ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)
(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)
RAJAMPET, Annamayya District, AP – 516126, INDIA

Department of Mechanical Engineering

III Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per Week			Credits
				L	T	P	C
1	PC	24AMEC51T	Machining Processes	3	0	0	3
2	PC	24AMEC52T	I.C. Engines & Gas Turbines	3	0	0	3
3	PC	24AMEC53T	Design of Machine Members	3	0	0	3
4	PE	24AMEC5AT 24AMEC5BT 24AMEC5CT 24AMEC5DT	1. Smart Materials 2. Automation & Robotics 3. Renewable Energy Resources 4. Mechanical Vibrations	3	0	0	3
5	OE	24AMEC5ET	MOOCs (Inter disciplinary 12 weeks)	3	0	0	3
6	PC	24AMEC51L	Machining Processes Lab	0	0	2	1
7	PC	24AMEC52L	I.C. Engines Lab	0	0	2	1
8	PC	24AMEC54L	Refrigeration & Air Conditioning Lab	0	0	2	1
9	SEC	24AMEC55S	MATLAB for Mechanical Engineers	1	0	2	2
10	MC	24AAUD51T	Gender Sensitization	2	0	0	-
11	INTERN	24AMEC56I	Community Service Internship	-	-	-	2
						Total Credits	**22**

III Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per Week			Credits
				L	T	P	C
1	PC	24AMEC61T	Heat Transfer	3	0	0	3
2	PC	24AMEC62T	Metrology & Measurements	3	0	0	3
3	PC	24AMEC63T	CAD/CAM	3	0	0	3
4	PE	24AMEC6AT 24AMEC6BT 24AMEC6CT 24AMEC6DT	1. Smart Manufacturing 2. Additive Manufacturing 3. Automobile Engineering 4. Design of Transmission System	3	0	0	3
5	PE	24AMEC6ET 24AMEC6FT 24AMEC6GT 24AMEC6HT	1. Modern Machining Processes 2. Operations Research 3. Computational Fluid Dynamics 4. Finite Element Methods	3	0	0	3
6	OE	24AMEC6IT	MOOCs (Inter disciplinary 12 weeks)	3	0	0	3
7	PC	24AMEC61L	Heat Transfer Lab	0	0	2	1
8	PC	24AMEC62L	Metrology & Measurements Lab	0	0	2	1
9	PC	24AMEC64L	Computer Aided Engineering Lab	0	0	2	1
10	SEC	24AENG61L	Soft Skills	1	0	2	2
11	MC	24AMBA61T	Technical Paper Writing & Intellectual Property Rights	2	0	0	-
						Total Credits	**23**
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation							

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RAJAMPET, Annamayya District, AP – 516126, INDIA

Department of Mechanical Engineering

IV Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per Week			Credits
				L	T	P	C
1	PC	24AMEC71T	AIML for Mechanical Engineering	3	0	0	3
3	PE	24AMEC7AT 24AMEC7BT 24AMEC7CT 24AMEC7DT	1. Composite Materials 2. Supply Chain Management 3. Power Plant Engineering 4. Mechatronics	3	0	0	3
4	PE	24AMEC7ET 24AMEC7FT 24AMEC7GT 24AMEC7HT	1. Flexible Manufacturing Systems 2. Production & Operations Management 3. Autonomous Vehicles 4. Design for Manufacturing	3	0	0	3
5	OE	24AMEC7IT 24AMEC7JT 24AMEC7KT 24AMEC7LT	Department Specific: 1. Total Quality Management 2. Non-Destructive Testing 3. Entrepreneurship Development 4. Hybrid and Electric Vehicles	3	0	0	3
6	OE		Other Branches to ME Dept.	3	0	0	3
7	PC	24AMEC72L	Applied Robotic Control Lab	0	0	2	1
8	PC	24AMEC73L	Computer Aided Manufacturing Lab	0	0	2	1
9	PC	24AMEC74L	Product Development Lab	0	0	2	1
10	INTERN	24AMEC75I	Evaluation of Industry Internship	0	0	0	2
						Total Credits	**20**

Open Elective – IV (offered by other departments to ME Department)

