JIMS Engineering Management Technical Campus, Greater Noida

(Affiliated to GGSIP University, Dwarka, Delhi)

Department of Mechanical Engineering

Academic Year 2018-19

VISION AND MISSION OF MECHANICAL ENGINEERING DEPARTMENT

Vision

The Department of Mechanical Engineering envisions to evolve into a reputed institution of the country by imparting quality education in the field of Mechanical Engineering fostering innovation, creativity and excellence in its students so that the graduates of this Department can face the challenges of the global market.

Mission

M 1 To have state of the art infrastructure facilities in place.
M 2 To conduct value-added training programme for students.
M 3 To maintain an active partnership program with industry.
M 4 To ensure holistic development of students' personality.

Program Specific Outcomes (PSO's):

PSO 1	To develop the ability among students to analyse, formulate and solve design engineering/real life problems based on the sound knowledge imparted inmathematics,scienceandengineering.
PSO 2	To demonstrate their ability to apply their knowledge and skills for achieving a successful career in diverse domains viz. Industry, Academia and R & D.
PSO3	To exhibit professionalism, social ethics, sound communication skills and an ability to correlate engineering issues to broader social context.
PSO4	To boost up the entrepreneurial spirit among students and converting them in to employment generators.
PSO5	To create value through industry focused teaching and research in a socially responsible and ethical context

PSO TO MISSION STATEMENT MAPPING

MISSION STATEMENTS	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
M1	3	3	3	2	3
M2	3	3	3	2	2
M3	3	3	2	3	3
M4	3	2	2	3	3

[3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

Programme Outcome (POs)/Graduate Attributes

S. No.	Graduate Attributes	Program Outcomes (POs)
1	**Engineering knowledge:**	**PO1:**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	**Problem analysis:**	**PO2:**Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions:**	**PO3:**Design solutions for complex 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.
4	**Conduct investigations of complex problems:**	**PO4:**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.
5	**Modern tool usage:**	**PO5:**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society:**	**PO6:**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.
7	**Environment and sustainability:**	**PO7:**Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics:**	**PO8:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work:**	**PO9:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication:**	**PO10:**Communicate effectively on complex engineering activities with the engineering community and with the 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.
11	**Project management and finance:**	**PO11:**Demonstrate knowledge 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.
12	**Life-long learning:**	**PO12:**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.

MAPPING OF POs TO PSOs

PEOs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PSO-1	3	3	3	2	3	2	3	2	3	1	3	2
PSO-2	3	3	3	2	3	2	3	2	3	3	3	2
PSO-3	3	3	3	2	2	2	2	3	3	3	3	2
PSO-4	3	3	3	3	3	3	3	3	3	2	3	3
PSO-5	3	3	3	3	3	2	2	3	2	3	2	3

[3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

MANUFACTURING PROCESS

Course Code: ETME105	**Semester: I**
L: T: P: 3:1:3	**Credit: 3**

After course completion students will be able to:	
CO1	Classifythe manufacturing process with engineering properties of material. Determine and describevarious casting process with description of Heat Treatment process.
CO2	Understanding Bench Work & Fitting including hot working and cold working process and various material removal processes.
CO3	Analyzethe welding technique and various welding process with the explanation of soldering and brazing
CO4	Explainingthe concept of sheet metal operation with various tools used and application of sheet metal shop, brazing and powder metallurgical techniques

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

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

[3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT-I:** **Introduction**. : Introduction of Manufacturing processes and their classification, Basic Metals & Alloys: Properties and Applications. Properties of Materials: Strength, elasticity, stiffness, malleability, ductility, brittleness, toughness and hardness. Ferrous Materials: Carbon steels, its classification based on % carbon as low, mild, medium & high carbon steel, its properties & applications. Wrought iron. Cast iron. Alloy steels: stainless steel, tool steel. Elementary introduction to Heat-treatment of carbon steels: annealing, normalizing, quenching & tempering and case- hardening. Non-Ferrous metals & alloys: Properties and uses of various non-ferrous metals & alloys and its composition such as Cu-alloys: Brass, Bronze, Al-alloys such as Duralumin **Casting Processes**: Principles of metal casting, Pattern materials, types and allowance, composition and properties of moulding sand, foundry tools, concept of cores and core print, elements of gating system, description and operation of cupola, special casting processes e.g. die-casting; permanent mould casting; centrifugal casting; investment casting; casting defects.	12	CO1
2	**UNIT-II:** **Smithy and Forging:** Hot working and cold working, Forging tools and equipments, Forging operations, Forging types: Smith forging, Drop forging, Press forging, Machine forging; Forging defects; Extrusion, wire drawing, swaging. **Bench Work and Fitting:** Fitting shop tools, operation: Fitting; sawing; chipping; thread cutting (with taps and dies); Marking and marking tools.	12	CO2
3	**UNIT-III:** **Metal joining:** Welding principles, classification of welding techniques, Oxyacetylene Gas welding, equipment and field of application, Arc-welding, metal arc, Carbon arc welding, submerged arc welding and atomic hydrogen welding, TIG and MIG welding, Electric resistance welding: spot; seam; flash; butt	12	CO3

	and percussion welding, Flux: composition; properties and function, Electrodes, Types of joints and edge preparation, Brazing and soldering, welding defects.		
4	**UNIT-IV:** **Sheet Metal Work**: Tools and equipments used in sheet metal work, metals used for sheets, standard specification for sheets, Types of sheet metal operations: shearing, drawing, bending. Other operations like spinning, stretch forming, embossing and coining. **Powder Metallurgy:** Introduction of powder metallurgy process: powder production, blending, compaction, sintering.	12	CO4

Text Books:

[T1]. Manufacturing Process by Raghuvanshi.(DhanpatRai and Co.)
[T2]. Manufacturing Technology by P.N.Rao (TMH publications)

Reference Book:

[R1]. Workshop Technology by Hazra-Chowdhary (Media Promoters and Publishers Pvt. Ltd.)
[R2]. Production Engineering by R.K.Jain (Khanna Publishers)
[R3]. Workshop Technology by Chapman (Elsevier Butterworth-Heinemann)
[R4]. Fundamentals of Modern Manufacturing by Mikell P. Groover (Wiley India Edition)
[R5]. Manufacturing Processes for Engineering Materials by Kalpakjian and Schmid (Pearson)

