SCHEME & SYLLABUS

(Choice Based Credit System)

for

M. TECH.

in

Production Engg.

(w.e.f. Session 2022-23)

Program Code: MEC-302

DEPARTMENT OF MECHANICAL ENGINEERING

SCHOOL OF ENGINEERING

RIMT UNIVERSITY, MANDI GOBINDGARH, PUNJAB

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SECTION 1

Vision & Mission of the University

VISION

To become one of the most preferred learning places a centre of excellence to promote and nurture future leaders who would facilitate in desired change in the society

MISSION

M1: To impart teaching and learning through cutting edge technologies supported by the world class infrastructure

M2: To empower and transform young minds into capable leaders and responsible citizens of India instilled with high ethical and moral values

SECTION 2

Vision and Mission of the Department

VISION

To contribute to the society through excellence in scientific and technical education and research. To contribute the country by providing globally competent Mechanical Engineers capable of working in an inter-disciplinary environment which foster spirits of innovation, entrepreneurship and leadership. To support industry for growth, being the valuable resource for them, and remain a role model for others in the field of Mechanical Engineering.

MISSION

M1: To provide a high-quality educational experience for undergraduate and graduate students that enables them to become leaders in their chosen professions and to make them globally competitive mechanical engineers.

M2: To create, explore, and develop innovations in engineering and science through undergraduate and graduate research. To develop linkages with world class R&D organizations and educational institutions in India and abroad for excellence in teaching, research and consultancy practices.

SECTION 3

About the Program

Mechanical Engineering Department was established in 2003 with the inception of the institute to produce high quality engineers in the field of Mechanical Engineering. The programme involves application of principles of physics for analysis, design, manufacturing, and maintenance of mechanical systems. It requires a solid understanding of key concepts including Mechanics, Kinematics, Thermodynamics and Energy. Mechanical engineers use these principles and others in the design and analysis of automobiles, aircraft, heating and cooling systems, manufacturing plants, industrial equipment and machinery, medical devices and more.

SECTION 4

Program Educational Objectives (PEOs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PROGRAMME EDUCATION OBJECTIVES (PEOs)

PEO1	To prepare learners with a solid foundation in mathematics, sciences, and technical skills needed to analyze and design in engineering problems.
PEO2	To be able to explore areas of research, application & innovation and make impact in different types of institutional settings such as corporate entities, government bodies, NGOs, inter-government organizations, & start-ups.
PEO3	To prepare learners to apply knowledge, strong reasoning, and quantitative skills to design and implement creative and sustainable solutions.
PEO4	To prepare learners to effectively use modern equipment's & programming tools to solve real life problems that are technically sound, economically feasible and socially acceptable.
PEO5	To prepare learners for successful professional career, to excel in higher studies and or to become entrepreneur.
PEO6	To be able to continuously learn and update one's knowledge, engage in lifelong learning habits and acquire latest knowledge to perform in current work settings.
PEO7	To prepare learners to become responsible citizens by serving the community locally, nationally, and internationally.

PROGRAMME OUTCOMES (POs)

PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and mechanical engineering to the solution of complex engineering problems.
PO 2	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	Design solutions for complex mechanical engineering problems 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.
PO 4	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.
PO 5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex mechanical engineering activities with an understanding of the limitations.
PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PO 7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	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.

PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1	Apply mechanical engineering and interdisciplinary knowledge for analyzing, designing and manufacturing products to address the needs of the society.
PSO 2	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.

SECTION 5

Curriculum / Scheme with Examination Grading Scheme

SEMESTER WISE SUMMARY OF THE PROGRAMME: B.TECH. (MECHANICAL ENGINEERING)

S. No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	14	500	18
2.	II	18	500	18
3	III	8	400	12
4	IV	-	-	12
	Total	**40**	**1400**	**60**

EXAMINATION GRADING SCHEME

Marks Percentage Range	Grade	Grade Point	Qualitative Meaning
80-100	O	10	Outstanding
70-79	A^+	9	Excellent
60-69	A	8	Very Good
55-59	B^+	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Fail
0-39	F	0	Fail
ABSENT	AB	0	Fail

Percentage Calculation: CGPA *10

First Semester:

Subject		Contact Hours/Week			Credit	Contact Hrs.	Evaluation Scheme (% of Total Marks)			Exam Duration (Hours)
Code	Title	L	T	P			Internal	External	Total	
Core Courses										
MMAT-1108	Research Methodology	3	1	-	4	4	40	60	100	3
MMEC-1104	Metal Casting & Joining	4	-	-	4	4	40	60	100	3
MMEC-1105	Plasticity & Metal Forming	4	-	-	4	4	40	60	100	3
MMEC-1103	Manufacturing of Composite Materials	4	-	-	4	-	100	-	100	3
MMEC-1171	Optimization Techniques Lab	-	-	2	2	2	50	50	100	-
Total		**15**	**1**	**2**	**18**	**14**	**280**	**220**	**500**	**12**

Second Semester:

