacture and Assembly", 2nd Ed., Taylor & Francis, 2002.
4. Boothroyd, G., Poli, C. and Murch, L. E., "Automatic Assembly", Marcel Dekker, 1982.
5. Tergan, V., Andreev, I. and Lieberman, B., "Fundamentals of Industrial Automation", Mir Publishers, 1986.

MTech/ME/1/CC4:CNC Technology and Programming

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To understand fundamentals of the CNC technology.
- To understand the programming methods in CNC machines.

Course Outcomes	At the end of this course, the student will be able to:

CO1	Understand the basics of CNC machines.
CO2	Write CNC programs proficiently.

CO-PO Mapping Matrix for Course MTech/ME/1/CC4

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	2	1	-	-	-	-	-
CO2	3	3	3	3	3	2	1	1	1	-	-	-
Average	3	2.5	3	2.5	3	2	1	0.5	0.5	-	-	-

Course Content
MTech/ME/1/CC4: CNC Technology and Programming

Unit- I	**Computer numerical control machining**: Axis standards, Coordinate systems, CNC machine motions. **CNC hardware basics**: Structure, Drives, Actuation systems, Sensors and Feedback devices.
Unit - II	**Programming fundamentals:** Coding standards, Preparatory functions, Miscellaneous functions. Programming features: Tool length and radius compensation, Tool nose radius compensation, Canned cycles, Branching logics, Thread cutting, Cut planning etc. Fundamentals and programming of CNC turning center and CNC machining center, Problems.
Unit - III	**CNC Advanced Part Programming**: Automatically Programmed Tools (APT) language: Language structure, Geometry commands, Motion Commands, Post Processor Commands, Compilation control commands, Repetitive Programming Complete part program, Problems. **CAD/CAM aided CNC part programming**: Use of WinNC, ELCAM and ELPULS for product design and manufacturing.
Unit - IV	**CNC Tooling**: Cutting tool material and characteristics, Turning tool geometry, Tooling system for turning, milling and wire cut EDM, Tool presetting, Automatic tool changers, Work holding.

Text/Reference Books

1. Jon S. Stenerson, Kelly Curran , "Computer Numerical Control: Operation and Programming", Prentice Hall, 3rd edition 2007.
2. Mattson Mike, "CNC Programming: Principles & Applications", Cengage learning, 1st edition 2013.
3. Fitzpatrick, "Machining and CNC Technology", McGraw-Hill Higher Education, 3rd edition 2013.
4. Michael J. Peterson, "CNC Programming: Basics & Tutorial Textbook", Create Space Independent Publishing Platform, 1st edition 2008.
5. Peter Smid, "CNC Tips and Techniques: A Reader for Programmers", Industrial Press Inc., 1st edition 2013.

MTech/ME/1/CC5:Total Quality Management							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To understand the basic concepts of quality.
- To understand the continuous process improvement & benchmarking.
- To understand the concept of statistical quality control & application of control charts.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Students will be able to understand various quality related terms commonly used in industries.
CO2	Student will be to understand the continuous process improvement & benchmarking .
CO3	Each student understands the concept of statistical quality control & application of control charts and will be able to solve problems based on them.

CO-PO Mapping Matrix for Course MTech/ME/1/CC5

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	1	1	1	2	-	-	-
CO2	3	2	3	2	3	3	2	1	2	1	1	1
CO3	3	3	3	2	3	1	1	-	1	1	-	-
Average	3	2.33	2.66	2.33	2.66	1.66	1.33	0.66	1.66	0.66	0.33	0.33

Course Content
MTech/ME/1/CC5: Total Quality Management

Unit- I	**Introduction**: Definition, Basic Approach, Guru's of TQM, Defining Quality, Historical Review. Leadership: Definitions, Characteristics of Quality Leaders, Leadership Concepts, Seven habits of highly effective people, The Deming Philosophy, Role of TQM Leaders, Implementation, Quality Council, Core values, Concepts and Framework, Strategic planning, Communications
Unit - II	**Customer Satisfaction and Employee Involvement**: Introduction, Customer perception of Quality, Feedback, Using Customer Complaints, Service Quality, Translating Needs into Requirement, Customer Retention, Motivation, Employee Surveys, Empowerment, Suggestion

	System, Recognition and Reward, Gain sharing, Performance Appraisal, Unions and Employee Involvements, Benefits of Employee Involvement
Unit - III	**Continuous Process Improvement and Benchmarking**: Process, The Juran Trilogy, Improvement Strategies, PDSA Cycle, Kaizen, Re-engineering, Six Sigma. Benchmarking: Definition, Reasons to benchmark, Understanding current Performance, Planning, Pitfalls and Criticisms of Benchmarking Tools and Techniques: Information Technology, Computers and the Quality Function, Internet and Electronic Media, Technologies of the Future. Quality Management System: ISO, benefits of Registration, Sector Specific Standards, Documentation, Internal Audits. Environmental Management System: ISO 14000, Requirements of ISO 14000
Unit - IV	**Failure Mode and Effect Analysis**: Reliability, Failure Rate, FMEA: Team and Documentation, Stages of FMEA, Design and Process of FMEA, Products Liability: Product Safety Law, Products Liability Law, Statistical Process Control: Cause and Effect Diagram, Process Capability, Control Charts for Attributes. Experimental Design: Hypothesis, t Test, F Test, Orthogonal Design

Text/Reference Books

1. Besterfield Dale H., "Total Quality Management", Pearson Education.
2. N Logothetis, "Managing for total quality from Deming to Taguchi and SPC", Prentice Hall.
3. Feigenbaum AV, "Total Quality Control" , McGraw Hill.
4. Sharma DD, "Total Quality Mangement ", Sultan Chand & Sons
5. Gilbert John, "A slice by slice guide to TQM", Affiliated East West Press.

MTech/ME/1/CC6: Advanced Mechanics of Solids Lab

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	50	-	3 Hours	TEE/ Practical File

Instructions to paper setter for Final Term Examination: Final Term Examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of practical file, performance in practical and a viva voce exam.

Course Objectives: To predict the behaviour of the solid bodies subjected to various types of loading.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Predict the behaviour of the solid bodies subjected to various types of loading.

CO2	Design machine elements using theories of deformable bodies.
CO3	Select material in engineering applications based upon experimental data.

CO-PO Mapping Matrix for Course MTech/ME/1/CC6

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	1	1	-	-	1	-
CO2	3	3	3	3	2	1	-	1	-	-	-	-
CO3	3	2	3	2	3	2	2	1	-	-	1	-
Average	3	2.66	3	2.66	2.33	1.33	1	1	-	-	0.66	-

List of Experiments
MTech/ME/1/CC6: Advanced Mechanics of Solids Lab

Experiment-1	To perform uniaxial tension and compression tests for ductile and brittle materials, compare stress-strain curves for ductile and brittle materials, verify failure criterions for ductile and brittle materials and find out reasons of erratic failure, if any.
Experiment-2	To perform torsion tests for ductile and brittle materials, verify failure criterions for ductile and brittle materials and find out reasons of erratic failure, if any.
Experiment-3	To find out hardness value (Vickers/Rockwell/Brinell) of the given specimen and interpret the obtained experimental results and use them as a tool for material selection in engineering applications.
Experiment-4	To understand principle of fatigue testing machine in a reverse loading manner and to find the endurance limit of the given specimen on Fatigue Testing Machine. To construct an S-N curve (stress level - number of cycles to failure) of the test samples provided and interpret the obtained experimental results and use them as a tool for material selection in engineering applications.
Experiment-5	To prepare a given specimen (mild steel) for micro structural examination. To observe different micro-structures like ferrite, pearlite, cementite, austenite, bainite and martensite and study their properties.

