DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Instruction
and
Syllabus of

B.E. MINOR
in
Mechanical Engineering

With effected from the Academic Year 2024-2025

UNIVERSITY COLLEGE OF ENGINEERING
(AUTONOMOUS)
OSMANIA UNIVERSITY
HYDERABAD–500007, TELANGANA.

SCHEME OF INSTRUCTION EXAMINATION

B.E Minor in Mechanical Engineering

S.No.	Semester	Course Code	Course Title	Scheme of Instruction			Contact hrs/wk	Scheme of Examination		Credits
				L	T	P		CIE	SEE	
1	V-Sem	MR501ME	Materials and Manufacturing Technology	3	-	-	3	40	60	3
2	VI-Sem	MR601ME	Digital Manufacturing	3	-	-	3	40	60	3
3	VI-Sem	MR602ME	Hybrid Vehicle Technologies	3	-	-	3	40	60	3
4	VII-Sem	MR701ME	Elements of Robotics	3	-	-	3	40	60	3
5	VII-Sem	MR702ME	Green Energy Technologies	3	-	-	3	40	60	3
6	VIII-Sem	MR851ME	MR-Project Work	-	-	6	6	50	100	3
Total				15	0	6	21	250	400	18

Note:

The **Minor programme** in **B.E Mechanical Engineering** is offered to the Non-Mechanical Engineering students from V-Semester onwards of the University College of Engineering (Autonomous), Osmania University.

Prof.NARSIMHULU SANKE
Chairperson, Board of Studies
Department of Mechanical Engineering
University College of Engineering
(Autonomous)
Osmania University
Hyderabad - 5000007

Course Code	Course Title							Course Type
MR501ME	**MATERIALS AND MANUFACTURING TECHNOLOGY**							**Core**
Prerequisite	**Contact hours per week**				**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**D**	**P**		**CIE**	**SEE**	
	3	**-**	**-**	**-**	**3**	**40**	**60**	**3**

Course Objectives:

- To understand the basic uses of ferrous and nonferrous alloys
- To know the properties and applications of ceramics, polymers and composites
- To understand the concept of various manufacturing processes like casting and forming
- To familiarize the different techniques of joining processes and manufacturing of plastics,
- To know the Working principle and applications of various Advanced manufacturing processes

Course Outcomes: Student will be able to

1. Acquire knowledge to tailor material properties of ferrous and non-ferrous alloys
2. Differentiate the properties and applications of ceramics, polymers and composites.
3. Explain the different manufacturing processes used for shaping components including casting, metal forming and welding
4. Describe various nontraditional /advanced manufacturing processes and their applications
5. Recommend appropriate part manufacturing processes when provided a set of functional requirements

UNIT–I

Crystal Structure: Unit cells, Metallic crystal structures. Imperfection in solids: Point, line, interfacial and volume defects; Plain Carbon Steels, stainless steel and tool steels, maraging steels; cast irons: grey, white, malleable and spheroidal cast irons; Non-ferrous metals: Copper and copper alloys, Aluminums and Al-Cu–Mg alloys, Nickel based super alloys and Titanium alloys.

UNIT-II

Ceramics - Crystalline ceramics, Glasses, Properties and applications of ceramics; Polymers - Polymerization, Thermoplastics and thermosetting plastics, Properties and applications of polymers; Composites - Concept of composites, Matrix and reinforcement, Rule of mixtures, Classification of composites, Applications of composites.

Materials Used In Medicine: Metals; Polymers; Hydrogels; Bioresorbable and Biodegradable Materials. Materials used in semiconductors, Magnetic Materials, Dielectric Materials,

UNIT-III

Manufacturing Process: Casting: Steps involved in making a casting, Advantages, limitations & applications of casting processes Shell moulding, Centrifugal Casting, Die Casting, Investment Casting, CO2moulding. Metal Forming: Cold and hot working Rolling, Extrusion, Introduction to Forging, Open Die, closed die forging, applications, Sheet Metal Forming: Blanking and Punching, Bending, Deep Drawing, Spinning,

UNIT –IV

Welding: Gas Welding, Arc Welding - Shielded Metal Arc, Submerged Arc, Inert Gas welding - TIG & MIG Welding. Resistance Welding, Thermit Welding, Plasma (Air and water) Welding. Friction Welding, Induction welding, Explosive Welding, Laser Welding,

Processing of Plastics: Processing methods & Equipment-blow moulding, injection moulding, extrusion, thermo forming, compression moulding, transfer moulding, calendaring. Introduction to Powder metallurgy, steps in PM and applications