Subject		Contact Hours/Week			Credit	Contact Hrs.	Evaluation Scheme (% of Total Marks)			Exam Duration (Hours)
Code	Title	L	T	P			Internal	External	Total	
Core Courses										
MMEC-1209	Theory of Cutting & Machine Tool Design	4	-	-	4	4	40	60	100	3
MMEC-1210	Modern Welding Processes	4	-	-	4	4	40	60	100	3
MTME-1271	Lab-II	-	-	2	2	2	50	50	100	-
Elective Course 1 (Any One)										
MMEC-1203	Rapid Prototyping	4	-	-	4	4	40	60	100	3
MMEC-1211	Tribology	4	-	-	4	4	40	60	100	3
MMEC-1212	Advanced Materials Technology	4	-	-	4	4	40	60	100	3
Elective Course 2 (Any One)										
MMEC-1206	Industrial Automation	4	-	-	4	4	40	60	100	3
MMEC-1204	Finite Element Methods	4	-	-	4	4	40	60	100	3
MMEC-1213	Product Design and Development	4	-	-	4	4	40	60	100	3
MMEC-1214	Operation Management	4	-	-	4	4	40	60	100	3
Total		**16**	**-**	**2**	**18**	**18**	**220**	**280**	**500**	**12**

Third Semester:

Subject		Contact Hours/Week			Credit	Contact Hrs.	Evaluation Scheme (% of Total Marks)			Exam Duration (Hours)
Code	Title	L	T	P			Internal	External	Total	
Core Courses										
MMEC-2303	MOOCs	3	-	-	3	4	40	60	100	3
MMEC-2304	MOOCs	3	-	-	3	4	40	60	100	3
MMEC-2371	Literature Survey	-	-	-	2	-	100	-	100	-
MMEC-2372	Synopsis	-	-	-	4	-	50	50	100	-
Total		**12**	**-**	**-**	**12**	**8**	**230**	**270**	**400**	**9**

Fourth Semester:

Subject		Contact Hours/Week			Credit	Contact Hrs.	Evaluation Scheme (% of Total Marks)			Exam Duration (Hours)
Code	Title	L	T	P			Internal	External	Total	
Core Courses										
MMEC-2471	Thesis	-	-	24	12	-	-	-	-	-
Total		-	-	24	12	-	-	-	-	-

SYLLABUS

SEMESTER-I

SUBJECT TITLE: RESEARCH METHODOLOGY
SUBJECT CODE: MMAT-1108
SEMESTER: 1
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of research i.e. meaning, definition, process and research design. The students will be able to understand the data collection methods, questionnaire designing, construction and sampling design & techniques.

S No.	Content	Contact Hrs.
1.	Introduction to Research: Meaning, Definition, Objective and Process Research Design: Meaning, Types - Historical, Descriptive, Exploratory and Experimental Research Problem: Necessity of Defined Problem, Problem Formulation, Understanding of Problem, Review of Literature Design of Experiment: Basic Principal of Experimental Design, Randomized Block, Completely Randomized Block, Latin Square, Factorial Design. Hypothesis: Types, Formulation of Hypothesis, Feasibility, Preparation and Presentation of Research Proposal	**12 hrs**
2	Sources of Data: Primary and Secondary, Validation of Data Data Collection Methods: Questionnaire Designing, Construction Sampling Design & Techniques – Probability Sampling and Non Probability Sampling Scaling Techniques: Meaning & Types Reliability: Test – Retest Reliability, Alternative Form Reliability, Internal Comparison Reliability and Scorer Reliability Validity: Content Validity, Criterion Related Validity and Construct Validity	**13 hrs**
3	Data Process Operations: Editing, Sorting, Coding, Classification and Tabulation Analysis of Data: Statistical Measure and Their Significance, Central Tendency, Dispersion, Correlation: Linear and Partial, Regression: Simple and Multiple Regression, Skewness, Time series Analysis, Index Number Testing of Hypothesis: T-test, Z- test, Chi Square, F-test, ANOVA	**12 hrs**
4	Multivariate Analysis: Factor Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Multi-Dimensional Scaling Report Writing: Essentials of Report Writing, Report Format Statistical Software: Application of Statistical Softwares like SPSS, MS Excel, Mini Tab or MATLAB Software in Data Analysis	**13 hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMAT-1108.1	Develop understanding on various kinds of research, objectives of doing .research, research process, research designs and sampling.
CO2	MMAT-1108.2	Have basic knowledge on qualitative research techniques
CO3	MMAT-1108.3	Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis
C04	MMAT-1108.4	Have basic awareness of data analysis-and hypothesis testing procedure.

Suggested Readings / Books:

1. Statistics for Management by R.I. Levin and D.S. Rubin, 7thEdn., Pearson Education, New Delhi, 2007.
2. Marketing Research–An Applied Orientation by N.K. Malhotra, 4thEdn., Pearson Education, New Delhi, 2000.
3. Business Research Methods by Donald Cooper, Tata McGraw Hill, New Delhi, 2001.
4. Research Methodology in Social Sciences, Sadhu Singh, Himalaya Publishers, 2007.
5. Research Methodology Methods & Techniques by C.R. Kothari, 2ndEdn., New Age International Publishers, 2008.

SUBJECT TITLE: METAL CASTING & JOINING
SUBJECT CODE: MMEC-1104
SEMESTER: 1
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of structure of silica and different types of clays, bonding mechanism of silica-water-clay systems. The students will be able to understand the riser and gate design, riser design shape, size and placement, effect of appendages on risering.