MTech/ME/1/CC7: CNC Technology and Programming Lab

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	50	-	3 Hours	TEE/ Practical File

Instructions to paper setter for Final Term Examination: Final Term Examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of practical file, performance in practical and a viva voce exam.

Course Objectives:

- To understand and operate CNC machines.
- To create manual part programming on CNC machines.

Course Outcomes	At the end of this course, the student will be able to:

CO1	Manually write, edit, debug, and use CNC programs to produce parts/products

CO-PO Mapping Matrix for Course MTech/ME/1/CC7

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	1	1	-	-	1	-
Average	3	3	3	3	3	2	1	1	-	-	1	-

List of Experiments
MTech/ME/1/CC7: CNC Technology and Programming Lab

Experiment-1	To perform basic setup, startup, and safely features in CNC turning, machining and wire-cut EDM machine tools.
Experiment-2	To select optimum cutters, cutting and spindle speeds, and other parameters of CNC turning, CNC machining center according to tool and work material.
Experiment-3	To set up cutting tools and part holding devices in CNC turning, CNC machining center for optimal movement of tool and piece.
Experiment-4	To create manual part programs for least machining time and simulate the tool-path on CNC turning, machining and wire-cut EDM machine tools.
Experiment-5	To operate CNC turning center, machining center and wire-cut EDM. Load a program and execute actual machining.

SEMESTER – II

MTech/ME/2/CC8:Advanced Machine Design							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To understand the concept of design and its considerations for manufacturing, assembly, aesthetics, ergonomics, fatigue and creep.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Design products for manufacturing, assembly, aesthetics, ergonomics, fatigue and creep.

CO-PO Mapping Matrix for Course MTech/ME/2/CC8

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	1	-	-	1	1
Average	3	3	3	3	3	3	2	1	-	-	1	1

Course Content
MTech/ME/2/CC8: Advanced Machine Design

Unit- I	**Design Philosophy**: Design process, design models, design phases, product design strategies, product design planning and specification, need analysis, concept generation, concept selection, concept testing. Statistical design considerations: Frequency distribution, Histogram and frequency polygon, Normal distribution, Units of measurement of central tendency and dispersion, standard variable -population combinations, Design and natural tolerance.
Unit - II	**Design for Manufacture and Assembly:** General considerations in design for casting, forging, machining, powder metallurgy, Design considerations for assembly.
Unit - III	**Design for aesthetics and ergonomics**: Aesthetics considerations in design-Basic types of product forms, designing for appearance –shape, features, materials and finishes, Ergonomic considerations in design display and controls, workspace design, hand tool design, human engineering considerations-Relation between man, machine and environmental factors, **Optimum Product Design**: Objective of optimum design, Johnson's method of Optimum Design (MOD), Optimum design with normal specification of simple machine elements.
Unit - IV	**Design for fatigue and creep**: Static failure theories, Fatigue mechanisms, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories, cumulative fatigue damage,

	thermal fatigue and shock, harmful and beneficial residual stresses, yielding and transformation.

Text/Reference Books

1. Richard G Budynas and Keith J Nisbett, "Shigley's Mechanical Engineering Design", McGraw-Hill Higher Education, 10th edition, 2014.
2. Bhandari V., "Design of machine Elements", McGraw Hill Education (India) Private Limited, 3rd edition, 2010.
3. William C. Orthwein, "Machine Component Design: v. 1 & 2", Jaico Publishing House, New Ed edition, 2006.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Components Design", Wiley, 5th edition, 2011.
5. Hall A. S., Holowenko A. R. and Laughlin H. G, "Theory and problems of Machine Design", Schaum, 1981.
6. Johnson R. C, "Mechanical Design Synthesis with optimization applications", Van Nostrand Reinhold Company, 1st edition 1971.
7. Harry Peck, "Design for Manufacture", Pittman Publication, 1983.
8. Robert Matousek, "Engineering Design – A systematic approach", Blackie & sons Ltd., 1963 Blackie & Son Ltd, 1972.
9. James G. Bralla, "Design for Manufacturability Handbook", McGraw Hill Co., 2 edition 1998.
10. K. G Swift, "Knowledge based design for manufacture", Kogan Page Ltd., 1987.
11. Penny R.K. And Marriott D. L., "Design for Creep", 2nd edition 1995.

MTech/ME/2/CC9:Computer Aided Design and Manufacturing

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question

there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To understand the basic parametric fundamentals that are used to create and manipulate geometric models.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Create the different wireframe and surface primitives using parametric modeling.
CO2	Create the different solid primitives using the different representation schemes.
CO3	Manipulate the created wireframe, surface and solid models.

CO-PO Mapping Matrix for Course MTech/ME/2/CC9

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	1	1	-	-	-	1
CO2	3	3	3	3	2	1	1	-	-	-	-	1
CO3	3	3	3	3	2	1	1	-	-	-	1	1
Average	3	3	3	3	2	1	1	0.33	-	-	0.33	1

Course Content
MTech/ME/2/CC9: Computer Aided Design and Manufacturing

Unit- I	**Introduction**: Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process. **Transformations**: 2D and 3D transformations.
Unit - II	**Curves and Surfaces**: Analytical, Synthetic curves with advantages, Disadvantages, Comparison with parametric curves, Geometric modeling curves and surfaces, Representation, Wire frame models, Parametric representations, Parametric curves and surfaces. **Solid modeling**: Solid models, Fundamentals of solid modeling, Different solid representation schemes, Half -spaces, Boundary representation (B-rep), Constructive solid geometry (CSG).
Unit - III	**CAD/CAM Data Exchange Formats**: Types of file formats & their exchange, Graphics standards. Simulation: Need of simulation , concept of a system, Model and its purpose , Types of simulation approaches- Event Scheduling Approach (ESA) , Activity Scanning Approach (ASA), Process Interaction Approach (PI A), Steps in a simulation study , advantages/ disadvantages and pitfalls of simulation.
Unit - IV	**Computer Aided Manufacturing** : CNC machine tools, principle of operation of CNC, Steps in manufacturing , construction features including structure and drives, Direct numerical control (DNC) and its application, advantages and limitations of CNC systems. **Computer Assisted Part Programming**: CNC part programming, axes of CNC machines, manual part programming using G code, use of subroutines, computer aided part programming using APT or any other language, Automatic NC program generation from CAD models, Machining of surfaces, Mould, Casting and Die design and manufacture using CAD/CAM software.

Text/Reference Books

1. Zeid, I., "CAD/CAM", McGraw Hill, 2008.
2. Rogers, D. F. and Adams, J. A., "Mathematical Elements for Computer Graphics", McGraw Hill 2nd edition, 1989.
3. Radhakrishnan, P. and Kothandaraman, C. P., "Computer Graphics & Design", Dhanpat Rai Publication",

2nd edition, 2005.
4. Krishnamoorathy, C. S. and Rajeev, J. S., "Computer Aided Design (Software and Analysis Tools)",
5. Narosa Publication House, 2nd edition, 2005.

MTech/ME/2/CC10 : Casting and Welding Technology

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To study the metallurgical concepts and applications of casting and welding process.
- To impart the knowledge of joining different metallic and non-metallic materials.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Model the solidification process of castings.
CO2	Evaluate the suitability of various casting processes for a product.
CO3	Analyze the influence of process parameters on the quality of weld.
CO4	Select appropriate advanced techniques for aerospace, nuclear, automobile and naval applications.