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

THERMAL SCIENCE	
Course Code: ETME 203	**Semester: 3rd**
L:T:P 3:1:1	**Credit: 4**

After course completion students will be able to:	
CO1	Understandthe concept of thermodynamic work. Calculateand comparework in case of a closed system executing different thermodynamicprocesses or different thermodynamic cycles. Quantify the second law of thermodynamics for a cycle by establishing the inequality of Clausius. Apply the inequality of Clausius and establishthe property entropy of a system. Derive and applyprinciple of increase of entropy to evaluatethe feasibility of a thermodynamic process.
CO2	Distinguishbetween ideal gas and pure substance. Calculate thermodynamic properties using tables of thermodynamic propertiesand analyzethe processes on T-v diagrams to solve advancedengineering problems.
CO3	Understand the states and performance parameters for vapour power cycles based on the Rankine cycle with superheat, reheat, and regeneration.
CO4	Students will gain ability to carry out a cyclic analysis of a gas turbine engine, including turbofan and will understand the working of various parts of gas turbines.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT-I:** **Basic concepts**: Introduction to the Basic definitions of Engineering Thermodynamics. Thermodynamic systems : Closed, Open and Isolated systems. Microscopic and Macroscopic view. Intensive and Extensive properties.Zeroth law of Thermodynamics. Phase, State, Process, Cycle. Point functions and Path functions. Gas Laws and Equation of State. Work and Heat. **First Law of Thermodynamics:** Introduction to First Law of Thermodynamics, Internal energy. Non flow processes, p-*v* diagrams. Concept of Flow work, Enthalpy. Analysis of steady flow and unsteady flow processes and their applications. Throttling process. **Second Law of Thermodynamics:** Limitations of First law and necessity of Second Law of Thermodynamics, Kelvin Planck statement and Claussius statement, Reversible and Irreversible processes. Carnot cycle, Reversed Carnot cycle. Carnot's Theorem, Clausius inequality. Entropy, Change in Entropy during various processes and representations on t-s diagrams, Entropy principle, Entropy Generation.	11	CO1
2	**UNIT-II:** **Availability and Irreversibility** : High grade and low grade energy. Available and unavailable energy. Dead state. Loss of available energy due to Heat transfer through a Finite temperature difference. Availability. Reversible work and Irreversibility. Availability in non flow systems and steady flow systems. Second law efficiency. **Thermodynamic Property Relations:**. Maxwell Relations. Clapeyron Equation. **Properties of a Pure Substance:** Phase equilibrium of a pure substance on t-*v* diagram. Normal boiling point of a Pure substance. Saturation states. Compressed liquid. p-v&p-t diagram of a pure substance. Saturated steam, Dry and saturated steam, Superheated steam. Use of Steam tables and Mollier diagram. Different processes of vapour on p-v and t-s diagrams. Measurement of Dryness fraction. .	11	CO2
3	**UNIT-III:** **Vapour Power Cycles :**Carnot cycle. Simple Rankine cycle. Effect of various parameters on the efficiency of Rankine cycle. Reheat and Regenerative cycles.	11	CO3
4	**UNIT-IV:** **Gas Power Cycles:** Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, and Ericsson cycle. **Gas Turbines:** Brayton cycle, Thermal refinements. Performance of Gas turbines, Combined cycle. Principles of Jet Propulsion. Turbojet and Turbo-prop engines, Rocket engines.	11	CO4

Text Books:

[T1] P.K. Nag, "Engineering Thermodynamics", 5th edition McGraw Hill
[T2] Y. A. Cengel& M.A Boles "Thermodynamics- An Engineering Approach
[T3] Gordon Rosers, &Yon Mahew; Engineering Thermodynamics", Pearson.

Reference Book:

[R1] M.J. Moran & H.N. Shapiro "Fundamentals of Thermal Engineering" John Wiley &sons.
[R2] C. P. Arora "Thermodynamics", McGraw Hill
[R3] S L Somasundaram "Engineering Thermodynamics", New Age International Publishers.
[R4] R. K. Rajput, "Engineering Thermodynamics", Lakshmi Publications
[R5] Shiv Kumar, " Fundamentals of Thermal Engineering" Ane Books Pvt. Ltd.

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

PRODUCTION TECHNOLOGY

Course Code: ETME205	**Semester: 3rd**
L: T: P: 3:1:1	**Credit: 4**

After course completion students will be able to:	
CO1	Select materials, types and allowances of patterns used in casting and analyze thecomponents of moulds.
CO2	Design core, core print and gating system in metal casting processes
CO3	Understand arc, gas, solid state and resistance welding processes.
CO4	Develop process-maps for metal forming processes using plasticity principles.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT I** **Moulding:** Introduction to sand moulding, Pattern design, Pattern layout and construction, testing of moulding sand. moulding and core making machines, CO_2 - Process, fluid sand process, shell moulding, cold curing process, hot-box method, flask less moulding, Design of metal moulds, Die Design for die Casting.	10	CO1
2	**UNIT II** **Casting:** Directional principles, Solidification, types of gating systems, Pouring time and temperature. Design criteria of pouring basin, sprue, runner, gate and riser, gating ratio- related numerical problems, Use of chaplet, chills and padding, Selection of melting furnaces, Crucible furnaces, Electric furnaces, Induction furnace, Control of melt and Cupola charge calculations. Foundry mechanization and layout.	10	CO2
3	**UNIT III** **Welding:** Principle, advantages, limitations and applications, Tungsten Inert Gas welding, Metal Inert Gas welding, Electro - slag welding, Electro - Gas Welding, Explosive Welding, Ultrasonic Welding, Electron Bean Welding, Laser Beam Welding, Friction Welding, Cold Welding, Thermit Welding. Welding Defects-causes and remedies. Numerical problems on electric arc welding and resistance welding.	11	CO3
4	**UNIT IV** **Metal Forming:** Introduction to Metal Forming, Elastic & plastic deformation, Hot working and cold working. Work required for forging, Hand, Power, Drop forging. Analysis of wire drawing and maximum reduction. Tube drawing, Extrusion, types and its application. Rolling process, rolling mills & rolled-sections. Defects in metal forming processes. Sheet metal processes, shearing, calculation of punch force, shearing dies, stretch forming, Deep drawing and its analysis.	11	CO4