S No.	Content	Contact Hrs.
1.	Casting Sands: Structure of silica and different types of clays, bonding mechanism of silica – water-clay systems, Swelling of clays, sintering adhesion and colloidal clay; silica grain shape and size distribution, standard permeability, A.F.S. clay, Characteristics, Ingredients and additives of moulding sand, core sands, sand testing	**12 hrs**
2	Solidification phenomenon: Solidifications of Metals, nucleation, free energy concept, critical radius of nucleus, Nucleation and growth in metals and alloys, constitutional super cooling, Columnar equi acquiesced and dendritic structures, Freezing of alloys centreline feeding resistance, Rate of solidification, time of solidification, mould constant, Fluidity of metals, volumes redistribution, Analysis of the process.	**13 hrs**
3	Riser and Gate Design: Riser design shape, size and placement, Effect of appendages on risering, Effective feeding distances for simple and complex shapes, Use of chills, gating design, filling time, Aspiration of gases, Top, bottom and inside gating. Directional solidifications stresses in castings, Metal mould reactions, Expansion scale and metal penetration, Analysis of the process	**12 hrs**
4	Advanced casting processes: Various moulding and casting processes, hot box, cold box process, investment, shell moulding, full mould process, die casting, ceramic shell mould, vaccum moulding, Non-ferrous Die-casting of Aluminium and its alloys, brass and bronze, casting defects and redressal	**13 hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-1104.1	Able to understand the basic concepts of structure of silica and different types of clays.
CO2	MMEC-1104.2	Understand the bonding mechanism of silica-water-clay systems.
CO3	MMEC-1104.3	Understand the riser and gate design, riser design shape, size and placement, effect of appendages on risering.

Suggested Readings / Books:

1. Fundamentals of Metals Casting by Flimm; Addison Wesley.2004.
2. Principles of Metal Casting by Heine Loper and Resenthal; McGraw Hill. 2007.
3. Product Design & Process Engineering by Hielel and Draper; Mcgraw Hill. 2008.
4. Foundry Practice by Salman &Simans; Issac Pitman. 2006.
5. Metals Handbook- Metal Casting; ASME. 2001.

SUBJECT TITLE: PLASTICITY & METAL FORMING
SUBJECT CODE: MMEC-1105
SEMESTER: 1
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of structure of true stress and true strain, true stress-strain curves, selection of stress-strain curves for cold and hot working, yield of isotropic plastic material, yield criteria. The students will be able to understand the forging, extrusion and lubrication processes.

S No.	Content	Contact Hrs.
1.	Theory of Plasticity: True stress and true strain, true stress-strain curves, selection of stress-strain curves for cold and hot working, yield of isotropic plastic material, yield criteria. Tresca maximum sheer-strain energy criterion, plastic incompressibility, Poisson's ratio for plastic deformation flow rule, strain hardening function, heat generation and heat transfer in metal forming processes, temperatures in Quasi continuous forming operations. Examination of Metal forming processes.	**12 hrs**
2	Drawing: Prediction of working loads and maximum deformation analysis of the processes of wire drawing/tube drawing, strip drawing and extrusion. various parameters/variables affecting the processes of wire drawing, tube drawing, strip drawing and extrusion; various methods of tube drawing and their comparison. Working loads for plain strain forging of strip and disc under conditions of well lubrications and sticking of material with die and under mixed conditions, prediction of working loads under above approach (simple plain strain and axis symmetric problems)	**13 hrs**
3	Forging and Extrusion: Determination of forces in disc forging considering sticking and slipping, Analysis of direct cold extrusion process through conical dies by Slab method, Upper bound and Slip line field, Forging and extrusion defects	**12 hrs**
4	Rolling: Classification of rolling mills, analysis of the process, Prediction of roll pressure for flat strip rolling in the leading and lagging zones, roll separating forces, torque on the roll, affect of front and back tensions, affect of support rolls, various factors which affect rolling force Lubrication in metal forming processes: Principles and mechanism of lubrications, hydrodynamic and their film lubrication, boundary and extreme pressure lubricants, solid lubricants, lubricants used for rolling and cold drawing, forging, extrusion and deep drawing processes; defects in various	**13 hrs**

	metal forming processes like rolling, forging, extrusion, wire drawing and deep drawing and their causes and remedial measures.	

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-1105.1	Able to understand the basic concepts of structure of silica and different types of clays.
CO2	MMEC-1105.2	Understand the bonding mechanism of silica-water-clay systems.
CO3	MMEC-1105.3	Understand the riser and gate design, riser design shape, size and placement, effect of appendages on risering.

Suggested Readings / Books:

1. An Introduction to the Principles of Metal working by Rowe, Arnold. 2003.
2. Metal forming analysis by Avitzer, Mcgraw Hill. 2008.
3. Plasticity for mechanical Engineering by Johnson &Merlore; Van Northand. 2009
4. High Velocity working Metals by ASME; EEE. 2002.

SUBJECT TITLE: MANUFACTURING OF COMPOSITE MATERIALS
SUBJECT CODE: MTME-1103
SEMESTER: 1
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of composite material, Classification based on matrix and topology, Constituents of composites. The students will be able to understand the industrial application of composite materials: civil constructions of structures/panels, aerospace industries, automobile and other surface transport industries.