CO-PO Mapping Matrix for Course MTech/ME/2/CC10

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	1	1	1	-	-	-	1
CO2	3	2	2	3	2	1	2	1	-	-	-	1
CO3	3	3	2	2	1	1	1	-	-	-	1	1
CO4	3	2	2	2	1	1	1	1	-	-	1	1
Average	3	2.5	2.25	2.25	1.75	1	1.25	0.75	-	-	0.5	1

Course Content
MTech/ME/2/CC10 : Casting and Welding Technology

Unit- I	**Casting Design and Metallurgy**: Heat transfer between metal and mold, Design considerations in casting, Solidification Mechanism, Centre-line feeding resistance **Recent Trends in Casting and Foundry Layout**: Review and critical comparison of various established processes; recent developments e.g. flask less molding, hot and cold box molding; ceramic shell molding; V process; continuous casting; squeeze and pressed casting; Nishiyama process; Shaw process; Anitoch process etc.
Unit - II	**Physics of Welding Arc**: Welding arc, arc initiation and maintenance, cathode and anode drops, Arc column, Thermionic and non- thermionic cathode, arc characteristics, Characteristics of power sources for various arc welding processes, arc length regulation in mechanized welding processes, cycle & power factor. **Welding Process & Modes of Metal Transfer**: Mechanism and types of metal transfer in various arc welding processes, factors controlling melting rate in various welding processes, Arc welding processes.
Unit - III	**Recent Trends in Welding**: Surfacing and Hot facing in welding, Friction welding, friction stir welding, diffusion bonding , ultrasonic welding ,electron beam welding ,Laser beam welding , Plasma welding, hybrid twin wire active TIG – Tandem, MIG.
Unit - IV	**Weldability**: Weldability tests, Varestraint testing, Lehigh Restraint test, Houldcroft test, Implant test, Oblique Y – Groove test (Tekken Test)- Weld mechanical testing. **Metallurgy of Welding** : Carbon equivalent, welding of carbon and low alloy steel, Welding of Stainless steel, Welding of Al and its alloys, Welding of Nickel based super alloys, Weld defects and weld failures.

Text/Reference Books

1. John K. C, (2015), "Metal Casting and Joining", PHI Learning, New Delhi
2. Khanna OP, "A Text Book of Foundry Technology", Dhanpat Rai Publications
3. Bowditch, W.A., Bowditch M. A., Bowditch, K. E., (2006), "Welding Technology Fundamentals", Goodheart -Willcox Pub., 4th Edition
4. O'Brien, (2004), "Welding Handbook: Welding Processes", Part 1, Vol. 2, American Welding
5. Pramar RS, " Welding Engineering and Technolgy", Khanna Publisher

MTech/ME/2/CC11 : Tool Engineering							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To understand the mechanics of various advanced machining processes including the material removal, tool design, effect of process parameters on the output responses.
- To impart depth knowledge on principle involved, accuracy involved, tooling requirement and knowledge about the process capability.
- To develop knowledge and skills design of various jigs and fixtures to increase the production rate.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Understand the mechanics of various advanced machining processes including the material removal, tool design, effect of process parameters on the output responses.
CO2	Impart depth knowledge on principle involved, accuracy involved, tooling requirement and knowledge about the process capability.
CO3	Develop knowledge and skills design of various jigs and fixtures to increase the production rate.

CO-PO Mapping Matrix for Course MTech/ME/2/CC11

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	1	-	-	1	1
CO2	3	2	2	2	1	1	1	1	-	-	-	1
CO3	3	2	2	3	2	1	1	1	1	-	-	2
Average	3	2	2	2.33	1.66	1	1	1	0.33	-	0.33	1.33

Course Content MTech/ME/2/CC11 : Tool Engineering	
Unit- I	**Cutting Tool Materials**: Introduction and Desirable Properties, Carbon and Medium-Alloy Steels, High-Speed Steels, Cast-Cobalt Alloys, Carbides, Coated Tools, Alumina-Based Ceramics, Cubic Boron Nitride, Silicon-Nitride Based Ceramics, Diamond, Reinforced Tool Materials, Cutting-Tool Reconditioning **Design of Cutting Tools**: Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of Single Point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps
Unit - II	**Gages and Gage Design**: Limits Fits and Tolerances, Geometrical Tolerances-Specification and Measurement, Types of Gages, Gage Design, Gage Tolerances, Material for Gages **Work Holding Devices**: Basic Requirements of Work Holding Devices, Location: Principles, Methods and Devices, Clamping: Principles, Methods and Devices
Unit - III	**Design of Drill Jigs**: Definition and Types of Drill Jigs, Chip Formation in Drilling, **Design of Fixtures**: Fixtures and Economics, Types of Fixtures, Milling Fixtures, Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding Fixtures
Unit - IV	Design of Sheet Metal Bending, Forming and Drawing Dies, Bending Dies, Forming Dies, Drawing Operations, Variables that Affect Metal Flow during Drawing, Determining Blank Size, Drawing Force, Single and Double Action Draw Dies. **Tool Design for Numerically Controlled Machine Tools**: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-Holding Methods for Numerical Control.

Text/Reference Books

1. Mehta, N. K., "Metal Cutting and Design of Cutting Tools, Jigs & Fixtures" , McGraw Hill Education (India) Private Limited, 2014.
2. Cyril Donaldson, George H LeCain, Goold V.C., Joyjeet Ghose , "Tool Design", Tata-McGraw Hill, 2012.
3. Jeff Lantrip, John G. Nee, David Alkire Smith, "Fundamentals of Tool Design", Society of Manufacturing Engineers, 2003.
4. Jones E.J.H., Town H.C., "Production Engineering: Jig and Tool Design", Butterworth and Co (Publishers) Ltd, 2009.
5. Maurice Henry Albert Kempster , "An Introduction to Jig and Tool Design', Maurice Henry Albert Kempster, English Universities Press, 1964.

MTech/ME/2/DSC1(i) : Modern Manufacturing Processes

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Optional Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To teach the fundamentals and advances in modern machining processes
- To provide knowledge in applied aspects of modern machining processes viz., high speed machining, non-traditional machining, hybrid machining, advanced finishing and micromachining

Course Outcomes	At the end of this course, the student will be able to:
CO1	Explain the working principle, process capabilities and applications of various modern machining/finishing processes
CO2	Analyse the inter-relationship between the process parameters and machining performances such as cutting forces, tool wear, material removal rate and surface finish
CO3	Discuss the specific characteristics and requirements of high speed machining system
CO4	Select a suitable modern machining/finishing process for manufacturing of macro/ micro components/features

CO-PO Mapping Matrix for Course MTech/ME/2/DSC1(i)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	2	2	1	-	-	1	1
CO2	3	2	2	2	3	1	1	1	-	-	-	1
CO3	3	2	2	2	2	1	1	1	-	-	1	1
CO4	3	3	2	2	3	1	1	1	-	-	1	1
Average	3	2.25	2.25	2	2.75	1.25	1.25	1	-	-	0.75	1

Course Content

MTech/ME/2/DSC1(i) : Modern Manufacturing Processes

Unit- I	**Mechanics of machining**: Mechanisms of chip formation, shear angle relations, and theoretical determination of cutting forces in machining - Thermal aspects of machining, tool wear and tool life. **High speed machining**: High speed machining (HSM) – Characteristics of HSM – Machine tools requirements for HSM – Cutting tools for HSM – Design of tools for HSM – Tool clamping systems - Applications of HSM – Hard machining
Unit - II	**Unconventional machining processes-I**: Water jet machining - Abrasive water jet machining - Ultrasonic machining – working principle, machining system, process variables, parametric analysis, process capabilities and applications. **Unconventional machining processes-II**: Electrochemical machining - Electric discharge machining - Laser beam machining – Electron beam machining - working principle, machining

	system, process variables, parametric analysis, process capabilities and applications.
Unit - III	**Hybrid machining processes**: Vibration assisted machining – Electro chemical grinding – Electro chemical honing –Electrical discharge grinding – Electro chemical discharge grinding - Thermal assisted machining. **Micromachining processes**: Introduction to microfabrication, Diamond micro-machining, ultrasonic micromachining, micro-EDM, micro-ECM laser beam micro-machining, electron beam micromachining and focused ion-beam techniques.
Unit - IV	**Advanced Finishing Processes**: Abrasive flow finishing, Magnetic abrasive finishing, Magneto rheological finishing and chemical mechanical finishing - working principle, machine tool set up, process variables, process performance and applications.