Sl. No.	Category	Course code	Course Title	Offered by the Dept.
1	OE	24ACIV7MT	Disaster Management	Civil Engineering
2		24ACIV7NT	Water Resource Harvesting	
3		24AEEE7UT	Electric Vehicles	Electrical & Electronics Engineering
4		24AEEE7TT	Sustainable Energy Sources	
5		24AECE7VT	Introduction to Image Processing	Electronics & Communication Engineering
6		24AECE7UT	Introduction to Microprocessors and Microcontrollers	
7		24ACSE7QT	Data Base Management Systems	Computer Science Engineering
8		24ACSE7RT	Operating Systems	
9		24AMBA71T	Human Resource Management	Master of Business Administration
10		24AMBA72T	Startup Management	
11		24AAID7MT	Introduction to Data Science	Artificial Intelligence & Data Science

Open Elective Courses to Other Departments Offered by ME Department

Sl. No.	Category	Course code	Course Title	Hours per Week			Credits
				L	T	P	C
1	OE	24AMEC7KT 24AMEC7MT	1. Entrepreneurship Development 2. Optimization Techniques	3	0	0	3

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Department of Mechanical Engineering

IV Year II Semester

Sl. No.	Category	Course code	Course Title	Hours per Week			Credits
				L	T	P	C
1	PROJ	24AMEC81P	Internship and Project	-	-	24	12

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Machining Processes
Category: PC
Year: III
Semester: I
Couse Code: 24AMEC51T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the fundamentals of metal cutting processes, tool geometry, cutting forces, and the effect of machining parameters on tool life and machinability.
2. To explain the construction, working principles, and operations of lathes, shaping, slotting, and planning machines used in machining.
3. To analyze the principles of drilling, boring, milling operations, and the application of jigs and fixtures for accurate machining.
4. To understand grinding theory, grinding machines, wheel specifications, and finishing processes such as lapping and honing.
5. To gain knowledge of the working principles, advantages, and industrial applications of major non-traditional machining processes such as EDM, ECM, LBM, and USM.

Course Outcomes:

At the end of the course, the student will be able to

1. Explain the principles of metal cutting, tool geometry, cutting forces, and evaluate the influence of machining parameters on tool life and machinability.
2. Demonstrate knowledge of construction, working, and operations of lathe and reciprocating machine tools for various machining applications.
3. Apply the concepts of drilling, boring, milling, and utilize jigs and fixtures for accurate and efficient machining.
4. Analyze abrasive machining processes including grinding, lapping, and honing, and select appropriate grinding wheels and finishing techniques.
5. Compare and interpret the working principles and applications of non-conventional machining processes such as EDM, ECM, LBM, EBM, USM, AJM, and WJM for advanced manufacturing needs.

Unit 1 Elementary treatment of metal cutting theory 12

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. Cutting Tool materials and cutting fluids –types and characteristics.

Unit 2 Lathe and Reciprocating Machine Tools 11

Engine lathe – Principle of working- specification of lathe – types of lathes–Taper turning, thread cutting operations and attachments for Lathes.

Shaping, Slotting and planning machines - Principles of working, specifications, types, Tools and tool holding devices – operations performed, machining time calculation.

Unit 3 Drilling and Milling 13

Drilling- Principles of working, specifications, types, Tools and tool holding devices, Principles of design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping –types.

Boring Machines - Principles of working and types.
Milling machine – Principles of working – specifications – classifications of milling machines – methods of indexing, machining operation.

Unit 4 Abrasives Machining 13

Grinding machine –Theory of grinding – classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – Grinding wheel specification - types of abrasives – bonds, Truing and Dressing of wheels.
Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing.

Unit 5 Introduction to non-conventional Manufacturing Process 12

Introduction to non-conventional Manufacturing Process: Benefits, application and working principle of EDM, ECM, LBM, EBM, USM, AJM, WJM.

Prescribed Textbook:

1. Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition.

Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. PN Rao, —Manufacturing Technology‖, Tata McGraw Hill, 2017.
3. Modern Machining Processes by P.C. Pandey& H.S. Shan.
4. Manufacturing science by Degarmo, Wiley India.
5. Tool Design by Cyril Donaldson, H. LeCain George, V. C. Goold & Joyjeet Ghose, 5th edition, McGraw Hill Education.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC51T.1	3	2	1	2	2	-	-	-	1	-	1	2	1
24AMEC51T.2	3	2	1	1	2	-	-	1	1	-	1	2	1
24AMEC51T.3	3	3	2	2	3	-	-	1	1	-	1	3	2
24AMEC51T.4	2	2	1	2	2	-	-	-	1	-	1	2	1
24AMEC51T.5	2	2	2	1	2	1	1	-	1	-	2	2	3

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: I.C. Engines & Gas Turbines
Category: PC
Year III
Semester: I
Course Code: 24AMEC52T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To Gain knowledge on basic concepts of an I C Engine.
2. To Acquaint with concept of combustion in SI & CI engines.
3. To Familiarize about various methods for measurement of engine performance.
4. To Provide insight on Air compressors.
5. To Provide knowledge on Gas turbines.

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the concepts of IC engines.
2. Comprehend the combustion in SI & CI engines.
3. Calculate the performance of IC Engines.
4. Calculate the performance of Air compressors.
5. Calculate the performance of Gas Turbines.

Unit 1 Introduction to I.C. Engines 14

Classification - Working principles, Valve and Port Timing Diagrams, Engine systems – Fuel, Simple Carburetor, Fuel Injection System – Air Injection system, Solid Injection system and Electronic Injection system. Ignition –Battery ignition system and Magneto ignition system, Cooling – Air cooling (Cooling Fins) and liquid cooing system – Thermo syphon system and Forced Circulation system and Lubrication - Importance - Mist Lubrication System, Wet sump Lubrication system and Dry sump Lubrication system.
Actual Cycles and Their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down - Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

Unit 2 Combustion in SI & CI Engines 11

Combustion in SI engine: Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers.
Combustion in CI Engines: Stages of Combustion – Delay Period and Its Importance – Effect of Engine Variables – Diesel Knock– Combustion Chambers (DI And IDI), Fuel Requirements and Fuel Rating.

Unit 3 Testing and performance of IC engines. 12

Testing and Performance: Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses and Indicated Power – Performance Test – Heat Balance Sheet and Chart**.**

Unit 4 Air Compressors 11

Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors,

Problems Related to Reciprocating Compressors, Working principles of Roots blower, Vane type Blower, Centrifugal Compressor - Axial Flow Compressors

Unit 5 Gas Turbines 12

Gas Turbines: Simple gas turbine plant, Brayton cycle, closed cycle and open cycle for gas turbines, actual cycle. Methods to improve performance: regeneration, intercooling and reheating.

Introduction to jet propulsion: working principle of ramjet, turbojet, turboprop and pulse jet engines, Thrust, Thrust Power and Propulsion Efficiency

Prescribed Textbooks:

1. I.C. Engines - V. Ganesan- TMH- 4th edition -2017- ISBN-13. 978-1259006197
2. Thermal Engineering-Rajput-Lakshmi Publications -11th edition -2020- ISBN-13. 978-8131808047.

Reference Books:

1. Internal Combustion Engine Fundamentals- John B. Heywood- TMH-2018-ISBN: 9781260116106
2. Thermodynamics & Heat Engines- B. Yadav- Central Book Depot., Allahabad -2002-ISBN-13: 978-8185444031
3. Treatise On Heat Engineering in MKS And SI Units, 4/e, V P Vasandani, Metropolitan Book Co. (p) Ltd. ISBN-13: 978-8120003507

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC52T.1	3	2	-	-	-	-	-	-	-	-	1	2	-
24AMEC52T.2	3	2	-	-	-	-	-	-	-	-	1	2	1
24AMEC52T.3	3	3	2	1	-	-	-	-	-	-	1	2	2
24AMEC52T.4	3	3	2	2	-	-	-	-	-	-	1	2	2
24AMEC52T.5	3	3	2	2	-	-	-	-	-	-	1	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Design of Machine Members
Category: PC
Year: III
Semester: I
Course Code: 24AMEC53T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the mechanical engineering design process for static loads under various loading conditions.
2. To understand the mechanical engineering design process for dynamic loads under various loading conditions and design of springs.
3. To explore the design principles and analysis of bolted and welded joints and butt welds under various loading conditions.
4. To study the design principles of power transmission shafts and couplings, focusing on the analysis of shafts subjected loads, as well as the design of various types of couplings.
5. To demonstrate the design principles of sliding and rolling contact bearings, gears, spur gears, beam strength, and load considerations.