Text Books:

[T1] Manufacturing processes Vol. 1, by H.S. Shan, Pearson Education
[T2] Manufacturing Engineering & Technology by Kalpakjian, Pearson Publication

Reference Books:

[R1] Mikell P. Groover"Principles of Modern Manufacturing, 5th Edition SI Version , Wiley
[R2] Jain P.L., "Principles of Foundry Technology", Tata McGraw Hill, New Delhi, 1998.
[R3] Sharma P.C., "A Text Book of Production Engineering", Vol.1, S. Chand Publication, New Delhi, 2001.
[R4] Heine & Rosenthal, "Principle of Metal Casting", Tata McGraw Hills, New Delhi, 2003.
[R5] Little Richard L, "Welding & Welding Technology", Tata McGraw Hill, New Delhi, 2003.
[R6] Jain, R.K., "Production Technology", Khanna Publishers, 2001.
[R7] HMT Bangalore, "Production Technology", Tata McGraw Hill, 1980.
[R8] A.K. Chakrabarti "Casting Technology and cast alloys" 2011, PHI learning

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	**Class Test (15)**	**Class Performance (10)**
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	**University Examination**
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

Strength of Material -1

Course Code:	**ETME-211**	**Semester:**	**5**
L: T: C:	**3:0:3**	**Credit:**	**3**

After course completion students will be able to:	
CO1	Understand statically determinate and indeterminate problems.
CO2	Determine the resistance and deformation in members subjected to axial, flexural and torsional loads.
CO3	Evaluate principal stresses, strains and apply the concept of failure theories for design.
CO4	Analyze and design thin, thick cylinders and springs

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
CO1	2	1		1	3	2	1	1	2	1	2	2
CO2	1		1	1		3	1	2	3	2	3	
CO3	2	1			2	2	1	2			3	1
CO4	2	1	2	2	3		3	1	1	2	2	1

[3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	UNIT – I **Simple Stresses & strains**: Concept of stress at a point, Tensile, Compressive, shear and volumetric stresses and Strains, Young's modulus, modulus of rigidity, complementary shear stress, lateral strain and Poisson's ratio. Strain relationships. **Compound bars and Temperature** stresses: Stresses in compound bars carrying axial loads and subjected to temperature stresses.	13	CO1
2	UNIT-II **Simple bending**: Shear force and bending moment diagrams of cantilevers, simply supported beams under concentrated, uniformly loaded and varying loads with and without overhangs. Stresses in beams and cantilevers under bending, beam of uniform strength, bending due to eccentric loads. Shear stress in beams, strain energy, Castigliano'stheorm Slope and defection of cantilevers and beams under concentrated and uniformly distributed loads. Moment Area method, MaCaulay's method; principle of superposition..	11	CO2
3	UNIT-III **Columns**: Combined direct and bending stresses in columns, Euler's and Rankine Gordon equations. **Torsion**: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts. Power transmitted by shafts; combined bending and torsion. Strain energy in torsion **Complex stresses and strains**: Principle stress and strain due to combination of stresses, Mohr's circle, strain energy, theories of Failures.	12	CO3
4	UNIT-IV **Springs**: Close-coiled springs, leaf springs. **Cylinder**s: Thin and thick cylinders, Lame's Theorem, compound cylinders, spherical vessels..	13	CO4

Text Books:

[T1] Dr. Sadhu Singh "Strength of Materials", Khanna Pub.
[T2] Hibbler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 1994.

Reference Books:

[R1] Timoshenko S.P., Gere J "Elements of Strength of Materials", East-West affiliated, New Delhi,
[R2] Bhavikatti S. S. Strength of Materials", Vikas Publishers 2000
[R2] Sri Nath L.S. et.al., "Strength of Materials", McMillan, New Delhi,2001
[R3] Popov Eger P., "Engg. Mechanics of solids", Prentice Hall, New Delhi, 1998
[R4] Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi, 1990

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	**Class Test (15)**	**Class Performance (10)**
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	**University Examination**
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

Material Science and Metallurgy

Course Code: ETME-207	**Semester:** 3
L: T: C: 3:0:0	**Credit:** 3

After course completion students will be able to:	
CO1	Understand the crystal structure of metal, defects and their relation to the mechanical properties. Understand the concept of diffusion, deformation and their relation to the mechanical properties.
CO2	Understand and apply the concept of material fracture and Creep for the selection of material for high and low temperature services. Understand the concept of solidification of metal and alloys ,its application in Iron – Carbon diagram, effect of alloying elements on TTT diagram, S-N curve.
CO3	Understandthe concept of heat treatment and its application in Mechanical Engineering. Understand the types of material in mechanical point of view, their application, effect of alloying elements and their usage.
CO4	Understand the concept of corrosion and methods of prevention. Understand the general characteristics of Fiber Reinforced Composite and their applications.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT – I** Structure of metal: Crystal structure (BCC, FCC and HCP, Packing factor and density calculation), X-ray diffraction, miller indices, lattices, imperfections, elementary treatment of point and line defects and their relation to mechanical properties.Diffusion: Diffusion mechanisms, steady state and non steady state diffusion, factors affecting diffusion Deformation: Slip, twinning, effect of cold and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.	11	CO1
2	**UNIT-II:** Fracture: Types of fracture ductile and brittle, fatigue Creep: Basic consideration in the selection of material for high and low temperature service, creep curve, effectof material variables on creep properties, brittle failure at low temperature.Solidification: Phases in metal system, lever rule, solidification of metal and alloys, solid solution, eutectic, eutectoid and inter-metallic compounds, Iron carbon equilibrium diagram, TTT-diagram. Effect of alloying elements on TTT diagram, S-N curve.	13	CO2
3	**UNIT-III:** Heat Treatment: Principles and purpose of heat treatment of plain carbon steels, annealing, normalizing,hardening, tempering, isothermal treatment, case hardening – carburizing, nitridingetc, precipitating hardening of aluminum alloys. Hardenability: determination of hardenability Jominy end quench test. Materials: Plain Carbon steels, effect of alloying elements, properties, uses, springs, and wear resisting steels, IS standards codes for steels.	10	CO3
4	**UNIT-IV:** Corrosion: Types of corrosion, Galvanic cell, rusting of Iron, Methods of protection from corrosion.Fiber Reinforced Composites: General characteristics, Applications, Introduction to Fibers – glass, carbon,Kevlar 49 fibers. Matrix – Polymeric, Metallic, Ceramic Matrix, Coupling agents and fillers.	10	CO4

Text Books:

[T1] Callister “Materials Science and Engineering”: An Introduction, 6th Edition
[T2] Parashivamurthy K.I “Material Science and Metallurgy”, Pearson,
[T3] Sidney H Avner,” Introduction to Physical Metallurgy”, Tata McGraw-Hill,New Delhi-1997.