Text/Reference Books

1. Jain V.K, (2010), Introduction to Micromachining, Narosa Publishers
2. J Paulo Davim (2011), Modern Machining Technology: A Practical Guide, Woodhead Publishing, USA
3. Hassan Abdel-Gawad El-Hofy (2014), Fundamentals of Machining Processes: Conventional and Nonconventional Processes, CRC Press, Taylor & Francis Group, USA

MTech/ME/2/DSC1(ii) : Instrumentation and Measuring Systems

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Optional Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The course is intended to give students a thorough understanding of a measuring system, different transduction principles, error analysis response etc. and various other issues related to instrumentation system.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Describe the operation of transducers for strain, acceleration, pressure, temperature, and fluid flow measurement
CO2	Select and assemble the components of basic analog and digital data acquisition systems.
CO3	Apply theoretical analysis of time-varying signals to selection of signal conditioning components.

CO-PO Mapping Matrix for Course MTech/ME/2/DSC1(ii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	1	1	1	-	-	1	1
CO2	3	2	2	3	2	1	1	1	1	1	1	1
CO3	3	3	2	2	2	1	1	1	-	-	1	1
Average	3	2.33	2.33	2.33	2.33	1	1	1	0.33	0.33	1	1

Course Content

MTech/ME/2/DSC1(ii) : Instrumentation and Measuring Systems

Unit- I	**Generalized Configuration of Measuring System**: Functional elements of a basic measuring system; different types of measurands, description of functional elements. Input-output configuration of a measuring system interfering and modifying inputs; methods for correction for interfering and modifying inputs. **Characteristics of Instruments**: Objective of studying the characteristics of the instruments. Static characteristics accuracy precision, error, sensitivity, hysterisis, threshold, drift, span, static stiffness etc. Dynamic characteristics - time domain and frequency domain characteristics terms input-output impedance's and meaning of impedance mismatching. Concept of mechanical loading.
Unit - II	**Response of Instruments**: Description of mathematical model for the generalized configuration of a measurement system. Order of the systems, response of zero, first and second order systems of step, ramp and sinusoidal inputs. Transfer function method to study the response of the system. **Errors**: Classification of various types of errors and statistical analysis of experimental data.
Unit - III	**Principles of Transduction and Transducers**: Description of various types of transduction principles. Transducers based on variable resistance, variable inductance, variable capacitance and piezo-electric effects. Displacement transducers - wire wound potentiometers, LVDT, strain gauges, strain gage designation system. Signal conditioners - filters, low, high, band pass and charge amplifiers. **DAS and Signal Analysis**: Data acquisition system via computers. The components of Data acquisition system, DAS Hardware, selection criteria for choosing a DAS. Techniques for signal analysis.
Unit - IV	**Flow Measurement**: Flow visualization, shadowgraph; schlieren and interferometric techniques; Pitot static tubes; hot wire anemometers; Laser Doppler velometer; flow measurements using coriolis effect. **Temperature and Heat Flux Measurement**: Thermoelectric sensors; electric resistance sensors; thermistors; radiations pyrometers; Temperature measuring problems in flowing fluids, dynamic compensation.

Text/Reference Books

1. Doeblin E. O., "Measurements System Application and Design", 5th Ed., McGraw Hill, 2004.
2. Trietly Harry L., Dekker Marcel, "Transducers in Mechanical and Electronic Design", Ist Ed., CRC Press, 1986.
3. Beckwith T. G., Marangoni R. D., and Lienhard J. H., "Mechanical Measurements", 6th Ed., Prentice Hall, 2006.
4. Eckert E. R. G. and Goldstein R. J., "Measurements in Heat Transfer", 2nd Ed., Springer, 1986.

MTech/ME/2/DSC1(iii) : Manufacturing Information Systems

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Optional Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To provide an importance of databases and its application in manufacturing systems that prepare students for their engineering practice by organization by conversant with order policies, data base terminologies, designing, manufacturing considerations.
- Define and explain basic terms in the area of manufacturing, as well as structure, design, configuration and practical use of IT systems for manufacturing.
- To provide specialist knowledge in the area of manufacturing information systems, as an upgrade of the basic knowledge about information systems provided in the core courses.

Course Outcomes	At the end of this course, the student will be able to:
CO1	To create simple to moderately complex manufacturing information system for manufacturing industry
CO2	Evaluate critically the role of management information systems for design, engineering and manufacturing
CO3	Demonstrate an appreciation of the complex relationship between information systems and organization

CO4	Explain system analysis and design tools

CO-PO Mapping Matrix for Course MTech/ME/2/DSC1(iii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	1	1	1	1	1
CO2	3	3	3	2	2	1	1	1	1	1	1	1
CO3	3	2	2	2	2	1	1	1	-	2	1	1
CO4	2	2	2	2	3	1	1	1	1	1	1	1
Average	2.75	2.25	2.25	2	2.25	1	1	1	0.75	1.25	1	1

Course Content

MTech/ME/2/DSC1(iii) : Manufacturing Information Systems

Unit- I	Management Information Systems: Need, Purpose and Objectives - Contemporary Approaches to MIS - Information as a strategic resource - Use of information for competitive advantage - MIS as an instrument for the organizational change Information, Management and Decision Making: Models of Decision Making - Classical, Administrative and Herbert Simon's Models - Attributes of information and its relevance to Decision Making - Types of information
Unit - II	**Information Technology**: Definition, IT Capabilities and their organizational impact - Telecommunication and Networks - Types and Topologies of Networks - IT enabled services such as Call Centers, Geographical Information Systems etc **Data Base Management Systems**: Data Warehousing and Data Mining
Unit - III	**Systems Analysis and Design**: Systems Development Life Cycle - Alternative System Building Approaches - Prototyping - Rapid Development Tools - CASE Tools – Object Oriented Systems (Only introduction to these tools &techniques) **Decision Support Systems**: Group Decision Support Systems - Executive Information Systems - Executive Support Systems - Expert Systems and Knowledge Based Expert Systems - Artificial Intelligence
Unit - IV	**Management Issues in MIS**: Information Security and Control - Quality Assurance -Ethical and Social Dimensions - Intellectual Property Rights as related to IT Services / IT Products - Managing Global Information Systems

Text/Reference Books

1. Jawadekar, (2013) Management Information Systems, Tata McGraw Hill, 5th Edition
2. Laudon and Laudon,, (2011), Management Information Systems, 12th Edition, Pearson Education Asia
3. Rajaraman, (2011), Analysis and Design of Information Systems, Prentice Hall, 3rd Edition
4. Turban and Aronson,(2010), Decision Support Systems and Intelligent Systems, Pearson Education Asia

MTech/ME/2/CC12: Computer Aided Design and Manufacturing Lab							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	50	-	3 Hours	TEE/ Practical File

Instructions to paper setter for Final Term Examination: Final Term Examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of practical file, performance in practical and a viva voce exam.

Course Objectives:

- To use professional CAD software(s) for modeling, analysis and computer assisted manufacturing.
- To learn advance machining features on CNC machines.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Use parametric CAD software(s) for geometric modelling, analysis and computer assisted manufacturing of mechanical components
CO2	Manually write, edit, debug, and use CNC programs to produce complex profiles on CNC machines.