S No.	Content	Contact Hrs.
1.	Introduction: Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites	**12 hrs**
2	Fabrication of Composites: Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes - Stir-casting & Compocasting, Screw extrusion, Liquid metal impregnation technique - Squeeze casting, Pressure infiltration, Lanxide process), Pinciple of molten alloy infiltration, rheological behaviour of meltparticle slurry, Synthesis of In situ Composites; Fabrication of Polymer Matrix Composites - Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, pultrusion, Filament winding, Fabrication of ceramic matrix composites - Various techniques of vapour deposition, Liquid phase method and Hot pressing etc., Fabrication of nano-composites	**13 hrs**
3	Secondary Processing and Joining of Composites: Forging and extrusion of composites – critical issues, dynamic recovery and dynamic recrystallization, mechanical properties; Induction Heating, Fusion Bonding, Ultrasonic welding, Gas tungsten arc welding, Gas metal arc welding, Resistance spot & seam welding, Resistance brazing, Resistance spot joining, Resistant spot brazing, Resistance welding of thermoplastic graphite composite, Weld bonding, Brazing of MMC.	**12 hrs**
4	Industrial Application of Composite Materials: Civil constructions of structures/pannels, Aerospace industries, Automobile and other surface transport industries, Packaging industries, House hold and sports components etc. Fracture & Safety of Composite: Fracture behaviour of composites, Mechanics	**13 hrs**

	and Weakest link statistics, Griffith theory of brittle fracture and modification for structural materials, Basic fracture mechanics of composite (Fracture toughness, COD and J-integral approaches, Fatigue crack growth rate), Fracture Mechanics of brittle matrix fibre composite, Fracture mechanics of metal matrix fibre composite, Experimental evaluation (composite), Elementary reliability analysis.	

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-1103.1	Understand basic concepts of composite material based on matrix and topology,
CO2	MMEC-1103.2	Able to understand the industrial application of composite materials
CO3	MMEC-1103.3	Able to understand distribution of constituents and Nano-composites

Suggested Readings / Books:

1. Composite Materials – Science & Engg. by K.K. Chawla, Springer- Verlag, 2001.
2. Composite Materials: Properties, Non-destructive testing and Repair by Mel M. Schwartz Prentice Hall, 2007.
3. Modern Composite Materials by L.J. Broutman and R.M. Krock Addison-Wesley, 2005.
4. Industrial Materials: Polymers, Ceramics and Composites by David A Colling& Thomas Vasilos, vol. 2, Prentice Hall, 2002

SUBJECT TITLE: OPTIMIZATION TECHNIQUE LAB (COMMON TO ALL)
SUBJECT CODE: MMEC-1171
SEMESTER: 1
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
-	-	2	2

Internal Assessment: 50
End Term Exam: 50
Duration of Exam: 3 Hrs

S No.	Content	Contact Hrs.
1	Introduction to MATLAB and its environment	**2 hrs**
2	Basic MATLAB commands, data types	**2 hrs**
3	Programs for branching statement and loops	**2 hrs**
4	Program for inbuilt and user defined functions	**2 hrs**
5	Program for plots, arrays, input/outputs, etc.	**2 hrs**
6	Dynamics and Vibration using as a single degree vibratory system as a case study	**2 hrs**
7	Implement optimization for reducing an environment impact of mechanical engineering components	**2 hrs**
8	Implement optimization technique to find the optimal cost of structure weight/volume/both	**2 hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-1171.1	Understand the potential of presenting through MATH Lab
CO2	MMEC-1171.2	Dynamics and Vibration using as a single degree vibratory system as a case study
CO3	MMEC-1171.3	Implement optimization technique to find the optimal cost of structure weight/volume/both

SYLLABUS

SEMESTER-II

SUBJECT TITLE: THEORY OF CUTTING & MACHINE TOOL DESIGN
SUBJECT CODE: MMEC-1209
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of elements of machine tools, selection of speed and feed, gear box design various types of clutch systems, Sohopke and report drives, double bond gears analysis, Lohr criterion. The students will be able to understand the Vibrations of machine tools and dynamic rigidity.

S No.	Content	Contact Hrs.
1.	Introduction, Classification of machine tools, elements of machine tools, selection of speed and feed, gear box design various types of clutch systems, Sohopke and Report drives, double bond gears analysis, Lohr criterion for optimizing double bond gear. Stepless drives, mechanical stepless drive analysis, hydraulic step less drive & circuit analysis, design features, throttle valves, tracer controlled hydraulic circuit, hydraulic servo controls, electrical stepless drive circuits and charters tics	**12 Hrs**
2	Strength and rigidity consideration, process capability and compliance, design of lathe bed, use of stiffness in bed, design of radial drill column and milling machine column. Analysis of spindle bearings, slides and guides, design of spindle/arbor, antifriction and journal bearings, hydro-dynamic action in slides, analysis of hydrostatic bearings, roller guides, recirculating ball analysis, stick slip motion in guides-models, force analysis of lathe guide ways.	**15 Hrs**
3	Vibrations of machine tools and dynamic rigidity: Effects of vibrations, source of vibrations, self excited vibration, single degree of freedom chatter, velocity principle and related models, regenerative principles, chatter in lathe, drilling milling and grinding. Tlusty and palace model, Peters model, elimination of machine tool structures matrix, finite elements and lumped constant models.	**7 Hrs**
4	Automation: Automation drives for machine tools, degree of automation, semi-automatics, analysis of collect action, design, of collet, bar feeding mechanism, tooling layout, single spindle, multispindle automatic, transfer machine, indexing Geneva mechanism, analysis, Swiss type automatic machine loading and unloading. Transfer-devices, modular – design concept in process gauging.	**16 Hrs**

	Control system of machine tools : Control: Mechanical, electrical, hydraulic, numerical, fluidic, basic principle of cam control, hydraulic controls, fluid controls, numerical controls, feed back systems, primary systems programming. Basic Devices, adaptive control.	