Course Outcomes:

At the end of the course, the student will be able to

1. Apply design principles for components subjected to static loads.
2. Apply design principles for components subjected to static loads and designing of springs subjected to external loads.
3. Design power transmission shafts and couplings for fluctuating loads, and selecting appropriate couplings such as flange, bushed pin, and universal couplings.
4. Design power transmission shafts and couplings for fluctuating loads, and selecting appropriate couplings such as flange, bushed pin, and universal couplings.
5. Design and analyze the sliding and rolling contact bearings, spur gears, considering beam strength, dynamic, and wear load factors.

Unit 1 Introduction & Design for Static loads 14

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.

Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Unit 2 Design for Dynamic Loads & Design of Springs 13

Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

Springs: Design of helical compression springs and leaf springs (simple problems)

Unit 3 Design of Bolted & Welded Joints 12

Design of Bolted Joints: Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening and eccentrically loaded bolted joints.

Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion. Eccentrically loaded welded joints.

Unit 4 Design of shafts & Couplings 12

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads.

Couplings: Design of flange and bushed pin couplings.

Unit 5 Design of Bearings and Gears 14

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

Prescribed Textbook:

1. Design of Machine Elements, V.B.Bhandari, 3/e, Tata McGraw Hill, 2010.ISBN-13:978-9390177479

Reference Books:

1. Machine Design, R.K. Jain, Khanna Publications, 1978.; ISBN-13:978-89195207503
2. Mechanical Engineering Design, J.E. Shigley, 2/e, Tata McGraw Hill, 1986.; ISBN-13:978-0073398204
3. Design data handbook, K. Mahadevan & K.Balaveera Reddy, CBS Publications, 4/e, 2019. ISBN-13:978-8123923154
4. Machine design, Dr. N. C. Pandya &Dr. C. S. Shah, 17/e, Charotar Publishing House Pvt. Ltd, 2022. ISBN-13:978-7385039539
5. Machine Design an Integrated approach, R.L. Norton, 2/e, Pearson Education, 2004. ISBN-13:978-0131481901

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC53T.1	3	2	2	2	-	-	-	-	-	-	-	2	3
24AMEC53T.2	3	3	2	3	-	-	-	-	-	-	-	2	2
24AMEC53T.3	3	3	3	3	-	-	-	-	-	-	-	2	2
24AMEC53T.4	3	3	3	3	-	-	-	-	-	-	-	3	2
24AMEC53T.5	3	3	3	3	-	-	-	-	-	-	-	2	1

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Smart Materials
Category: PE
Year: III
Semester: I
Course Code: 24AMEC5AT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the fundamental characteristics of different metals and gain insight into smart materials, including their classification and real-world applications.
2. To acquire knowledge of various types of smart materials, including electro-rheological fluids and shape memory materials.
3. To explore the processing techniques of smart materials and fluids, with emphasis on synthesis and fabrication methods such as metallization and UV curing.
4. To develop an understanding of different types of sensors, including advanced carbon nanotube and polymer-based sensors.
5. To comprehend the principles, types, and applications of actuators used in smart systems, including electro-thermal actuators.

Course Outcomes:

At the end of the course, the student will be able to

1. Explain and distinguish between traditional engineering materials and smart materials, and identify appropriate smart materials for various engineering applications.
2. Explain the working principles, properties, and applications of different smart materials and evaluate their suitability for specific engineering and technological applications.
3. Describe and apply suitable processing and fabrication techniques for different smart materials in engineering applications.
4. Identify, describe, and equate different sensor technologies and select appropriate sensors for engineering applications.
5. Demonstrate the working mechanisms of various actuators compare and select suitable actuation methods for different smart materials for create system applications.