CO-PO Mapping Matrix for Course MTech/ME/2/CC12

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	2	1	1	-	1	1	1
CO2	3	3	2	2	2	1	1	1	-	-	1	2
Average	3	3	2.5	2	2.5	1.5	1	1	-	0.5	1	1.5

List of Experiments
MTech/ME/2/CC12: Computer Aided Design and Manufacturing Lab

Experiment-1	Practicing the part modeling, assembly and simulation operations on available CAD package(s).
Experiment-2	Generating automatic Cutter Location (CL) data from CAD models and post processing for machining on CNC machines.
Experiment-3	Producing complex cylindrical shaped piece on CNC machining center.
Experiment-4	3-D virtual machining on offline CNC machining center.
Experiment-5	Creating radial and axial surface profiles by using C-axis and driven tools on CNC turning

	center.
Experiment-6	Manufacturing parts on CNC machining center with WinNC/ Other available software.
Experiment-7	Fabrication of 3-D physical part using additive manufacturing technology from 3-D CAD model.
Experiment-8	Simulate a complex part model & analyze with available CAM software.

MTech/ME/2/CC13: Casting and Welding Technology Lab							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	50	-	3 Hours	TEE/ Practical File

Instructions to paper setter for Final Term Examination: Final Term Examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of practical file, performance in practical and a viva voce exam.

Course Objectives: To provide practical knowledge in advances casting & welding processes & understand the industrial applications of these processes in different conditions.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Design welding and casting systems and quality control of components
CO2	Understand the industrial applications of welding & casting processes in different conditions.

CO-PO Mapping Matrix for Course MTech/ME/2/CC13

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	1	2	1	1	-	1	1
CO2	3	3	2	2	2	1	1	1	-	-	1	1
Average	3	2.5	2.5	2.5	2	1	1.5	1	0.5	-	1	1

List of Experiments
MTech/ME/2/CC13: Casting and Welding Technology Lab

Experiment-1	Study Sand Testing, Green sand moulding , Shell Moulding, Vacuum Moulding, NDT of castings, along with Design of gating systems.
Experiment-2	Measurement of fluidity, melting and casting of aluminium alloy castings.
Experiment-3	Study of various Advanced Casting Processes used in industries.
Experiment-4	Study Heat flow in Welding (Equipment for use-Gas Welding equipment).
Experiment-5	Effect of shielding gases on performance of GMAW process.
Experiment-6	Dye-penetrant inspection for determining surface defects & Ultrasonic inspection for assessing sub-surface defects in welding joints.

SEMESTER – III

MTech/ME/3/CC14 : Tribology							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The course has been designed to give an understanding of tribological phenomena, industrial lubricants and additives.

Course Outcomes	At the end of this course, the student will be able to:
CO1	To understand the interdisciplinary subject 'Tribology' and its technological significance
CO2	To understand the genesis of friction and wear
CO3	To learn about the principles of lubrication, lubrication regimes, hydrodynamic lubrication and hydrostatic lubrication
CO4	To learn about emerging areas such as bio Tribology and micro/nano Tribology

CO-PO Mapping Matrix for Course MTech/ME/3/CC14

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	2	1	1	-	1	1
CO2	3	2	2	2	1	1	1	-	-	-	1	1
CO3	3	2	2	2	2	1	1	1	1	-	1	1
CO4	3	2	2	1	1	1	2	1	-	-	1	1
Average	3	2	2	1.75	1.5	1	1.5	0.75	0.5	-	1	1

Course Content
MTech/ME/3/CC14 : Tribology

Unit- I	**Introduction**: History of Tribology, Introduction to Friction, Wear and Lubrication, economic aspects of Tribology. **Friction**: Laws of static friction, causes of friction, Adhesion, Adhesion theory, laws of rolling friction **Wear**: Wear definitions, types of wear mechanisms: Adhesive wear, Abrasive wear, Fatigue wear, impact wear, Corrosive war, Fretting wear.
Unit - II	**Physical Properties of Lubricants**: Introduction, Oil viscosity, Viscosity temperature relationship, Viscosity index, Viscosity pressure relationship, Viscosity-shear rate relationship, Viscosity measurements, Viscosity of mixtures, Oil viscosity classification, Lubricant density and specific gravity, Thermal properties of lubricants, Temperature characteristics of lubricants, Other lubricants characteristics, Optical properties of lubricants, Additive compatibility and solubility, Lubricant impurities and contaminants, Solubility of gases in oils.

	Lubricants and Their Composition: Introduction, Mineral oils, Synthetic oils, Emulsions and aqueous lubricants, Greases, Lubricant additives.
Unit - III	**Fluid Film Lubrication**: Regimes of fluid film lubrication, Hydrodynamic Lubrication; Introduction, Generalized Reynolds equation, Converging-diverging wedges, Journal bearings, Thermal effects in bearings, Limits of hydrodynamic lubrication, Hydrodynamic lubrication with non-Newtonian fluids, Reynolds equation for squeeze films, Porous bearings. Hydrostatic Lubrication; Basic concepts, Aerostatic bearings, Hybrid bearings, Stability of journal bearings.
Unit - IV	**Bearing Materials**: Selection of bearing materials, Metal bearings, Nonmetal bearing materials Future Directions in Tribology: Biotribology-basic concepts; Nanotribology-basic concepts; Environmental implications of Tribology.

Text/Reference Books

1. Conner, J.J. and Boyd, J., "Standard Handbook of Lubrication Engineering", McGraw Hill (1968)
2. Khonsari, M. M. and Booser, E. R., "Applied Tribology: Bearing Design and Lubrication", 2nd Ed, Wiley (2008)
3. Kudish, I. I. and Covitch, M. J., "Modeling and Analytical Methods in Tribology", Chapman and Hall/CRC (2010)
4. Bhushan, B., "Principles and Applications of Tribology", 2nd Ed., Wiley (2013)
5. Stachowiak, G.W. and Batchelor, A. W., "Engineering Tribology", 4th Ed, Butterworth-Heinemann (2013)
6. Wyong B., "Tribology: Engineering Applications", NY Research Press (2015)

MTech/ME/3/DSC2(i) : Smart Mobility and Intelligent Vehicles

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Optional Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- Introduce students to the various technologies and systems used to implement advanced driver assistance systems in vehicles
- Highlight impact of automation in various driving functions and connecting the automotive systems to sources of information that assist with a task.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Understand the rational for and evolution of automotive electronics
CO2	Acquire knowledge on basics of how automotive ECUs function in conjunction with the vehicle data bus networks and sensors
CO3	Understand the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles
CO4	Familiarize with the basic concepts of wireless communications and wireless data networks
CO5	Understand the fundamental principles of data networking and its roll in ADAS and future autonomous vehicles

CO-PO Mapping Matrix for Course MTech/ME/3/DSC2(i)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	1	2	1	1	-	1	1
CO2	3	1	1	1	2	1	1	1	-	-	-	1
CO3	3	1	1	1	2	1	2	1	1	-	1	1
CO4	2	1	1	1	2	1	1	1	1	1	-	1
CO5	2	1	1	1	2	1	2	-	1	1	-	1
Average	2.6	1.2	1.2	1	2	1	1.6	0.8	0.8	0.4	0.4	1

Course Content
MTech/ME/3/DSC2(i):

Unit- I	**Introduction to Automated, Connected, and Intelligent Vehicles:** Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Power-train Electronics, Advanced Driver Assistance Electronic Systems **Connected and Autonomous Vehicle Technology**: Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy
Unit - II	**Sensor Technology for Smart Mobility:** Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion **Overview of Wireless Technology** & **Networking:** Wireless System Block Diagram and Overview of Components, Transmission Systems –Modulation/Encoding, Receiver System Concepts–Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals

Unit - III	**Connected Car & Autonomous Vehicle Technology:** Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues. **Advanced Driver Assistance System & Prognostics Technology:** Basics of Theory of Operation, Applications, Integration of ADAS Technology into Vehicle Electronics, System Examples, Role of Sensor Data Fusion. Vehicle Prognostics Technology, Advanced Driver Assistance System Sensor Alignment and Calibration
Unit - IV	**Connected Car Display:** Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, and Warning Technology – Driver Notification. **Impaired Driver Technology**: Driver Impairment, Sensor Technology Sensor Technology for Driver Impairment Detection

Text/Reference Books

1. Radovan Miucic, Connected Vehicles: Intelligent Transportation Systems, Springer, 2015
2. Intelligent Transportation Systems and Connected and Automated Vehicles, Transportation
3. Research Board 2016
4. Osseiran, Afif, Jose F. Monserrat, and Patrick Marsch, eds. 5G mobile and wireless
5. communications technology. Cambridge University Press, 2016.
6. Benevolo, Clara, Renata Paola Dameri, and Beatrice D'Auria. "Smart mobility in smart city."
7. In Empowering Organizations, pp. 13-28. Springer, Cham, 2016.

