DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MET351	**Advanced Machining & Additive Manufacturing**	**3**	**3**	**0**	**0**	**0**

PREREQUISITE: Casting, Welding, Forming, Machining and CAM

COURSE OUTCOMES:

CO1	Classification and grouping of manufacturing processes based on various criteria and need.
CO2	Understanding of the Electro-Thermal-based Machining Processes.
CO3	Understanding of the Abrasive-based Advanced Machining/Finishing Processes.
CO4	Understanding of the Chemical and Electro-Chemical based Machining Processes.
CO5	Understanding of the Additive Manufacturing Processes including metal powder-based Manufacturing Processes

COURSE CONTENTS

Classification of Manufacturing Processes: Classification of manufacturing processes, Limitations of conventional machining processes, Classification of Advanced Machining Processes, ISO/ASTM-based Classification of Additive Manufacturing Processes,

Electro-Thermal Energy Based Machining Processes: EDM, LBM, PAM, EBM – Process Science & Working Principles, Equipment, Process parameters, Modelling MRR and Applications**.**

Abrasive Machining Processes: AJM, AWJM, USM, AFM, MRF- Process Science & Working Principles, Equipment, Process parameters, Modelling MRR and Applications**.**

Chemical/ Electro-Chemical Energy Based Machining Processes: CHM, ECM, CMP: Process Science & Working Principles, Equipment, Process parameters, Modelling MRR and Applications**.**

Polymer Additive Manufacturing Processes: Material extrusion, Vat-Photopolymerization, Material Jetting: Working Principles, Equipment, Process Parameters, Modelling Part Build Time and Applications**.**

Metal Additive Manufacturing Processes: Metal Powders, Metal-based AMPs like Binder jetting, Sheet Lamination, Powder Bed Fusion, Direct Energy Deposition: Working Principles, Equipment, Process parameters, Modelling Part Build Time and Applications**.**

TEXT BOOKS/ REFERENCE BOOKS: -

1. "Nontraditional Manufacturing Processes", G.F. Benedict, Marcel Dekker, Inc. New York, Latest Edition
2. “Advanced Machining Processes” Vijay.K. Jain, Allied Publishers Pvt. Ltd., New Delhi, Latest Edition
3. “Manufacturing Engineering & Technology”, Kalpakjian. S., Pearson Education Asia, Latest Edition
4. Additive Manufacturing Technologies, by Ian Gibson, Springer, Latest Edition

ONLINE/E RESOURCES

1. Downloads - Harlal Singh Mali

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MET352	**Design of Mechanical Systems**	**4**	**3**	**1**	**0**	**0**

PREREQUISITE : Engineering Mechanics, Mechanics of Solids, Kinematics and Dynamics of Machines

COURSE OUTCOMES

CO1	Understand the advance design practices with regard to material selection, material properties, manufacturing considerations, and standards and codes.
CO2	Apply the concepts of advance design practices with regard to material selection, material properties, manufacturing considerations, and standards and codes
CO3	Design and Analysis of transmission mechanical systems, such as gears and gear boxes, flexible machine elements
CO4	Design and Analysis of mechanical systems involving multiple machine components.

COURSE CONTENTS

Design of gears: Force analysis and design of spur, helical, and bevel gears;

Design of Flexible Elements: Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

Gear Boxes: Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

Design Case Studies involving multiple machine components (any two): Design of Floor Crane, Design of Overhead Crane; Design of Belt conveyor System, Design of IC Engine Components, etc.

TEXT BOOKS/ REFERENCE BOOKS :

1. Machine Design: An Integrated Approach, Norton Robert L., Pearson Education Asia, 2020.
2. Mechanical Engineering Design, Shigley J. E. and Mischke C. R., Budynas R. G. and Nisbett K. J., Tata–McGraw Hill, 2020.
3. Design of Machine Elements, M. F. Spotts, Prentice Hall of India, 2019.

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MET353	**Refrigeration and Air-Conditioning**	**3**	**2**	**1**	**0**	**0**

PREQUISITE –

Engineering Thermodynamics, Fluid Mechanics and Machines, Heat Transfer

COURSE OUTCOMES:

CO1	Awareness about different types refrigeration systems and illustrate basics, ideal and actual refrigeration cycles and heat pump cycle and their analysis
CO2	Explain the working of vapour compression and vapour absorption cycles system and identify methods for performance improvement. Also identify suitable refrigerant for various refrigerating systems.
CO3	Estimate the performance of air-conditioning systems using the principles of psychometry. Also compute and interpret cooling and heating loads in an air-conditioning system.
CO4	Explain working, analysis and applications of air conditioning systems, human comfort and air distribution system
CO5	Recognize components in load estimation, role of solar radiations and other heat transfers.

COURSE CONTENTS;

Introduction, Applications of air-conditioning and refrigeration, Reverse Carnot cycle, Different methods of refrigeration, heat pump.

Air refrigeration cycles- Bell Coleman air cycle, actual cycle and its application in air-crafts air conditioning, performance and comparison.

Vapour compression refrigeration- Ideal, theoretical and actual cycle, cycle analysis, factors affecting its performance, Multi stage compression, use of flash gas removal and flash inter cooling, cascade systems. Different refrigerants, including eco-friendly refrigerants, and their applications

Vapour absorption refrigeration and its components, solar powered refrigerator, Electrolux refrigerator.

Psychometry- Properties, charts and its uses, processes, air washer, evaporative cooling and air cleaners.

Air conditioning- winter and Summer Air conditioning system and their analysis, human comfort and comfort charts, air distribution system.

Load estimation- heating/cooling load components, solar load, ventilation and infiltration, air changes, load calculation.

