Scheme of Teaching & Examination of Bachelor of EngineeringMinors Specialization (Mechanical Engineering)

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total	
1.	METM301	Manufacturing Engineering	3	0	0	3.00	40	60	100	3 Hrs.
2.	METM401	Automotive Engineering	3	0	0	3.00	40	60	100	3 Hrs.
3.	METM501	Computer Aided Design	3	1	0	4.00	40	60	100	3 Hrs.
4.	METM601	Solar Energy Technology	3	1	0	4.00	40	60	100	3 Hrs.
5.	METM701	Project (Minors)	0	0	8	4.00	50	50	100	-

III Semester (Honors Specialization)
Department of Mechanical Engineering

Course Code: METH301 **Course: Digital Manufacturing**

L: 3 Hrs, T: 0 Hr, P: 0 Hrs. Per week **Total Credits: 03**

Course Objectives:

The students shall able to: -

1. To create, slice, 3D prints parts and post process if required.
2. To understand the subtractive manufacturing and microfabrication (MEMS).

Course Objectives:

Upon successful completion of the course students shall be able to:

1. To understand basic Conventional and Modern Machining Processes and Advanced Materials and their associated properties
2. Students should able to understand the 2D and 3D Machining operations and Manual CNC Programming
3. Demonstrate 3D modelling ability using geometric modelling software
4. Differentiate between subtractive and additive manufacturing methods
5. Identify the different microfabrication methods and thin film deposition methods using micro manufacturing methods.

Syllabus:

Unit I: Overview of Digital manufacturing process

Introduction to Digital Manufacturing Science, Operation mode and architecture, Operation reference model, System Architecture, Computation in Digital Manufacturing, case studies.

Unit II: CNC machines and Programming

Introduction to Numerical Control, Components of NC System, NC system Controls, Adaptive Control for NC System, N Words, NC programming, Examples, CNC, DNC combined DNC/CNC system, Computer Integrated manufacturing system, Machine Tools and related Equipment, Materials Handling and Storage system, computer system Tool Path Generation in CAM Software for different operations.

Unit III: CAD CAM Modelling and Machine Control

Basics of Computer Graphics, Elementary Transformations in CAD, computer programming for graphics, Computer graphics Software and Database: Configuration, Graphics Packages, Constructing the Geometry, Design process and role of CAD, Types and applications of design models, Solid modelling -Parametric modelling.

Unit IV: Additive Manufacturing Process

Introduction to Tableau, Creating Basic Visualizations, Tableau Desktop UI, Connecting to Data, Review of Tableau Desktop, Making Visualizations, Creating Effective Dashboards.

Unit V: Microfabrication and Nanofabrication Methods

Introduction to different methods for manufacturing components by additive manufacturing, Overview of different RP Processes, STL file generation; file verification & repair, STL/AMF Slicing CURA, Pre-processing and post processing techniques.

Textbooks:

1. “Fundamentals of Digital Manufacturing Science- Zhou, Zude, Xie, Sheng, Chen,Dejun, eBook, Springer publication ISBN 978-0-85729-564-4
2. Automation, Production System and CIM, Goover, Prentice hall.
3. CAD/CAM/CIM P. Radhakrishnan & Subramanyam, Willey Eastern Limited.
4. Rapid Prototyping Theory and practice – Ali Karmani- Springer

IV Semester (Honors Specialization)
Department of Mechanical Engineering

Course Code : METH401 **Course : Tool Design**

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits : 03**

Course Objectives

1. To provide comprehensive understanding of various design parameters required for tool design.
2. Enable the students to design provides specific tools.

Course Outcomes

The expected learning outcome is that the students will be able to:

1. Understand basic principle of the metal cutting.
2. Describe design criterion for designing single point and multipoint cutting tools.
3. Understand press working operations in die design.
4. Understand working of bending, forming and drawing dies.
5. Describe forging die design and mould design.
6. Understand the principles of clamping, jigs and designing fixtures for machining.

Syllabus

UNIT - I

Theory of metal Cutting: Introduction, Mechanics of chip formation, Cutting tool

materials, Single point cutting tool, Designation of cutting tools, ASA system, Importance of Tool angles, Orthogonal rake system, Classification of cutting tools, Types of chips, determination of shear angle, velocity relationship, force relations, Merchant's Theory, Cutting power, Energy consideration in metal cutting, Tool wear, Tool life, Tool life criteria, variable affecting tool life, Machinability. (7)

UNIT-II

Design of single Point Cutting Tool: Form tools- Introduction, Types, design of form tools. Drills- Introduction, Types, Geometry, Design of drill.

Milling cutters - Introduction, Types, Geometry, and Design of milling cutters. (6)

UNIT-III

Introduction, Press operations - Blanking, piercing, Notching, Perforating, Trimming, Shaving, Slitting, Lancing, Nibbling , Bending, Drawing , Squeezing . Press working equipment - Classification, Rating of a press, Press tool equipments, arrangement of guide posts . Press selection, press working terminology, Working of a cutting die , Types of dies.