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MMEC-1209.1**	Understand basic concepts of elements of machine tools
CO2	**MMEC-1209.2**	Able to Understand the selection of speed and feed,
CO3	**MMEC-1209.3**	Understand the Vibrations of machine tools and dynamic rigidity.

Suggested Readings / Books:

1. Machine tool design by Mehta; Tata McGraw Hill. 2000.
2. Principles of machine Tools by Sen& Bhattacharya; New Central Book Agency. 2007.
3. Machine Tool design by Basu& Pal; Oxford & IBH. 2004.
4. Machine tool Design Vol. I to IV by Acherkan; Mir Publishers. 2008.
5. Design principles of Metal cutting machine tools: Koerigsberger; Pergaman Press. 2003.

SUBJECT TITLE: MODERN WELDING PROCESSES
SUBJECT CODE: MMEC-1210
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of weldability, weld thermal cycle, metallurgy of fusion welds, solidification mechanism and microstructural products in weld metal. The students will be able to understand the welding power sources: arc welding power sources basic charters tics of power sources.

S No.	Content	Contact Hrs.
1.	Basic classification of welding processes, weldability, weld thermal cycle, metallurgy of fusion welds, solidification mechanism and microstructural products in weld metal, epitaxial, cellular and dendritic solidification, metallurgical changes in weld metal, phase transformation during cooling of weld metal in carbon and low alloy steel, prediction of microstructures and properties of weld metal. Heat affected zone, re-crystallization and grain growth of HAZ, gas metal reaction, effects of alloying elements on welding of ferrous metals Welding Arc: Arc efficiency, temperature distribution in the arc; arc forces, arc blow, electrical characteristics of an arc, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc.	**13 Hrs**
2	Coated Electrodes: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires Fusion Welding reviews: Critical reviews of manual metal arc welding (MMAW) GTAW, GMAW, FCAW and CO welding processes, plasma arc, submerged arc welding, electro gas and electro slag welding, analysis of the process.	**12 Hrs**
3	Welding power sources: Arc welding power sources basic charters tics of power sources for various arc welding processes, duty cycles, AC, DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorised units, inverter systems, Arc length regulation in mechanised welding processes. Metal Transfer and Melting Rate: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal	**12 Hrs**

	transfer and melting rate.	
4	Solid State welding: Theory and mechanism of solid sate welding, Techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding. High energy rate welding, Analysis of the Process Welding Techniques using Radiation energy: Technique, scope and application of the electron beam and laser welding processes	**12 Hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MMEC-1210.1**	Understand the basic concepts of weld ability, weld thermal cycle
CO2	**MMEC-1210.2**	Understand metallurgy of fusion welds, solidification mechanism
CO3	**MMEC-1210.3**	Understand the welding power sources: arc welding power sources

Suggested Readings / Books:

1. Welding Processes & Technology by Dr. R.S.Parmar Khanna Publishers
2. Welding Handbook, Vol. 1 & 2, seventh edition; American welding society.
3. Welding Technology by Rossi; McGraw Hill.
4. Welding Technology by Koenigsberger and Adaer; Macmillan

SUBJECT TITLE: LAB-II (COMMON TO ALL)
SUBJECT CODE: MMEC-1271
SEMESTER: 1st
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
-	-	2	2

Internal Assessment: 50
End Term Exam: 50
Duration of Exam: 3 Hrs

One lab /field/industrial oriented project /problem will be allocated to each student related to the subjects related to the subjects taught in 1st semester.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MMEC-1271.1**	Understand the basic concept of machinability
CO2	**MMEC-1271.2**	Able to Understand the selection of topic and its presentation
CO3	**MMEC-1271.3**	Understand the use of seminar at different areas and places

(Departmental Elective-I)

SUBJECT TITLE: RAPID PROTOTYPING
SUBJECT CODE: MMEC-1203
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of rapid manufacturing: customization and mass customization, classification of rapid manufacturing processes. The students will be able to understand 3D printing, direct metal deposition/3D welding, laser/electron beam melting based technologies.