Reference Books:

[R1] Degarmo E. Paul et.al, “Materials & Processes in Manufacture”, Prentice Hall India, New Delhi, 2001.
[R2] L. Krishna Reddi, “Principles of Engineering Metallurgy”, New Age Publication, New Delhi, 2001.
[R3] Buduisky et al, “Engineering Materials & Properties”, Prentice Hall India, New Delhi, 2004.
[R4] Peter Haasten, “Physical Metallurgy”, Cambridge Univ. Press, 1996.
[R5] Raymond A Higgin., “Engineering Metallurgy Part 1”, Prentice Hall India, New Delhi, 1998

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

MANAGEMENT OF MANUFACTURING SYSTEMS

Course Code: ETME 301 | **Semester: 5th**

L: T: P 3 0 0 | **Credit: 3**

After course completion students will be able to:	
CO1	Understand and compare the production functions, productivity concept, organization structures, lay-outing of plant and concept of group technology
CO2	Understand and apply the various concept of production planning and control. Understand the concept of Method study and perform the calculations for various parameter required in Method study. Understand the concept of Work Measurement and its techniques
CO3	Understand the importance of maintenance concept and its importance. Calculate the EOQ and analyze the replacement analysis.
CO4	Analyze the production cost and calculate the Break Even point for production systems. Understand the management principles, scientific approach and the human relation aspects.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT-I:** **Introduction:** Production functions, Management systems, production and productivity. **Plant Organization:** Principles of organization, Organization structure-line and staff organization. **Plant Location, Layout:** Process layout, product layout and combination – methods of layout, economics oflayout; group technology.	11	CO1
2	**UNIT-II:** **Production Planning & Control**: Types of products, demand, demand forecasting, marketing strategies,scheduling and control of scheduling production control. **Method Study:** Definition and concepts, method study procedures, symbols, advantages, Operation processchart, Flow process charts, Two hand process chart, Motion study, micro motion, SIMO charts, SystemsConcepts, Classification analysis techniques, Principle of motion economics. **Work Measurement**: Definition, objectives & techniques, Time study equipment, performance rating,allowances, standard time, work sampling, PMTS.	11	CO2
3	**UNIT-III:** **Industrial Maintenance:** Types, organization for maintenance department, Breakdown and preventivemaintenance and corrective maintenance. **Inventory control and replacement analysis:** Introduction replacement policy and method adopted, EOQ.	11	CO3
4	**UNIT-IV:** **Management Concepts:** Development of management principles, scientific management, human relationaspects. **Production Cost Concepts**: Introduction, cost of production, cost centre and unit, Classification and analysis of cost, break Even Analysis.	11	CO4

Text Books:

[T1] Ravi Shankar, "Industrial Engg. & Management", Galgotia Publications
[T2] S.K. Sharma, "Industrial Engg. & Operation Management", S.K. Kataria& Sons.

Reference Book:

[R1] Joseph S. Martinich, "Production & Operation Management", John Wiley & Sons.
[R2] S. N. Chary," Production and operations management, TMH 4th edition
[R3] Harold T. Amrine, John A. Ritchey, Colin L. Moodie, Joseph F. Kmec "Manufacturing organizationand Management" Pearson publication 6th edition
[R4] S.Anil Kumar, N. Suresh"Production and operations management",New age International,2nd Ed.
[R5] M. Mahajan, "Industrial Engg. & Production Management", DhanpatRai& Co.

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

HEAT TRANSFER

Course Code: ETME303	**Semester:** 5
L: T: C: 3:0:1	**Credit:** 3

After course completion students will be able to:	
CO1	The students are able to learn about the basics of modes of heat transfer such as conduction , convection, and radiation. and Compute temperature distribution in steady-state and unsteady-state heat conduction.
CO2	Understand and analyses heat transfer through extended surfaces such as rectangular, triangular, circular.
CO3	Interpret and analyze forced and free convection heat transfer. Application of heatt transfer through forced and free convection.
CO4	Design heat exchangers using LMTD and NTU methods. Understand the principles of radiation heat transfer and basics of mass transfer.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

[3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT – I** **Introduction: Heat Transfer** – Different Modes, Governing Laws, Applications to Heat Transfer, Simple Problems pertaining to the above. General Heat Conduction Equation: Derivation of the equation in (i) Cartesian, (ii) Polar and (iii) Spherical Co-ordinate Systems. Steady-state one-dimensional heat conduction problems in Cartesian System: Steady-state one dimensional heat conduction problems (i) with and without heat generation and (ii) with and without varying thermal conductivity - in Cartesian system with various possible boundary conditions, Thermal Resistances in Series and in Parallel, Various Numerical Problems concerned to the above	12	CO1
2	**UNIT-II** **Steady-state radial heat conduction problems in Polar System**: Steady-state one-dimensional heat conduction problems (i) with and without heat generation and (ii) with and without varying thermal conductivity - in Cylindrical system with various possible boundary conditions, Thermal Resistances in Series, Various Numerical Problems concerned to the above. Steady-state radial heat conduction problems in Spherical System: Steady-state one-dimensional heat conduction problems (i) with and without heat generation and (ii) with and without varying thermal conductivity - in Spherical system with various possible boundary conditions, Thermal Resistances in Series, Various Numerical Problems concerned to the above. Critical Thickness of Insulation: Concept, Derivation and Numerical Problems Extended Surfaces or Fins: Classification, Straight Rectangular and Circular Fins, Temperature Distribution and Heat Transfer Calculations, Fin Efficiency and Effectiveness, Applications, Numerical Problems covering all the topics. Transient [Unsteady-state] heat conduction: Definition, Different cases - Negligible internal thermal resistance, negligible surface resistance, comparable internal thermal and surface resistance, Lumped body, Infinite Body and Semi-infinite Body, Numerical Problems, Heisler and Grober charts: Solutions to various one-dimensional problems using the charts, Numerical problems.	13	CO2