MTech/ME/3/DSC2(ii) : Sustainable Manufacturing

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Optional Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To provide students with knowledge of key environmental and sustainability issues relevant to modern manufacturing
- To provide a set of tools and skills that may be used to design, analyze, and improve manufacturing processes, products, and business operations.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Identify key requirements and concepts in lean manufacturing
CO2	Understand the need for sustainability assessment and their types
CO3	Develop sustainability assessment framework model depending on the process under investigation
CO4	Leverage sustainability concepts in a supply chain.

CO-PO Mapping Matrix for Course MTech/ME/3/DSC2(ii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	2	1	-	-	1	1
CO2	2	2	2	2	2	1	2	1	-	-	-	1
CO3	2	2	2	2	2	1	2	1	-	-	-	-
CO4	3	2	2	2	1	1	2	1	1	-	1	1
Average	2.5	2	1.75	1.75	1.75	1	1	1	0.25	-	0.5	0.75

Course Content

MTech/ME/3/DSC2(ii) : Sustainable Manufacturing

Unit- I	**Need for Sustainable Manufacturing:** Introduction to the environmental issues pertaining to the manufacturing sector – pressure to reduce costs – processes that minimize negative environmental impacts – environmental legislation and energy costs – acceptable practice in society – adoption of low carbon technologies – need to reduce the carbon footprint of manufacturing operations.
Unit - II	**Techniques for non-market valuation:** Cost and income based approaches, demand estimation methods – expressed and revealed preference, choice modeling – Multi-criteria analysis- Stakeholder analysis – Environmental accounting at sector and national levels **Sustainability performance evaluators:** Frameworks and techniques – environmental management systems – life cycle assessment – strategic and environmental impact assessments – carbon and water foot-printing
Unit - III	**Strategies and Design Approaches:** Concepts of Competitive Strategy and Manufacturing Strategies and development of a strategic improvement programme – Manufacturing strategy in business - success Strategy formation and formulation – Structured strategy formulation – Sustainable manufacturing system design options – Approaches to strategy formulation – Realization of new strategies/system designs **Challenges and Opportunities:** Challenges in logistics and supply chain – developing the right supply chain strategy for the products – need to align the supply network around the strategy – Tools that can be used systematically to identify areas for improvement in supply chains – Specific challenges and new thinking in the plan, source and delivering of sub-processes
Unit - IV	**Principles of sustainable operations:** Life cycle assessment Manufacturing and service activities –Influence of product design on operations – Process analysis – Capacity

	management – Quality management –Inventory management – Just-In-Time systems – Resource efficient design – Consumerism and sustainable well-being.

Text/Reference Books

1. Seliger, G,(2012), Sustainable Manufacturing: Shaping Global Value Creation, Springer
2. Dornfeld, David.(2012), Green Manufacturing, Springer-Verlag, New York
3. Davim, J.P.(2010), Sustainable Manufacturing, John Wiley & Sons.
4. Gupta, S.M. and Lambert, A.J.D.(2008), Environment Conscious Manufacturing, CRC Press
5. Douglas C.Montgomery, "Design and Analysis of Experiments", 5th Edition, John Wiley & Sons, 2012

MTech/ME/3/DSC2(iii) : Flexible Manufacturing System

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Optional Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Learn the concepts and technologies associated with Flexible Manufacturing System.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Design the basic Flexible Manufacturing Systems

CO-PO Mapping Matrix for Course MTech/ME/3/DSC2(iii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	1	2	1	1	1	1	1

Average	3	3	3	3	3	1	2	1	1	1	1	1

Course Content

MTech/ME/3/DSC2(iii) : Flexible Manufacturing System

Unit- I	**Manufacturing Systems**: Introduction, Single station manufacturing cells, Manual Assembly lines, Automated Production and Assembly lines. Different types of manufacturing systems. **Manufacturing Automation**: Types of Automation systems, Logic Controllers and its applications, Programming of controllers.
Unit - II	**Flexible Manufacturing System:** FMS components, Different types of flexibility in manufacturing, FMS compared to other manufacturing approaches, Optimization of FMS, FMS applications, FMS planning and implementation.
Unit - III	**Numerical Control**: Fundamentals of NC technology, Computer Numerical Control, Distributed Numerical Control, Applications of NC. **Industrial Robotics**: Robot Anatomy, Robot Control System, Sensors, Robot Accuracy and Repeatability.
Unit - IV	**Cellular Manufacturing**: Part classification and coding, production flow analysis, Machine Cell design, Group Technology. **Material Handling and Identification**: Material Transport Systems, Storage systems, Automatic Identification.

Text/Reference Books

- Mikell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Third edition,PHI, 2009.
- Alavala Chennakesava R., "Cad/Cam: Concepts and Applications", PHI, 2008.
- Mikell P. Groover, "Automation, Production Systems, and Computer - Integrated Manufacturing", PHI, 2008
- S. Joshi , Jeffrey Smith, "Computer control of flexible manufacturing systems: Research and development", Springer; 1994.

MTech/ME/3/CC15: Tribology Lab							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	50	-	3 Hours	TEE/ Practical File

Instructions to paper setter for Final Term Examination: Final Term Examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of practical file, performance in practical and a viva voce exam.

Course Objectives: To learn about tribotesting and experimental techniques in Tribology and analysis of real time results.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Predict the performance characteristics of hydrodynamic journal bearings experimentally.
CO2	Determine the behaviour of lubricants under different operating conditions.
CO3	Predict the friction and wear characteristics under different loads.

CO-PO Mapping Matrix for Course MTech/ME/3/CC15

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	2	1	1	-	-	1
CO2	3	1	1	1	1	1	1	1	-	-	-	1
CO3	3	2	2	3	1	1	1	1	-	-	-	1
Average	3	1.66	1.66	2	1.33	1	1.33	1	0.33	-	-	1

List of Experiments
MTech/ME/3/CC15: Tribology Lab

Experiment-1	To perform experiment on the journal bearing test rig for the measurement of Pressure and Temperature distribution in the fluid film of hydrodynamic journal bearings at different loads and speeds. To analyze the real time results obtained through data acquisition system for predicting the performance characteristics of bearing.
Experiment-2	To perform experiment on the journal bearing test rig for investigating the fluid film thickness of hydrodynamic journal bearings at different loads and speeds. To analyze the real time results obtained through data acquisition system for predicting the performance characteristics of bearing.
Experiment-3	To measure the frictional torque in hydrodynamic journal bearings at different loads and speeds on journal bearing test rig. To analyze the real time results obtained through data acquisition system for predicting the performance of bearing.