S No.	Content	Contact Hrs.
1.	Introduction to Rapid Manufacturing: Customization and Mass Customization, Classification of Rapid Manufacturing Processes (Additive/Subtractive/Formative), Process Chain for Additive and Other Rapid Manufacturing Processes.	**11 Hrs**
2	Prototype Design: Data Formats for additive and Other Rapid Manufacturing Processes and associated details, Data Conversion for Layered/additive manufacturing and Associated Difficulties, Data Validity Checks for Layered Manufacturing, Data repair procedures for Layered Manufacturing, Slicing Algorithms, Part Deposition Orientation and its Importance, Direct Slicing and STEP	**11 Hrs**
3	Fused Deposition Modelling of Polymers, Ceramics and Metals, Extruder deposition System, Laminated Object Manufacturing and Laminated Tooling Systems, Shaped Deposition Manufacturing and Modular configuration, Stereolithography and other liquid based systems, Laser Sintering based technologies.	**11 Hrs**
4	3D printing, Direct Metal Deposition/3D welding; Laser/Electron Beam melting based technologies, Silicon Rubber Moulding, Metal Arc Spray System and other RT processes	**10 Hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-1203.1	Understand the basic concepts of rapid manufacturing: customization and mass customization

CO2	MMEC-1203.2	Understand the classification of rapid manufacturing processes
CO3	MMEC-1203.3	Understand 3D printing, direct metal deposition/3D welding, laser/electron beam melting based technologies

Suggested Readings / Books:

1 Rapid Manufacturing by Pham D T and Dimov SS, 2004.
2. Stereo lithography and other RP&M Technologies by Jacobs PF, 2002.
3. Additive Manufacturing Technologies; Rapid Prototyping to Direct Digital Manufacturing by Ian Gibson, David W. Rosen, and Brent Stucker, 2001.

(Departmental Elective-I)

SUBJECT TITLE: TRIBOLOGY
SUBJECT CODE: MMEC-1211
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of friction, wear and lubrication, types of egg, contacts i.e. conforming and non-conforming and types of motion i.e. rubbing sliding. The students will be able to understand the solid lubricants: their applications in metal forming processes.

S No.	Content	Contact Hrs.
1.	Introduction: Friction, wear and lubrication, types of egg. Contacts: conforming and non-conforming. Types of motion; rubbing sliding, Oscillating, Rolling and Surface of interactions, elastic and plastic deformations, Properties of materials, Surface energy and flash temperature theory.	**7 Hrs**
2	Friction: Laws of sliding friction, concept of adhesion, Tabor's mode off friction elastic thermo friction, rolling friction, measurement of friction. Wear: Laws of wear, Types of wear such as adhesive, declamination, abrasive, fatigue, corrosive, fretting, erosive, electrical and oxidative. Measurement of wear in dry at me sphere and different environments, Prevention and control of wear and friction in machines, wear of cutting tool and dies, study of abrasion in grinding, lapping and honing.	**12 Hrs**
3	Lubrication: Mechanisms of lubrication, Boundary. Squeeze film hydrodynamic and elasto hydro-dynamic and hydro static lubrications plasto hydrodynamic lubrication, solution of Reynolds's equation in two and three-dimensional flow, Pressure distribution load carrying capacity friction forces in oil film and Co-efficient of friction in journal bearing, Sold lubricants types and applications. Bearing Design: Design of bearing: clearance in journal bearing, minimum film thickness, sommar-field Number, Oil grooves and flow of oil in axial and circumferential grooves ca vi tat ions and turbulence in oil bearings, Heat generation and cooling or bearing Hydrostatic and dynamic and their applications in machine Tools, Design of air bearing and other gas bearing.	**12 Hrs**
4	Rolling Friction: Reynold's slip, Heathe cote concept selection of roller bearings and their methods of lubrication design aspects and modes of	**12 Hrs**

	bearing failures and elasto hydro dynamic lubrication Solid Lubricants: Their applications in metal forming processes.	

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-1211.1	Understand basic concepts of wear and friction
CO2	MMEC-1211.2	Understand contacts i.e. conforming and non-conforming and types of motion i.e. rubbing sliding.
CO3	MMEC-1211.3	Understand the solid lubricants: their applications in metal forming processes

Suggested Readings / Books:

1. Industrial Tribology, Tribology failures and their analysis by B.S. Prabhu, 2001.
2. Introduction to Tribology by Bharat Bhushan, 2004.
3. Tribology: Friction and Wear of Engineering Materials by Ian M Hutch, 1999.

(Departmental Elective-I)

SUBJECT TITLE: ADVANCED MATERIALS TECHNOLOGY
SUBJECT CODE: MMEC-1212
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of material science fundamentals properties of single and multiphase, materials, fatigue, creep and fracture process.

S No.	Content	Contact Hrs.
1.	Material science fundamentals. Properties of single and multiphase. Materials. Fatigue, creep and fracture process. Ferrous materials and alloying properties. Engineering properties of non-ferrous and refractory materials-ceramics, plastics, fibre reinforced and composite materials. Environmental degradation of materials and surface modification techniques. Non Destructive testing.	**43 Hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-1212.1	Understand the basic concepts of material science,
CO2	MMEC-1212.2	Understand the fundamentals and properties of single and multiphase materials
CO3	MMEC-1212.3	Understand the fatigue, creep and fracture process.

Suggested Readings / Books:

1 Physical Metallurgy Principles by R.E. Reed Hill, 2000.
2. Engineering Physical Metallurgy & Heat treatment by YU. Lakhtin, 2007.
3. Physical Metallurgy for Engineers by D.S. Clark & W.R. Varney, 2003.
4. Engineering Physical Metallurgy Part - 1 by R.A. Higgins, 2002.
5.Solid State Transformation by V. Raghavan, 2007.
6. Phase Transformations in Materials by A.K. Jena & M.C. Chaturvedi, 2002.
7. An Introduction to Metallurgy by A. Cottrell, 2004.
8. Material Science & Engineering by V. Raghavan, 2002.