3	**UNIT-III** **Forced Convection**: Boundary Layer Theory, Velocity and Thermal Boundary Layers, Prandtl number, Governing Equations – Continuity, Navier-Stokes and Energy equations, Boundary layer assumptions, Integral and Analytical solutions to above equations, Turbulent flow, Various empirical solutions, Numerical Problems, Forced convection flow over cylinders and spheres, Internal flows –laminar and turbulent flow solutions, Numerical Problems. Free convection: Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes, Empirical solutions, Numerical Problems.	10	CO3
4	**UNIT-IV** **Thermal Radiation**: Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's, Rayleigh-Jeans' and Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws, View factor, View factor algebra, Net radiation exchange in a two-body enclosure, Typical examples for these enclosures, Radiation Shield, Numerical problems on all the above topics. **Heat Exchangers**: Definition, Classification, LMTD method, Effectiveness - NTU method, Analytical Methods, Numerical Problems, Chart Solution Procedures for solving Heat Exchanger problems: Correction Factor Charts and Effectiveness-NTU Charts, Numerical Problems. Mass Transfer: Definition, Examples, Fick's law of diffusion, Fick's law as referred to ideal gases, Steady-state equi-molal counter diffusion of ideal gases, Mass diffusivity.	12	CO4

Text Books

[T1] R K Rajput," A text Book on Heat Transfer ", Laxmi publication

Reference Books:

[R1] M. NecatiOzisik, Heat Transfer – A Basic Approach, McGraw Hill, New York, 2005
[R2] Incropera, F. P. and De Witt, D. P., Fundamentals of Heat and Mass Transfer, 5th Edition, John Wiley and Sons, New York, 2006
[R3] Holman, J. P., Heat Transfer, 9th Edition, Tata McGraw Hill, New York, 2008.
[R4] Alan J. Chapman, Heat Transfer, 4th Edition, Macmillan, New York, 1987.

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category **Marks**	**Class Test** **(15)**	**Class Performance** **(10)**
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category **Marks**	**University Examination**
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

DYNAMICS OF MACHINES

Course Code: ETME 305	**Semester:** V
L: T: P: 3:1:4	**Credit:** 4

After course completion students will be able to:	
CO1	To Analysis and balance the static and dynamic equilibrium of single slider crank mechanism and four bar mechanism by the understanding principle of equilibrium of two body ,three body , two body with torque, four body condition and principle of virtual work.
CO2	To analysis static and dynamic Balancing of rotating and reciprocating masses in same plane and different plane
CO3	Define and derive the different types of governor. To Analysis the controlling forces, stability, sensitiveness, Isochronisms and effect of power of porter and Hartnell governors. Analysis on gyroscopic effect on aero plane, ship and auto motive vehicle.
CO4	Understand free and forced vibrations of single degree freedom systems.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

[3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT-I** **Force Analysis and Flywheel:** Static equilibrium, Static, superposition, Static force analysis of simple mechanisms, Inertia force and Inertia torque , D Alembert's principle, Dynamic force analysis of four link mechanism and slider crank mechanism, Engine force analysis-Piston and crank effort,Gas forces, Equivalent dynamical systems, inertia of connecting rod, inertia force in reciprocating engines (graphical method), Turning moment diagrams ,Fluctuation of energy, Fly Wheel, Punch press.	11	CO1
2	**UNIT-II** **Balancing:** Balancing of rotating parts and primary balancing of reciprocating parts, primary and secondary balancing of in-line engines, Balancing of Radial Engines, partial balancing of locomotive engines and its effect, balancing machines, Field Balancing.	11	CO2
3	**UNIT-III** **Mechanisms for Control:** **Governors:** Types of Governor, Watt Governor, Porter governor, Proell Governor, Hartnell Governor, Wilson-Hartnell governor, Sensitiveness of a Governor, Stability, Isochronism, Hunting, Governor Effort and Power, controlling force. **Gyroscope:** Gyroscopic effect and Gyroscope: gyroscopes, Gyroscopic Torque, gyroscopic stabilization, Gyroscopic Effects on Aeroplanes, and ship, stability of an automobile.	11	CO3
4	**UNIT-IV** **Free Vibration:** Basic features of vibratory systems, Degrees of freedom, single degree of freedom, Free vibration, Equations of motion, Natural frequency, Types of Damping, Damped vibration, Extending to multi degree freedom systems, Critical speeds of shafts, Torsional vibration.. **Forced Vibration:** Harmonic disturbances, Disturbance caused by unbalance, Support motion, force transmissibility and amplitude transmissibility, Vibration isolation.	11	CO4

Text Books

[T1] Theory and Machines: S.S. Rattan, Tata McGraw Hill.

[T2] Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York

Reference Books

[R1] Thomas Beven, "The Theory of Machines", CBS Publishers,

[R2] V.P. Singh, "Theory of Machines", DhanpatRai& Co.(P)Ltd

[R3] Malhotra& Gupta, "The Theory of Machine", SatyaPrakashan,.

[R4] Ghosh A & Malik A K " Theory of Mechanisms and Machines" Affiliated East West Press

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	**Class Test (15)**	**Class Performance (10)**
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	**University Examination**
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

AUTOMOBILE ENGINEERING

Course Code: ETME-401	**Semester: VI**
L: T: P 3 0 3	**Credit: 3**

After course completion students will be able to:	
CO1	The students are able to learn about the basics of Diesel Engine and Petrol Engine and Parts of IC engines. Performance characteristics of internal combustion engines drive effectiveness for 2 wheel and 4 wheel drive vehicles.
CO2	Understand the transmission system of 2 wheel and 4 wheel engines. Arrangements of Clutch and gear box and Friction materials. Bonding materials. Fluid fly wheel clutch.
CO3	Study about manually operated gearboxes like sliding mesh, constant mesh, and synchromesh. Hydraulic torque converter and its construction, working and performance. Learn about parts of steering.
CO4	Understand the suspension system shock absorbers. Mechanical and hydraulic brakes,Concept of Anti lock brakes.

APPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

[3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT – I** **Power Plant**: Selection of power plant for automotive vehicle, requirements of vehicle. Characteristics of various power plants (Petrol engines, Diesel engines, CNG and LPG engine,); constructional details of C.I. and S.I. engines, crank shafts, connecting rods, pistons, piston pins, piston rings, valves mechanisms, manifolds, air cleaners, mufflers, radiators and oil filters. **Vehicular Performance**: Load, air and grade resistance; matching of engine output and demand power, performance requirements of Passenger cars, heavy duty trucks. Performance characteristics of internal combustion engines, drive effectiveness for 2 wheel and 4 wheel drive vehicles.	12	CO1
2	**UNIT-II** **Transmission Systems:** Transmission requirements, general arrangement of clutch, gear box and transmission, for various combinations of front wheel, rear wheel, front engine and rear engine for 2 wheels and 4 wheels drives De-Dion drive. **Clutches**: Principle of friction clutch, single and multi-plate clutches, centrifugal clutch and related Numericals. Friction materials. Bonding materials. Fluid fly wheel clutch	11	CO2
3	**UNIT-III** **Transmission:** Description and working of manually operated gearboxes like sliding mesh, constant mesh, synchromesh. Hydraulic torque converter and its construction, working and performance. Analysis of Semi-automatic and Automatic transmission, overdrives, Differentials and Wilson Gear Box. Construction and working of Live axles. **Steering System**: Steering terminologies and geometry. Davis and Ackermann steering. Power steering	11	CO3
4	**UNIT-IV** **Suspension**: Types of suspension systems, Dead Axle and Independent suspension;., air suspension, shock absorbers. **Wheels, Tyres and Brakes**:, Mechanical and hydraulic brakes, shoe arrangements and analysis, disc brakes, braking effectiveness requirements. Concept of Anti lock brakes. Wheel and tyre requirements, Tyre dynamics.	12	CO4

Text Books:

[T1] N.K. Giri, "Automotive Mechanics", Khanna Publishers

[T2] R K Rajput," A text Book on Automobile Engineering", Laxmi publication

[T3] Kirpal Singh, "Automobile Engg.", Vol. .I & II, Standard Publishers, 2004

Reference Books:

[R1] Narang G.B.S., "Automobile Engg.", Khanna Publishers

[R2] Srinivasan, "Automotive Engines", Tata McGraw Hill

[R3] K.K. Jain & R.B. Asthana, "Automobile Engineering", Tata McGraw Hill

[R4] Joseph Haitner, "Automotive Mechanics", C.B.S. Publications

ASSESSMENT PATTERN:
Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

Power Plant Engineering

Course Code:	**ETME405**	**Semester:**	**7**
L:T:C:	**3:0:3**	**Credit:**	**3**

After course completion students will be able to:	
CO1	To understand the general operation of a Power Plant and to have a sound knowledge of components like boiler, economizer, fan etc.
CO2	To understand the concept of nozzle and its discharge with a brief knowledge of steam turbine and turbine plant.
CO3	To discusesand describe the functioning of IC Engine plant and careful handling of nuclear waste in nuclear power plant.
CO4	To commission and control the various control instruments like water level indicator, combustion control, plant site checking.

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

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT-I** **Steam Generator Plant**: Fuel handling systems, Indian coals, combustion of coal in furnaces; Elementary boilers- Cochran, Babcock & Wilcox. High pressure heavy duty boilers, Super critical and once through boilers layout of evaporator, super heater, re-heater and economizer; dust collectors; ash disposal, fans and draft systems, fluidized bed combustion;	11	CO1
2	**UNIT-II** **Steam Nozzles:** Application of Nozzles. Types of Nozzles. Expansion of steam through a Nozzle. Effect of friction. Critical pressure ratio. Areas at Throat & Exit for maximum discharge conditions. Performance at off- design conditions. **Steam Turbines:** Classification. Impulse and Reaction Turbines. Compounding of steam turbines. Velocity diagrams. Conditions for maximum efficiency.. Losses in steam turbines. Reheat Factor. **Turbine Plant**: Feed water heaters-surface and de-aerator, construction of large condensers- zoning, air cooling zone. Calculations effect of air cooling on vacuum pump rating, cooling water systems and cooling towers Feed water treatment-make up and internal conditioning. Governing of steam turbine.	11	CO2
3	**UNIT-III** **Other Power Plants**: General layout of I.C. Engines and turbine power plants, types, gas turbine plants, fields of application, Nuclear power plants, power reactors and nuclear steam turbines; handling of nuclear waste and safety measures, peak load power generation methods.	11	CO3
4	**UNIT-IV** **Control:** Important instruments on steam generator and turbine; drum water level control, combustion control and super heat temperature control; testing of power plants and heat balance. **Economics**: Planning for power generation in India, super thermal power plants, estimation of cost of power generation; choice of plant site.	11	CO4

Text Books:

[T1] Arora&Domkundwar, "A course in Power Plant Engineering", DhanpatRai& Sons
[T2] P.L.Balaney "Thermal Engineering", Khanna Publishers.

Reference Books:

[R1] R.K.Rajput "Thermal Engineering", Laxmi Publications (P) Ltd.
[R2] A.S Sarao "Thermal Engineering", SatyaPrakshan.
[R3] ShamsherGautam "Power Plant Engineering" Vikas Publishing House

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

Optimization Techniques

Course Code: ETME 407	**Semester: 7th**
L: T: P 3 0 0	**Credit: 3**

After course completion students will be able to:	
CO1	To understand the preliminary concept of linear programming problems (LPP) and enabling the students to formulate the mathematical models of LPP and solutions thereof by graphical method and also by using simplex technique including Big M method.
CO2	To understand the concept of duality and converting the primal problem in to its dual. Also to help the students to understand how primal and dual solutions are inter-related.
CO3	To understand the need and procedure of special technique to solve special LPP – Transportation Problem (finding out initial basic feasible solution and its optimization by MODI Method) and Assignment Problem by Hungarian Algorithm.
CO4	To acquaint the students with Project Scheduling Techniques- CPM and PERT and enabling them to understand how slacks and floats are calculated by forward and backward pass methods and how these slacks could be utilized in projects without affecting the critical path.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

.	COURSE CONTENT	HRS	Cos
1	**UNIT-I:** **Linear Programming:** Mathematical Preliminaries, Formulation of the problem and solution by Graphical Method, The Simplex Method, The Big M Method.	11	CO1
2	**UNIT-II:** **Linear Programming:** Dual problem formulation and solution, Primal and Dual Simplex Method.	10	CO2
3	**UNIT-III:** Transportation problems & solutions, Assignment problems and its solutions by Hungarian Method.	10	CO3
4	**UNIT-IV:** PERT and CPM, Arrow network, Time estimates, Earliest expected time, Latest allowable occurrence time, Calculation of CPM network, Floats for activities, Critical path.	10	CO4

Text Books:

[T1] KantiSwarup, P.K. Gupta and Man Mohan: Operations Research, Sultan Chand and Sons.