UNIT-V

Advanced Manufacturing Processes: Working principle and applications of Ultrasonic Machining (USM), Abrasive Jet Machining(AJM), Water Jet Machining (WJM), Electro Discharge Machining (EDM), Electro-Chemical Machining (ECM), LASER Beam Machining (LBM), Electron Beam Machining (EBM)

Suggested Reading:

1. W. D. Callister, 2007, adapted by R.Balasubramaniam, "Materials Science and Engineering", 7th Edition, Wiley India.
2. Kodgire V.D, Kodgire S.V., "Material Science and Metallurgy for Engineers" Everest Publishing House, 42nd Edition, 2018
3. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
4. P.N. Rao, "ManufacturingTechnology," Vol.1, Tata McGraw Hill Publ.,3rdEd.,2011.
5. Amitabh Ghosh & Mallick, "Manufacturing Science", Assoc. East west Press Pvt. Ltd. 4thEd.,2011.

Additional Readings:

1. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addison, Wesley Publishing Company, 2006
2. Kaushish J.P, "Manufacturing Processes", PHI Learning Pvt. Ltd.,2nd Ed.,2010

Course Code	Course Title							Course Type
MR601ME	**DIGITAL MANUFACTURING**							**Core**
Prerequisite	**Contact hours per week**				**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**D**	**P**		**CIE**	**SEE**	
	3	**-**	**-**	**-**	**3**	**40**	**60**	**3**

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

1. Understand the fundamentals of Digital Manufacturing System
2. Interpret the role of CAD and design process in Digital Manufacturing
3. Appreciate the role of Reengineering (Reverse Engineering) and CAM in Digital Manufacturing
4. Illustrate various additive manufacturing technologies and softwares.
5. Understand the wide range of applications of AM and also cost estimation for various AM Technologies

UNIT – I

Introduction to Digital Manufacturing: Definition of digital manufacturing, Historical perspective on industrial production and outlook, Industrial Revolutions, Industry 4.0, Cyber- physical system, Factory of the future, Operation Mode and Architecture of Digital Manufacturing System.

UNIT – II

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software: CAD Software: System software, Application Software, Graphic Standards & Exchange formats, CAD database and structure, 2D Geometric Transformations, 3D Geometric Transformation, Geometric modelling: Bezier Curve, Spline curves, NURBS, Surface: Plane surface, ruled surface, Surface of revolution, Tabulated Cylinder, Bezier surface, B-spline surface and solid modelling: CSG and B-Representation

UNIT – III

Reengineering: Reengineering Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development.

Computer Aided Manufacturing: Introduction – Features & Elements of NC, Types of input media and NC Classification, CNC Hardware, NC and NC part programming, Machining Centers, CNC-Adaptive Control systems, FMS: Definition, components of FMS and FMS layouts.

UNIT – IV

Additive Manufacturing: Introduction to additive manufacturing, Additive manufacturing process chain, Material selection, Manufacturing, Post processing, Additive manufacturing technologies and processes, Vat photo polymerization, Material extrusion, Material jetting, Sheet lamination, Powder bed fusion, Binder jetting, Planning and slicing additive manufacturing software. AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, MeshLab.

UNIT – V

AM Applications: Application – Material Relationship, Application in Design, Engineering Analysis and Planning, Aerospace, Automotive, Jewelry, Coin, GIS, Arts, Architecture. Medical and Bioengineering Applications, Forensic Science and Anthropology, Visualization of Biomolecules.

Suggested Reading:

1. Zude Zhou Shane (Shengquan) Xie Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer Series in Advanced Manufacturing, 2012
2. Ibrahim Zeid and Sivasubramanian R, "CAD/CAM - Theory and Practice", Tata McGraw Hill Education, 2011.
3. Radhakrishnan, P. Sbramanyam, S.Raju.v, "CAD/CAM/CIM", New Age International (P) Ltd, 2nd Edition
4. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific.

Course Code	Course Title							Course Type
MR602ME	**HYBRID VEHICLE TECHNOLOGIES**							**Core**
Prerequisite	**Contact hours per week**				**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**D**	**P**		**CIE**	**SEE**	
	3	**-**	**-**	**-**	**3**	**40**	**60**	**3**

Unit-I

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit-II

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit-III

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency. Energy Storage.

Unit-IV

Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Unit- V

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Suggested Readings:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
4. Sira-Ramirez, R. Silva Ortigoza, Control Design Techniques in Power Electronics Devices', Springer, 2006.
5. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, 'Sliding mode control of switching Power Converters' CRC Press, 2011.