9. Introduction to Material Science for Engineers by James F. Shackelford, 2001.
10. Non-Destructive Testing techniques by Shirvastav, 2005.
11. Non-Destructive Testing hand books of American Society of Non-Destructive Testing, 2005.

(Departmental Elective-II)

SUBJECT TITLE: INDUSTRIAL AUTOMATION
SUBJECT CODE: MMEC-1206
SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of computer based control i.e. implementing control system using computer or microprocessor. The students will be able to understand advanced functions of PLC i.e. analog input and output functions, analog input and output modules, analog signal processing in PLC.

S No.	Content	Contact Hrs.
1.	Computer based control: Implementing control system using computer or microprocessor; computer based controller: hardware configuration and software requirements. Distributed control system: Meaning and necessity of distributed control; hardware components of DCS; DCS software. Introduction programmable logic controller (PLC): What is PLC? PLC versus microprocessor/microcontroller/computer, advantages and disadvantages of PLC, architecture and physical forms of PLC	**10 Hrs**
2	Basic PLC functions: Registers: holding, input and output registers; Timers and timer functions; counters and counter functions Intermediate PLC functions: Arithmetic functions: addition, subtraction, multiplication, division and other arithmetic functions; Number comparison and conversion. Data handling functions of PLC: Skip function and applications; master control relay function and applications; jump with non-return and return; data table, register and other move functions. Bit functions of PLC: Digital bit functions and applications; sequencer functions and applications.	**11 Hrs**
3	Advanced functions of PLC: Analog input and output functions, analog input and output modules, analog signal processing in PLC; PID control function, network communication function. PLC programming: PLC programming languages, ladder programming,	**11 Hrs**

	mnemonic programming and high level language programming.	
4	SCADA: Supervisory control versus distributed control; Layout and parts of SCADA system, detailed block schematic of SCADA system; Functions of SCADA system: data acquisition, monitoring, control, data collection and storage, data processing and calculation, report generation; MTU: functions, single and dual computer configurations of MTU; RTU: functions, architecture / layout; MTU-RTU communication and RTU-field device communication.	**11 Hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MMEC-1206.1**	Understand the basic concepts basic concepts of computer based control i.e. Implementing control system using computer or microprocessor.
CO2	**MMEC-1206.2**	Understand advanced functions of PLC
CO3	**MMEC-1206.3**	Understand analog input and output functions, analog input and output modules, analog signal processing in PLC

Suggested Readings / Books:

1. Process Control Instrumentation Technology, C.D. Johnson, Prentice Hall, 2000.
2. Programmable Logic Controllers, J.W. Webb, R.A. Reis, Prentice Hall, 2004.
3. Programmable Logic Controllers, J.R. Hackworth and F.D. Hackworth, Pearson Edition, 2008.
4. Supervisory Control and Data Acquisition (SCADA), S.A. Boyer, International Society of Automation, 2001.

(Departmental Elective-II)

SUBJECT TITLE: FINITE ELEMENT METHODS
SUBJECT CODE: MMEC-1204
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of the finite element method, comparison with finite difference method. The students will be able to understand the finite element analysis of 2-D problems: Finite element modeling of single variable problems, triangular and rectangular elements

S No.	Content	Contact Hrs.
1.	Introduction: Historical background, basic concept of the finite element method, comparison with finite difference method.	**7 Hrs.**
2	Variation Methods: Calculus of variation, Rayleigh-Ritz and Galerkin methods; Finite Element Analysis of 1-D problems: Formulation by different approaches (direct, potential energy and Galerkin); Derivation of elemental equations and their assembly, solution and its post processing, Applications in heat transfer, fluid mechanics and solid mechanics: bending of beams analysis of truss and frame.	**15 Hrs.**
3	Finite Element Analysis of 2-D problems: Finite element modelling of single variable problems, triangular and rectangular elements; Applications in heat transfer, fluid mechanics and solid mechanics; Axi-symmetric and 3D bodies.	**10 Hrs.**
4	Numerical Considerations: numerical integration, error analysis, meshes refinement. Plane stress and plane strain problems; Bending of plates; Eigen value and time dependent problems.	**10 Hrs.**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MMEC-1204.1**	Understand the basic concepts of finite element method,

CO2	**MMEC-1204.2**	Understand the difference between finite element and finite difference methods.
CO3	**MMEC-1204.3**	Understand some programming aspects: mesh generation, mesh refinement, numerical integration etc.

Suggested Readings / Books:

1. Finite Element Procedures in Engineering Analysis by K.J. Bathe, Prentice-Hall, Englewood Cliffs, NJ, 1982.
2. Introduction to the Finite Element Method by J.N. Reddy, McGraw-Hill', New York, 1993.
3. Finite Element Analysis by C.S. Krishnamoorthy, Tata McGraw Hill, 2001
4. Finite Element Methods by Chandupatla, Pearson Publication, 2004.

(Departmental Elective-II)

SUBJECT TITLE: PRODUCT DESIGN & DEVELOPMENT
SUBJECT CODE: MMEC-1213
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of principal requirements of good product design, factors and considerations affecting product design. The students will be able to understand value engineering, concept, advantage and applications.