Experiment-4	To determine wear preventive (WP) and extreme pressure(EP) behavior of lubricants on four ball tester and to measure viscosity of lubricants with the help of viscometer . To analyze the real time results obtained through data acquisition system for predicting behavior of lubricants.
Experiment-5	To determine the friction and wear characteristics in sliding contacts under various normal loads and speeds on wear and friction monitor. To analyze the real time results obtained through data acquisition system for predicting tribological characteristics.
Experiment-6	The modeling and analysis hydrodynamic/hydrostatic bearings using software (ARMD)

MTech/ME/3/SEC1:Dissertation Part-I with Seminar

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Research Work	04	04	-	-	100	-	Teacher Interaction/ Dissertation/Viva-voce

Instructions to paper setter for Final Term Examination: Final Term Examination will be conducted internally through synopsis presentation/seminar/viva-voce before the faculty members of the department. Each student is required to submit a detailed synopsis report about the work done on topic of Dissertation

Course Objectives:

- To identify research issue/problem on advance engineering topics related to Mechanical Engineering.
- To gain knowledge on the research problems identified through extensive literature survey.
- To understand the tools required to carry out research work.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Gain knowledge on the research problems identified through extensive literature survey
CO2	Understand professional & ethical research issues.
CO3	Present effectively the research topic through synopsis presentation

CO-PO Mapping Matrix for Course MTech/ME/3/SEC1

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2	2	2	2	2	3
CO2	2	2	2	2	2	2	2	3	2	2	2	3
CO3	3	3	3	3	3	2	3	3	2	3	2	3
Average	2.66	2.66	2.33	2.33	2.33	2	2.33	2.66	2	2.33	2	2

Course Work
MTech/ME/3/SEC1:Dissertation Part-1 with Seminar

The Dissertation work should be of research nature only. During the third semester, following must be carried out by the student:

- Literature Survey
- Problem Formulation

Dissertation work will be started during the third semester and must be continued in fourth semester. Around 35% of the dissertation work should be completed in this semester. The remaining 65% work will be carried out in the fourth semester.

SEMESTER – IV

MTech/ME/4/SEC2:Dissertation Part-II							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Research Work	10	04	-	250	-	-	Teacher interaction/ Dissertation/Viva voce

Instructions to paper setter for Final Term Examination: Final Term Examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated on the bases of dissertation and a viva voce exam.

Course Objectives:

- Ability to bring ideas into practice through simulation of analysis of research topic.
- Ability to identify specific industrial problems in the form of research objectives.
- Ability to propose a novel idea/modified technique/new interpretation after analyzing the existing research work.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Contribute in the Research and Development
CO2	Upgrade knowledge of scientific community and society in general through their research.

CO-PO Mapping Matrix for Course MTech/ME/4/SEC2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	3	3	2	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3	3	3
Average	3	3	3	3	3	2.5	3	3	2	3	2.5	3

Course Work
MTech/ME/4/SEC2:Dissertation Part-II

Around 35% of the Dissertation work is required to be completed in third semester. The remaining 65% work will be carried out in this semester. Each student is required to submit a detailed Dissertation report about the work done (III Sem + IV Sem) on the topic of Dissertation. One paper in national/international conference/journal of repute is required before submission of Dissertation.

Syllabus of Open Elective Courses offered by Mechanical Engineering Department

ME/OEC1: Supply Chain and Logistics Management

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Open Elective Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- To improve the overall organization performance and customer satisfaction by improving product or service delivery to consumer.
- To fulfill customer demands through the most efficient use of resources, including distribution capacity, inventory and labor.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Foresee the trends and importance of value chain in the operations of logistics and supply chain
CO2	Apply automation and outsourcing techniques for improving in customer service in logistics and warehouse operations
CO3	Analyse the impact of relationships and benchmarking on the performance of the supply chain using appropriate metrics.
CO4	Demonstrate the effective use of emerging information technologies in logistics and supply chain management
CO5	Develop appropriate models in transportation management for decision-making

CO-PO Mapping Matrix for Course ME/OEC1

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	2	2	1	2	1	2	1
CO2	3	2	3	2	3	2	1	1	1	1	1	1
CO3	3	3	2	2	2	1	1	1	1	1	1	1
CO4	2	2	2	2	2	1	2	1	1	2	1	1
CO5	3	2	2	2	2	1	1	1	1	2	1	2
Average	2.8	2.2	2.2	2	2.4	1.4	1.4	1	1.2	1.4	1.2	1.2

Course Content
ME/OEC1: Supply Chain and Logistics Management

Unit I	**Supply Chain Management:** Introduction and Development- Nature and Concept - Importance of Supply Chain - Value Chain - Components of Supply Chain - The Need for Supply Chain - Understanding the Supply Chain Management - Participants in Supply Chain – Global Applications. **Logistics Management:** Origin and Definition – Types of Logistics – Logistics Management – Ware House Management – Automation and Outsourcing - Customer Service and Logistics Management – A Perspective - Concepts in Logistics and Physical Distribution - Distribution and Inventory-3PL and 4PL.

Unit - II	**Logistics and Supply chain relationships:** Benchmarking the logistics process and SCM operations –Mapping the supply chain processes – Supplier and distributor benchmarking –setting benchmarking priorities –identifying logistics performance indicators –Channel structure – Economics of distribution –channel relationships – logistics service alliances.
Unit - III	**Information System:** Introduction-Positioning of information in logistics and supply chain management (L&SCM)- Logistical information system-Operational logistical information system-Integrated information technology solution for L&SCM-Emerging Technologies in L&SCM. Transportation System: Introduction-Position of transportation in L&SCM-Elements of transportation cost-Modes of transportation-Multi-modal transportation-Containerization-Selection of transportation mode, Transportation decision (Pricing and Rate)-Transportation network (Routing and Scheduling).
Unit - IV	**Inventory Management:** The role of cycle inventory in a supply chain –Managing multi echelon cycle inventory – Estimating cycle inventory – related costs in practice – the role of safety inventory in a supply chain – managing safety inventory in a multi echelon supply chain – the role of information technology in inventory management – estimating and managing safety inventory in practice. **Logistics Organization:** Introduction-Evolutionary trends of logistics and supply chain organization-Basic organization principles-Factors influencing organizational structure.

Text/Reference Books

7. Donald J. Bowersox and David J. Closs, (2006), Logistical Management: The Integrated Supply Chain Process,
8. Edward J Bradi, John J Coyle (2010), A Logistics Approach to Supply Chain Management, Cengage learning, New Delhi
9. Chopra, S. and Meindl, P., (2014), Supply Chain Management: Strategy, Planning & Operations, 6th edition, Pearson Education (Singapore) Pvt. Ltd.
10. Agrawal D K, (2003), Logistics & Supply Chain Management, Macmillan India Ltd.
11. Simchi-Levi, D. Kaminsky, P. Simchi-Levi, E. and Ravi Shankar (2008), Designing & Managing the Supply Chain: Concepts, Strategies & Case Studies, Third Edition, Tata McGraw-Hill, Third Edition

ME/OEC2: Entrepreneurship Development Skills

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Open Elective Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four

units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives:

- To understand small enterprises, problems faced by small enterprises, engineering economics, product planning and development, the contents of a project report and formulation of a project report.
- Starting innovative practices in their entrepreneurial activities & developing their skills on the traits that they want to carry forward.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Students will be able to describe the concept of entrepreneurship, the role of entrepreneurship in economic development of the country and the scope for an entrepreneur
CO2	Students will be able to apply the basic steps in setup a new business
CO3	Students will be able to examine the development of a startup

CO-PO Mapping Matrix for Course ME/OEC2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	2	2	2	2	2	2
CO2	3	3	2	2	2	2	2	2	3	2	2	2
CO3	3	2	3	1	1	1	2	1	1	2	2	2
Average	3	2.3	2.3	1.66	1.66	1.66	2	1.66	2	2	2	2