Principle of metal cutting, clearance, angular clearance, cutting forces, method of reducing cutting forces, Die block, Die block thickness, Die opening, Fastening of die block, back up plate, Punch, Methods of holding punches, Blanking & Piercing die design - Single & progressive dies. (7)

UNIT-IV

Bending Forming & Drawing dies, Bending methods - Bending Terminology, V- Bending, Air bending, bottoming dies, Wiping dies, spring back & its prevention, channel dies.

Forming Dies- Introduction, Types - solid form dies, pad type form dies, curling dies, Embossing dies, coining dies , Bulging dies, Assembly dies.

Drawing Dies - Introduction, Difference between blending, forming & drawing, Metal flow during drawing and design considerations. (7)

UNIT-V

Forging Die Design & mould Design: Introduction, Classification of forging dies, Single impression dies, Multiple Impression dies and Forging design factors.

Preliminary forging operation - fullering, edging, bending, drawing, flattering, blacking finishing, cutoff. Die design for machine forging in closed & open die forging, materials of forging dies .

Mould Design: of Simple Blow Moulds for Articles such as bottles, cans Design of simple two plate injection moulds , Mould Materials. (6)

UNIT-VI

Design of jigs & fixture :- Introduction, locating & clamping - principle of location, principle of pin location, locating devices, radial or angular location, V - location, bush location. Design principle for location purpose, principle for clamping purposes, clamping devices, design principles common to jigs & fixtures. Drilling Jigs:- Design principles, drill bushes, design principles for drill bushings, Types of drilling jigs.

Milling Fixtures:- Essential features of a milling fixtures, milling machine vice, Design principles for milling fixtures. (7)

Text Books

1. Production Engineering ,P.C. Sharma, S. Chand Publication
2. Tool Design, Donaldson, Tata McGraw Hill, New Delhi
3. Jigs and Fixtures, Joshi, Tata McGraw Hill, New Delhi.

Reference Books

1. Fundamentals of the Tool Design, ASTME, Prentice-Hall of India Private Ltd., New Delhi.
2. Manual of Jigs and Fixtures Design, Henrickson, Industrial Press Inc., New York.
3. Theory and Application of Metal Cutting, Juneja, Wiley Eastern Ltd., New Delhi.

V Semester (Honors Specialization)
Department of Mechanical Engineering

Course Code : METH501 **Course : Turbo Machinery**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Objectives

1. To learn and understand principle of working and application of rotary compressors, gas turbines and combustion systems.
2. To provide the student the necessary and analytical skills to analyze steam power cycles along with steam nozzles and steam turbines.

Course Outcomes

Students will be able to

1. Apply thermodynamic concepts to understand the working of turbo machines.
2. Differentiate ideal and practical gas turbine cycles.
3. Understand the working of compressors and analyze their performance.
4. Understand the gas turbine combustion system.
5. Analyze the steam power plant cycles.
6. Design steam nozzles and steam turbines.

Syllabus

Unit I :

Review of Basics: Introduction to Prime Movers, Gas Turbines, Review of Basic principles - Thermodynamics, Review of Basic principles - Fluid Dynamics and Heat Transfer, Fundamentals of Rotating Machines - Energy Equation, Dimensional Analysis, Airfoil Theory.

Unit II :

Ideal Gas Turbine Cycles: Analysis of Ideal Gas Turbine Cycles, Simple Cycle, Regeneration Cycle, Reheat Cycle, Inter cooling Cycle. Practical Gas Turbine Cycles: Analysis of Practical Gas Turbine Cycles, Methods of accounting for component losses, changes in the composition of the working fluid. Working of Turbojet, Turbofan, Turboprop, Ramjet, Scramjet and Pulsejet Engines and cycle analysis –thrust, specific impulse, specific fuel consumption, thermal and propulsive efficiencies.

Unit III :

Centrifugal Compressors: Centrifugal Compressors- Principle of Operation, T-s diagram, Energy equation, velocity triangles, types of blades. Analysis of flow, Performance characteristics.

Axial Flow Compressors: Axial Flow Compressors - Construction, Principle of Operation, T-s diagram, Energy equation, velocity triangles. Analysis of flow. Work done factor, Stage efficiency, Degree of reaction, Performance characteristics.

Unit IV :

Combustion Chambers: Gas turbine combustion systems - Introduction, Geometry, Factors affecting Design & Performance, Requirements of the Combustion Chamber, Gas Turbine Combustion Emissions.

Unit V :

Rankine Cycle: Properties of Pure Substances, Property diagrams, Steam Power plant Layout, Rankine Cycle- Analysis, Modified Rankine Cycle, and Combined Cycle.