S No.	Content	Contact Hrs.
1.	Importance of product design in industry. Principal requirements of good product design. Factors and considerations affecting product design. Ergonomic factor in product design. Product design methodology and techniques. Basic elements and concepts of visual design.	**15 Hrs**
2	Materials, forms, function and color relationships. Product graphics, product development and testing.Packaging materials their characteristics and applications. Packaging design considerations	**15 Hrs**
3	Value engineering, concept, advantage and applications. Value, types of values. Analysis of function, using and evaluating functions. Value engineering techniques. Value control.	**13 Hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MMEC-1213.1**	Understand the basic concepts of principal requirements of good product design.
CO2	**MMEC-1213.2**	Understand the factors and considerations affecting product design
CO3	**MMEC-1213.3**	Understand value engineering, concept, advantage and applications

Suggested Readings / Books:
1. Industrial Design by MayallMcGruw Hill, 2004.

2. Product Design & Process Engineering by Niebel& Draper McGraw Hill, 2001.
3. Introduction to Design Asimov Prentice Hall Value Engineering by MudgeMcGraw Hill, 2000.

(Departmental Elective-II)

SUBJECT TITLE: OPERATION MANAGEMENT
SUBJECT CODE: MMEC-1214
SEMESTER: 2
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	-	-	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

Course Objectives:
The course has been designed to cover the basic concepts of computer based control i.e. implementing control system using computer or microprocessor. The students will be able to understand advanced functions of PLC i.e. analog input and output functions, analog input and output modules, analog signal processing in PLC.

S No.	Content	Contact Hrs.
1.	Unit-I: Overview Historical Evolution Operations as a source of competitive Advantage Operations Management Definition Interface with other management functions Link Between Operations and Finance Productivity and Productivity Measures Unit-II: Strategy, Products, and Capacity Operations Strategy NPD Strategic Capacity Management Project Management	**10 Hrs**
2	Unit-III: Process Management Process selection Product-process matrix Process mapping Throughput Time, Cycle time Little's Law Waiting Lines, Queuing Theory Process Simulation Unit-IV: Capacity Planning and Facilities Design Capacity Analysis Overall Equipment Effectiveness Bottleneck analysis Basic Layouts and their designing	**11 Hrs**
3	Unit-V: Process Improvement Quality Management Evolution of Quality Management and Contribution of quality Gurus Six Sigma, SQC, SPC Systematic Problem Solving Methodology Lean Operations	**11 Hrs**
4	Unit-VI: Inventory Management: Single period, Multi-period models Quantity Discounts Unit-VII: Planning & Scheduling Sales & Operations Planning Process Aggregate Planning CRP, MRP, ERP Scheduling, TOC	**11 Hrs**

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	**MMEC-1214.1**	Understand the basic concepts of production, productivity and function of management
CO2	**MMEC-1214.2**	To gain knowledge of hierarchy, principles and dimensions of planning function of organizations
CO3	**MMEC-1214.3**	Determine the various theories and approaches related to Industrial Engineering

Suggested Readings / Books:

1. Ravi Anupindi, Sunil Chopra et al (2013) Managing Business Process Flows: Principles of Operations Management, Pearson
2. Edward Pound, Jeffrey Bell, Mark Spearman(2014) Factory Physics for Managers_ How Leaders Improve Performance in a Post-Lean Six Sigma World-McGraw-Hill Education
3. Russell & Taylor, Operations Management along Supply Chain, Wiley
4. Slack N, Chambers S, Johnston R(2010) Operations management 6th ed_ Prentice Hall

SYLLABUS

SEMESTER-III

SUBJECT TITLE: MOOCs
SUBJECT CODE: MMEC-2303
SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	-	-	3

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

The students have to register for a MOOC course and thereafter enroll for examination. The marks for the same will be added in the semester marks card.

SUBJECT TITLE: MOOCs
SUBJECT CODE: MMEC-2304
SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	-	-	3

Internal Assessment: 40
End Term Exam: 60
Duration of Exam: 3 Hrs

The students have to register for a MOOC course and thereafter enroll for examination. The marks for the same will be added in the semester marks card.

SUBJECT TITLE: LITERATURE SURVEY
SUBJECT CODE: MMEC-2371
SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
-	-	-	2

Internal Assessment: 100

The students have to undergo a research work by finding some appropriate literature review. The report file along with presentation will be submitted or presented to the Department.

SUBJECT TITLE: SYNOPSIS
SUBJECT CODE: MMEC-2372
SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
-	-	-	4

Internal Assessment: 50
End Term Exam: 50

The students have to undergo a research proposal based upon the literature review. The report file along with presentation will be submitted or presented to the Department.

SYLLABUS

SEMESTER-IV

SUBJECT TITLE: THESIS
SUBJECT CODE: MMEC-2471

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
-	-	-	12

Students should do the research thesis and submit a report file to the department. The ppt. is compulsory for the same.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	MMEC-2471.1	Understand the potential of doing the research
CO2	MMEC-2471.2	Able to Understand the selection of topic and its presentation
CO3	MMEC-2471.3	To effectively use the different tools, report writing and present in schematically way the research area selected