Course Content
ME/OEC2: Entrepreneurship Development Skills

Unit I	**Introduction to Entrepreneurship:** Meaning, Role of Entrepreneur, Entrepreneur Process: different approaches, Motivation for becoming an Entrepreneur. SME Concept, its role, status, prospects and policies for promotion of SMEs. Importance of Entrepreneurship: innovations, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices.
Unit - II	**Importance of Entrepreneurship:** Entrepreneurship and Innovations, Converting Innovation to Economic Value which includes, Growth Strategies, value position, Market Segments, Value Chain Structure, Revenue Model, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices. Contribution of Entrepreneurs: Towards R&D, creates Wealth of Nation & Self prospect with Challenge. Entrepreneur Carrier: Different Stages, Entrepreneur Development Programmes (EDPs).
Unit - III	**Characteristics of Entrepreneurship:** Risk taker, Perceptive, Curious, Imaginative, Persistent, Goal setting, and Hardworking, Research & Management Skill, Organizing & Controlling, Soft skills and Feasibility. Women Entrepreneurship: Opportunities, promotion Hurdles and Prospects of women Entrepreneurs, Factors & Models of Entrepreneurial Development. Social Entrepreneurial Initiative: Solving social problems through opportunity identification, idea generation techniques, Business plan, Strategic Plan etc.
Unit - IV	**Applications of Entrepreneurship**: Product Planning and Development: Introduction, Requirement of a good product design, product development approaches, Product development process, Elements of concurrent engineering, Various controlling agencies involved their role and formalities for getting clearance before starting individual venture. Preparation of Feasibility Project Report: Tools for evaluation of techno-economic feasibility project report, Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information, Benchmarking, SWOT analysis.

Text/Reference Books
1. “The Practice of Entrepreneurship” - G.G. Meredikh, R.E. Nelson and P.A. Neck 2. “Handbook of Entrepreneurship” - Rao and Pareek 3. S.S.Khanka “Entrepreneurial Development”, S.Chand & Co. Ltd., New Delhi, 1999. 4. Kuratko & Hodgetts, “Enterprenuership – Theory, Process and Practices”, Thomson Learning 6th Edition. 5. Hisrich R D and Peters M P, “Entrepreneurship”, 5th Edition Tata McGraw-Hill, 2002. 6. Mathew J Manimala, “Enterprenuership Theory at Cross Roads: Paradigms and Praxis”, Dream Tech 2nd Edition, 2006. 7. Rabindra N. Kanungo “Entrepreneurship and Innovation”, Sage Publications, New Delhi, 1998.

ME/OEC3: Quality and Reliability Engineering							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Open Elective Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term Examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives:

- Demonstrate the approaches and techniques to assess and improve process and/or product quality
- Develop the understanding of principles and techniques of statistical quality control and their practical uses in product and/or process design and monitoring.
- Present a problem oriented in depth knowledge, underlying concepts, methods and application of reliability engineering.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Relate the process variability in terms of cost of quality
CO2	Demonstrate the ability to design, use, and interpret control charts for monitoring the process quality

CO3	Apply basic quality improvement and problem solving tools like QFD, FMEA and bench marking
CO4	Design basic factorial experiments and Taguchi methods to identify the main effects, interaction effects, and their significance

CO-PO Mapping Matrix for Course ME/OEC3

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	1	1	1	1	1
CO2	3	2	2	2	2	1	1	1	1	2	1	1
CO3	3	2	2	2	3	1	1	1	1	2	1	1
CO4	3	3	3	2	3	1	1	1	1	2	1	1
Average	3	2.25	2.25	2	2.5	1	1	1	1	1.75	1	1

Course Content
ME/OEC3: Quality and Reliability Engineering

Unit I	**Quality Management: Evolution of Quality Control;** Quality Control vs. Assurance, Basic stages of Quality Control, Elements of Quality Cost, Elements of Quality costs. **Statistical Process Control (SPC):** Process Capability/Process Control: Process capability (Cp, Cpk, Pp, Ppk), Z scores, Special Causes and Common Causes of Variation, Process control charts for variables: X-R charts. Process control for attributes: p, np, c, u charts, Cusum Charts, Multi-Vari charts, Six – Sigma approach.
Unit - II	**Acceptance Sampling:** Lot by lot sampling-types - probability of acceptance in single, double, multiple sampling techniques- O.C. curves - producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts standard sampling plans for AQL and LTPD- uses of standard sampling plans. **Strategic tools and Techniques:** Quality Function Deployment, Deming's PDCA Cycle - Poka Yoke, Failure modes & Effects Analysis – Benchmarking - 5S concepts.
Unit - III	**Experimental Design and Taguchi Method:** Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array. **Reliability:** Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markove analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.
Unit - IV	**Hazard models:** Constant hazard model, linearly increasing hazard model, nonlinear hazard model and Weibull distribution, Advantages of Weibull distribution; System reliability models: series system, parallel system, series-parallel system, faulty tree analysis (FTA), Design based on reliability, Redundancy in design.

Text/Reference Books

1. D.C. Montgomery, John Wiley, (2011), "Introduction to Statistical Quality Control", 6th Edition, 2011.
2. Krishnaiah.K, (2014), "Applied Statistical Quality Control and Improvement", Prentice Hall of India (PHI).
3. P. A. Tobias and D. C. Trindade, (2011), "Applied Reliability", 3rd Edition, Chapman and Hall/CRC.

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ME/OEC4: Computer Integrated Manufacturing							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Open Elective Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment(s)/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:

- Develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques.
- Develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.
- Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.

Course Outcomes	At the end of this course, the student will be able to:
CO1	Understand the effect of manufacturing automation strategies and derive production metrics
CO2	Analyze automated flow lines and assembly systems, and balance the line
CO3	Design automated material handling and storage systems for a typical production system
CO4	Design a manufacturing cell and cellular manufacturing system

CO-PO Mapping Matrix for Course ME/OEC4

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	1	1	1	1	1	1
CO2	3	2	2	2	2	1	1	1	1	1	2	1
CO3	3	2	3	2	2	1	1	1	1	1	1	1
CO4	3	2	3	2	3	2	2	1	1	1	2	1

Average	3	2	2.5	2	2.25	1.5	1.25	1	1	1	1.5	1

Course Content
ME/OEC4: Computer Integrated Manufacturing

Unit- I	**Concept of CIM:** Manufacturing and its types – Definition of CIM, Elements of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Product Life-Cycle Management (PLM), Collaborative Product Development. **Application of Computer Integrated Manufacturing (CIM) systems:** CIM in automotive industry, Contributing Factors on CIM Application, Group Technology applications for Computer-Integrated Manufacturing, Computer-Aided Tooling Design for Manufacturing Processes.
Unit- II	**CIM Technology and Systems:** Design for Manufacturability (DFM): Component Design, Design for Assembly. Computer-Aided Process Planning: Variant and Generative Process Planning, Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP -II), Cellular Manufacturing, Programmable Logic Controllers, Flexible Manufacturing Systems: Physical Components of an FMS, FMS benefits and limitations of FMS.
Unit- III	**Computer Aided Planning and Control:** Production planning and control-cost planning and control-inventory management-Material requirements planning - (ERP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system. **Computer Monitoring:** Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC – contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.
Unit- IV	**Intelligent Systems in Manufacturing:** Current Developments and Future Prospects-Artificial intelligence techniques and the components of an intelligent manufacturing system. key artificial intelligence technologies (fuzzy logic, artificial neural networks, expert systems and genetic algorithms). **Cloud-Based Design and Manufacturing:** Evolution of design and manufacturing systems, Characteristics and requirements for cloud-based design and manufacturing systems, Cloud-based design and manufacturing example scenario, Cloud-Based Desktop Factory.

Text/Reference Books

1. Mikell Groover, (2016), "Automation, Production Systems and Computer-Integrated Manufacturing", 4th. Ed., ISBN # 0-13-349961-8, Pearson, New Jersey.
2. T.C. Chang, R. Wysk and H.P. Wang, (2009), "Computer aided Manufacturing", Third Edition, Pearson Education.