TEXT BOOKS/ REFERENCE BOOKS:-

1. Elementary Refrigeration and Air conditioning. Stoecker, W.F., and Jones, J.W., McGraw-Hill, 1982
2. Principles of Refrigeration. Dosset, R.J., Pearson Education ,2001
3. Refrigeration and Air conditioning. Arora, C.P., Tata-McGraw-Hill, 2017
4. Refrigeration and Air Conditioning. Prasad, M., New Age International, 2015
5. ASHRAE Handbook (Fundamentals) ,2005

ONLINE/E RESOURCES

1. NPTEL

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MEP354	**Advanced Machining & Additive Manufacturing Lab**	**1**	**0**	**0**	**2**	**0**

PREREQUISITE : Casting, Welding, Forming, Machining and CAM Labs

COURSE OUTCOMES:

CO1	The understanding and skilling in additive manufacturing technologies like FDM, SLA, etc. process for faster product realization.
CO2	The understanding and skilling in Manual and CAM-based EDM, Micro-EDM, and AFM processes.
CO3	The understanding and skilling in hybrid machining processes
CO4	The understanding and skilling in the manufacturing flow for need-based product manufacturing

COURSE CONTENTS

- Experiments based on: Design, Part program, Simulate and additively manufacture (AM) using Fused Deposition Modelling or any other AM to machine a convergent divergent die-kind component for rapid prototype/tooling.
- To make a die-kind of the component while doing CAM-based experimentations on :
    - Vertical Machining Center and (b) Turning Centre
- To make a die-kind of insert out of hard material on a Die Sink - Electro Discharge Machine (EDM)
- Finish internally a die kind component on Abrasive Flow Machine.
- Experimentation on EDM assisted grinding and Centre less grinding setup
- Understand the need and working of Hybrid-Micro-Machine for miniaturization.
- Experimentation on laser-based manufacturing system.
- Experimentation on electro chemical-based manufacturing system.

TEXT BOOKS/ REFERENCE BOOKS:-

1. "Nontraditional Manufacturing Processes", G.F. Benedict, Marcel Dekker, Inc. New York.
2. “Advanced Machining Processes” Vijay.K. Jain, Allied Publishers Pvt. Ltd., New Delhi.
3. “Manufacturing Engineering & Technology”, Kalpakjian. S., Pearson Education Asia.

ONLINE/E RESOURCES

1. Downloads - Harlal Singh Mali
2. Software and Services for Education | Autodesk Education Community

DETAILS OF THE COURSE:

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MEP355	**Computer Aided Engineering Lab**	**1**	**0**	**0**	**2**	**0**

PREREQUISITE : Engineering Drawing, Machine Drawing and Machine Design, and Basics of Finite Element Method

COURSE OUTCOMES

After completing this lab course, the students will be able to

CO1	Understand and explain the basic steps solid modelling
CO2	Construct 3-D solid models, 2-D drawing, assembly and sub-assembly structure.
CO3	Generate 2-D and 3-D models for finite element analysis.
CO4	Design and analyse basic structural/mechanical elements using FEA.

COURSE CONTENTS

Analysis of Mechanical Components – Using Software like Hyperworks/ABAQUS/ANSYS.
The exercises would include the followings:

- Introduction to FEA.
- Introduction to CAE tool environment (Hyperworks/ABAQUS/ANSYS)
- Analysis of machine elements under Static loads
- Thermal Analysis of mechanical systems
- Modal Analysis of Machine elements
- Analysis of Machine elements under Dynamic loads
- Analysis of Machine elements under Fatigue Loads
- Non-linear Analysis of Machine elements.

TEXT BOOKS/ REFERENCE BOOKS:-

1. The Finite Element Method: A Practical Course by G. R. Liu & S. S. Quek, Butterworth-Heinemann Ltd, 2013.
2. Introduction to Finite Element Analysis Using MATLAB and Abaqus by Amar Khennane, CRC Press Inc; 2013.
3. CAE Lab Manual and Lecture Slides/Lab tutorials to be provided in the class.

DETAILS OF THE COURSE:

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22MEP356	**Refrigeration and Air-Conditioning Lab**	**1**	**0**	**0**	**2**	**0**

PREREQUISITE: Engineering Thermodynamics, Fluid Mechanics and Machines, Heat Transfer

COURSE OUTCOMES:

CO1	To perform experimentations on refrigeration tutor
CO2	To perform experimentations for refrigeration system(s)
CO3	To perform experimentations for air conditioning system(s)
CO4	To learn advances in R & AC technologies

COURSE CONTENTS

- To perform test on the **refrigeration tutor** to determine different COPs and other performance parameters.
- To study the **air conditioning test rig** and calculate different parameters of actual and theoretical COP.
- To perform test on **cooling tower** and calculate various performance parameters such as efficiency, evaporation loss, range and approach.
- To study the performance characteristics of **Hilton Mechanical Heat Pump**.
- To study **experimental ice plant** and determine its Coefficient of Performance.
- To study and evaluate the performance of a **two-stage reciprocating air compressor.**
- To find out the performance parameters of a **LPG refrigerator (Eco-fridge)**
- To study the **solar air heater** and calculate its performance parameters.

TEXT BOOKS/ REFERENCE BOOKS:-

1. Elementary Refrigeration and Air conditioning. Stoecker, W.F., and Jones, J.W., McGraw-Hill, 1982
2. Principles of Refrigeration. Dosset, R.J., Pearson Education ,2001
3. Refrigeration and Air conditioning. Arora, C.P., Tata-McGraw-Hill, 2017
4. Refrigeration and Air Conditioning. Prasad, M., New Age International, 2015
5. ASHRAE Handbook (Fundamentals) ,2005

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1. NPTEL