References Books:

[R1] G. Hadley, "Linear Programming", Narosa Publications.
[R2] Taha H. A. "Operation Research An Introduction" Mc Milan Publishing Company, NY.
[R3] Miller and Lieberman G. J., "Introductions of Operational Resource" Holden Day, NY.
[R4] Kambo N. S., "Mathematical Programming Techniques", McGraw Hill.

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

MECHATRONICS

Course Code:ETAT-403	**Semester:-VII**
L:T:P:-3-0-3	**Credit: 3**

After course completion students will be able to:	
CO1	Describe the construction, structure & working Principle of various Hydraulic pumps,motors and Actuators and their Performance Characteristics. Comprehend& Analyse Single& Double Acting Hydraulic Cylinder circuits and their Control Components and Maintenance of Hydraulic Systems. Describe the construction, structure & working Principle of various Pneumatic Actuators, Pneumatic Control Valves Applications. Distinguish between electrical and mechanical systems
CO2	Summarize the evolution of microprocessor and its concepts. Review the basics of Boolean algebra, logical gates, binary, hexadecimal, decimal number systems, conversions of real, floating point notations. Explain the architecture of 8085A processor & its terminologies like CPU, ALU, registers, fetch cycles, Intel 8085, programming languages. Compare microprocessor and microcontrollers.
CO3	Define and Choose measuring & control systems on microprocessor-based controllers, understand working principals of various sensors, transducers. Use the knowledge of various sensors, transducers, their principles and applications., switches. Electrical actuators, DC, AC, stepper motors. Explain and discuss signal conditioning principles of various amplifiers, ADC, DAC, multiplexers, etc. to solve modern engineering problems.
CO4	Understand the principle, applications and limitations of Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus computer, Programming Languages, programming using Ladder Diagrams, Logic Functions, Latching, Sequencing, Timers, Internal Relays and Counters, Shift Registers, Master and Jump Controls, Jumps, Data Movement, Code Conversion, Data handling and manipulation, selecting a PLC.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT - I** **Mechanical Actuating Systems:** Types of motion, Degrees of freedom, constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Belt drive, chain drive, Bearing, pre-loading. **Hydraulic & Pneumatic Actuation Systems:** Fluid power systems, hydraulic systems, Pneumatic systems, system structure and signal flow, hydraulic pumps and Pressure Control Valves and regulation, air compressors and treatment, Cylinders, Direction Control Valves, Process control valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems.	11	CO1
2	**UNIT - II** **Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST, SPDT, DPDT, keypads; Relays, Electronic sensors, Diodes, Thyristors, Transistors, solenoid operating Valve, Solenoid Operated Hydraulic and Pneumatic Valves, Electro-Pneumatic Sequencing Problems. Control of DC Motors, Permanent Magnet DC Motors, Bush less Permanent Magnet DC Motors, AC Motors and speed controls, Stepper Motors and Controls, Servo Motors. **Digital Electronics and systems:** Number Systems, Binary Mathematics, Boolean Algebra, Gates and Integrated Circuits Like 7408, 7402, Karnaugh Maps, Application of Logic Gates as: Parity Generators, Digital Comparators, BCD to Decimal Decoders, Flip Flops and applications, sequential logic, Microprocessor and microcontrollers, programming, instruction set, assembly language, C programming for Intel 8051 / 8082 micro-controller.	11	CO2
3	**UNIT - III** **Sensors, transducers and application:** Performance Terminology, Static and Dynamic Characteristics, Displacement, Position and Proximity Sensors, Potentiometer Sensors, Strain Gauge Element, LVDT, Optical Encoders, Pneumatic Sensors, Hall Effect Sensors, Tachogenerators, Strain Gauge Load Cell, Thermostats, Photo Darlington. Interfacing Sensors in Mechatronic System. **System Interfacing and data acquisition:** Data acquisition systems, Data loggers, SCADA, Interfacing requirements, Buffers, Darlington Pair, Handshaking, Serial and Parallel Port Interfacing, Peripheral Interface Adapters, Analog to Digital Conversion, Digital To Analog Conversion, Sample and Hold Amplifiers, Multiplexers, Time Division Multiplexing,	11	CO3

	Digital Signal Processing, Pulse Modulation, Component Interconnection and Impedance Matching, Interfacing Motor drives. Electrical power supply and protection. **Introduction to signal conditioning:** Signal Conditioning Processes, Inverting Amplifiers, Non Inverting Amplifiers, Summing, Integrating, Differential, Logarithmic Amplifiers, Comparators, Amplifiers Error, Filtering, wheatstone Bridge, Temperature Compensation, Thermocouple Compensation,		
4	**UNIT - IV** **Programmable logic controllers:** Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus computer, Programming Languages, programming using Ladder Diagrams, Logic Functions, Latching, Sequencing, Timers, Internal Relays And Counters, Shift Registers, Master and Jump Controls, Jumps, Data Movement, Code Conversion, Data handling and manipulation, selecting a PLC. **Case studies:** Mechatronic approach to design, Boat Auto pilot, high speed tilting train, automatic car park system, coin counter, engine management system, autonomous mobile system, antilock brake system control, Auto-Focus Camera, Printer, Domestic Washing Machine, Optical Mark Reader, Bar Code Reader and Pick and Place robot Arm, Using PLC for extending and retracting a pneumatic piston and two pneumatic pistons in different combinations, control of vibrating machine, control of process tank, control of conveyor motor, detecting, sorting and packaging unit.	11	CO4

Text Book:

[T1] W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd., 2003.