Unit VI :

Steam Nozzles: Steam Nozzles- Introduction, Area- velocity relationship, Mass flow rate, Choking of Nozzles, Performance characteristics of Nozzles.

Steam Turbines: Steam Turbines - Impulse and Reaction Turbines, Compounding of steam turbines, Multistage reaction Turbines, Reheat factor and Efficiency.

Text Books

1. Ganesan, V., Gas Turbines , Tata McGraw Hill Book Company, New Delhi, 2011.
2. Vasandani, V.P. and Kumar, D.S., Treatise on Heat Engineering, Chand and Co Publishers, New Delhi, 2011.
3. Saravanmuttoo, H.I.H., Rogers, G.F.C. and Cohen H., Gas Turbine Theory, Pearson Prentice Education, 2008.

Reference Books

1. Khajuria P.R and Dubey S.P, Gas Turbines and Propulsive Systems, Dhanpat Rai Publications, 2003
2. Hill P G and Peterson C R, Mechanics and Thermodynamics of Propulsion, Addition- Wesley, 1970.
3. Mattingly J D, Elements of Gas turbine Propulsion, McGraw Hill, 1st Edition. 1997

VI Semester (Honors Specialization)
Department of Mechanical Engineering

Course Code : METH601 **Course : Design of Heat Exchangers**

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 04**

Course Objectives

To understand the thermal analysis and basics of heat exchanger design for different applications.

Course Outcomes

1. Understanding Classifications & Applications of Heat Exchangers.
2. Apply Principles of Fluid Mechanics & Heat Transfer to the Design of Heat Exchanger.
3. Understanding the Basic Design Aspects of Heat Exchangers.
4. Understanding the Design of Shell & Tube Heat Exchangers.
5. Understanding the Selection Criteria & Maintenance of Industrial Heat Exchangers.
6. Understanding of Design Considerations & Performance Enhancement Techniques for Practical Heat Exchangers.

Syllabus

Unit I :

Classification of Heat Exchangers, Constructional Details of Shell & Tube Heat Exchangers, Counter Flow Exchanger & Parallel Flow Exchanger, Industrial applications.

Unit II :

Fluid & Heat Transfer Aspects, Basic Thermal Design: LMTD Method, LMTD Correction Factor, Effectiveness of Heat Exchanger, Heat Capacity Rate Ratio, - NTU Method.

Unit III :

Heat Exchanger Design Methodology, Process and Design Specifications, Thermal, Hydraulic & Mechanical Design, Manufacturing Considerations, Heat Exchanger Design Sheets.

Unit IV :

Design of Shell & Tube Heat Exchanger: Preliminary Analysis, Sizing Analysis, Rating Program, Kerns Method, Pressure Drop Analysis.

Unit V :

Selection of Heat Exchangers & their Components, Selection Criteria Based on Operating Parameters, Operating Pressures and Temperatures, General Selection Guidelines for Major Exchanger Types, Quantitative Considerations, Fouling and Corrosion, Testing & Maintenance.

Unit VI :

Heat Exchanger Surface Geometrical Characteristics, Design Considerations for Tube-Fin Heat Exchangers, Plate-Fin Heat Exchangers, Condensers, Evaporators, Cooling Tower, Compact Heat Exchangers etc. Heat Transfer Enhancement Techniques.

Text Books

1. Fundamentals of Heat Exchanger Design Ramesh K. Shah, Dusan Sekulic, John Wiley & Sons Ltd.
2. Heat Exchanger Design, P. O. Fraas, John Wiley & Sons, 1988
3. Process Heat Transfer, Donald Q. Kern, McGRAW Hill Book Company

Reference Books

1. Heat Exchangers: Theory & Practices, T. Taboreck, G. F. Hewitt & N. Afgan, TMH,1980
2. Industrial Heat Exchanger: A Basic Guide, Walkar, TMH Book co,1980
3. Heat Exchangers: Basics Design Applications, Edited by Jovan Mitrovic, InTech Publisher
4. Tubular Exchanger Manufacturers Association, Manual

VII Semester (Honors Specialization)
Department of Mechanical Engineering

Course Code: METH701 **Course: Project (Honors)**

L: 3 Hrs. T: 0 Hrs. P: 8 Hrs. Per week **Total Credits: 04**

Course Objectives:

To gain exposure to the process of resolving real-world problems, product development and industrial challenges in order to arrive to insightful conclusions, design products, and find solutions.

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Carry out a thorough theoretical analysis/simulation study/model fabrication/experimental work in accordance with the problem solution requirements.
2. Interpret the results of simulation or experimental studies to reach a specific conclusion or decision to repeat the studies.
3. Ability to arrive to a precise and acceptable conclusion about the study
4. To compile the findings, prepare a thorough presentation and a full project report.

On the completion of work, the students should submit the final report in a prescribed format as per the guidelines. Term work will be assessed by the project guide along with project evaluation panel, on continuous evaluation basis.