[T2] K. P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics - Integrated Mechanical Electronic Systems, Wiley;

Reference Books:

[R1] Joji P, Pneumatic Controls, Wiley.

[R2] Dan Necsulescu, Mechatronics, Pearson

[R3] David g Alciatore, Michael B Histand, "Introduction to Mechatronics and measurement systems", Mc Graw Hill Education.

[R4] A Smaili, F Mrad, "Mechatronics – Integrated Technologies for Intelligent Machines, Oxford Higher Education.

[R5] NitaigourPremchandMahalik, "Mechatronics Principles, Concepts & Application", Tata McGraw Hill Publishing Co.Ltd., 2003.

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category Marks	Class Test (15)	Class Performance (10)
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	

COMPUTER INTEGRATED MANUFACTURING

Course Code:ETME-403	**Semester:-VII**
L:T:P:-3-0-3	**Credit: 3**

After course completion students will be able to:	
CO1	Demonstrate the knowledge of classifying elements of NC/CNC, differentiate types of Machining centres, Robot configurations, sensors, to identify and formulate NC codes todevelop part program for milling and turning. Ability to identify the type of machining centre for the geometry given (cylindrical or prismatic), write the part program, explain the instructions, examine for the error in the program and choose right G and M codes to optimize the program and construct the final geometry by running the simulation using the software.
CO2	Functions and Components of CIM System,Concept of CAD/CAM and CIMS; Software Technology for CIM System to store and handle the data. Demonstrate the knowledge of cutting tool materials, types of cutting tools for NC machines, tool selection, ISO specification of cutting tools, different clamping system in tool holders, tooling for milling, angle plates, CNC vices, work holding devices, clamps, rotary tables.
CO3	Demonstrate the knowledge to describe different types of Planning and Scheduling Functions in CIM System like APP, MPS, MRP, CRP, MRP-II,JIT,etc. and also generate the programme with the help of CAD, CAM in CNC to control the motion of machines.
CO4	Demonstrate the knowledge to describe different types of automated assembly system, Parts feeding devices, automated guided vehicles, Vehicle guidance and routing, System management, CAPP systems such as retrieval type or generative type, short term or long-term capacity planning. Memorize the models and solve numerical problems using engineering fundamentals.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

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

3=Highly Significant, 2=Moderate Significant, 1=Least Significant]

S. NO.	COURSE CONTENT	HRS	Cos
1	**UNIT-1** **An overview of CNC machines**: Need, benefits & limitations, classification of CNC machines, Constructional features of CNC machines, Design considerations of CNC machine tools, elements of CNC machine & systems, precision measuring & positioning of CNC, Function of MCU, machining centre, Turning centre, CNC EDM, Ball screw, Bearings, Centralized lubrication systems. **Manual part programming** - preparatory, miscellaneous functions- Fanuc, Sinumeric, Hass controls. Linear interpolation, circular interpolation, canned cycles, cycles of threading & grooving operations, tool compensation, sub-program, main program, part programming structure, work co-ordinate system, absolute & incremental commands, feed, program zero-point, co-ordinate system, process planning & flow chart for part programming, scaling, rotating, mirroring, copy & special cycles for CNC lathe and milling.	10	CO1
2	**UNIT- II** **Functions and Components of CIM System:** Concept of CAD/CAM and CIMS; Software Technology for CIM System:Business Database System: File processing, Data Processing and Database Design, File Organization and Relational Analysis; Decision Support System, Personal / Distributed Computing and Local Area Network. **Tooling for CNC machine:** introduction, cutting tool materials, types of cutting tools for NC machines, tool selection, ISO specification of cutting tools, different clamping system in tool holders, tooling for milling, angle plates, CNC vices, work holding devices, clamps, rotary tables.	12	CO2
3	**UNIT-III** **Planning and Scheduling Functions in CIM System:** Aggregate Production Planning (APP), Master Production Schedule (MPS), Material Requirement Planning (MRP), Capacity Requirement Planning (CRP), Manufacturing Resource Planning (MRPII), Just-In-time Production Systems and Concept of Enterprise Resource Planning (ERP). CNC Program generation from CAD, CNC controller & motion control in CNC system. Application of CNC and recent advances in CNC machines, maintenance of CNC machine tools, CNC trainer, DNC.	10	CO3
4	**UNIT-IV** **Computer-Aided Process Planning:** Approaches – Variant and Generative, Feature Classification and	10	CO4

	Recognition; Process Classifications and Selections, Machines and Tool Selection, Setting Process Parameters, Process Sheet Documentation. Programming; **Automated Material Handling Systems and Advanced Manufacturing Systems:** Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems**;** Lean Manufacturing Systems, Agile Manufacturing Systems, Reconfigurable Manufacturing Systems, Holonic Manufacturing Systems and Agent-Based Manufacturing Systems. Programming.		

Text Books:

[T1] T.K. Kundra, P. N.Rao&N.K.Tiwari, "Numerical Control and Computer Aided Manufacturing",TMH

[T2] Mikell P. Groover, "Automation, Production Systems and Computer- Integrated Manufacturing", 2nd Edition, Prentice Hall, 2001.

[T3] S.K. Sinha, "CNC Programming", Galgotia Publications 2003.

Reference Books:

[R1] P. Radhakrishnan, "Computer Numerical Control Machine & Computer Aided Manufacturing", New Academic Science Limited.

[R2] U.Rembold, "Computer Integrated Manufacturing and Engineering", Addison Wesley Publishers, 1993 edition

[R3] S. Kant Vajpayee, "Principles of Computer Integrated Manufacturing", PHI Learning Private Limited, New Delhi, 2012

[R4] M. Adithan, B.S. Pabla, "CNC Machines", New Age

[R5] Binit Kumar Jha, "CNC programming made Easy", Vikas Publication

ASSESSMENT PATTERN:

Continuous Internal Evaluation (25 Marks)

Bloom's Category **Marks**	**Class Test** **(15)**	**Class Performance** **(10)**
Remember		
Understand		
Apply		
Analyze		
Evaluate		
Create		

End Semester Examination (75 Marks)

Bloom's Category Marks	University Examination
Remember	
Understand	
Apply	
Analyze	
Evaluate	
Create	