Unit 1 Fundamentals of Smart Materials 10

Introduction: Characteristics of metals, polymers and ceramics. Introduction to smart materials. Classification of smart materials, Components of a smart System, Applications of smart material.

Unit 2 Smart Materials and Their Applications 11

Smart Materials Piezoelectric materials, Electro strictive Materials, Magnetostrictive materials, Magnetoelectric materials, Magnetorheological Electrorheological fluids, Shape Memory materials.

Unit 3 Processing and Fabrication of Smart Materials 12

Processing of Smart Materials Semiconductors and their processing, Metals and metallization techniques, Ceramics and their processing, Polymers and their synthesis, UV radiation curing of polymers, fluids.

Unit 4 Smart Sensors and Their Applications 13

Sensors Introduction, Conductometric sensors, Capacitive sensors, Piezoelectric sensors, Magnetostrictive sensors, Piezoresistive sensors, Optical sensors, Resonant sensors, semiconductor-based sensors, Acoustic sensors, polymerize sensors, Carbon nanotube sensors.

Unit 5 Actuators and Smart Actuation Systems 13

Actuators Introduction, Electrostatic transducers, Electromagnetic transducers, Electrodynamic transducers, Piezoelectric transducers, Electro-strictive transducers, Magneto-strictive transducers, Electro thermal actuators, Comparison of actuation, Applications

Prescribed Textbook:

1. Smart Material Systems and MEMS: Design and Development Methodologies, V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, John Wiley and Sons, England, 2006

Reference Books:

1. Smart Structures and Materials, Brain Culshaw, Artech House, London, 1996
2. Smart Materials and Structures, Mukesh V. Gandhi, Brian S. Thompson, , Springer, May- 1992.
3. Smart Structures: Analysis and Design, A. V. Srinivasan, Cambridge University Press, Cambridge, New York, 2001.
4. Smart Structures, P. Gauenzi, Wiley, 2009.
5. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, Berlin, New York, 2002
6. Analysis and Performance of Fiber Composites, B. D. Agarwal and L. J. Broutman, John Wiley & Sons
7. Engineering aspects of Shape memory Alloys, T. W. Duerig, K. N. Melton, D. Stockel,C.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC5AT.1	3	2	2	-	-	1	-	-	-	-	2	2	2
24AMEC5AT.2	3	3	2	2	-	-	-	-	-	-	2	2	3
24AMEC5AT.3	3	2	3	2	2	-	-	-	-	-	2	3	3
24AMEC5AT.4	3	2	2	2	3	-	-	-	-	-	2	2	2
24AMEC5AT.5	3	2	3	2	2	-	-	-	-	-	2	2	3

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Automation & Robotics
Category: PE
Year: III
Semester: I
Course Code: 24AMEC5BT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To acquire basic knowledge on automation and automated flow lines in automatic manufacturing systems.
2. To learn about the line balancing methods and automated assembly systems
3. To learn about the robotics and fundamentals of robots with their needs in present trend.
4. To understand robot kinematics, dynamics and to acquire knowledge on importance of trajectory planning in robots.
5. To learn about the sensors, actuators and robot programming methods used in robots

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the concepts of an automation and automated flow lines
2. Analyze the line balancing methods and assembly systems
3. Summarize the fundamentals of Robots
4. Analyze the Robot kinematics, dynamics and trajectory planning
5. Summarize the concept of Robot actuators, sensors and applications.

Unit 1 Automation & Automated flow lines 09

Introduction to Automation, Need, automation principles, automation strategies, Types, Basic elements of an automated system, levels of automation, hardware components for automation and process control.
Automated flow lines: Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage- Elementary treatment

Unit 2 Assembly Systems and Line Balancing 08

The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines.

Unit 3 Introduction to Industrial Robots 08

Need for robots in Present customization, Classification, laws of robots. Robot configurations, Functional line diagram, Degrees of Freedom, Components, common types of arms, joints, grippers.

Unit 4 Manipulator Kinematics, Dynamics & Trajectory Planning 13

Manipulator Kinematics: Homogeneous transformations as applicable to rotation and translation – D-H notation, Forward and inverse kinematics
Manipulator dynamics: Differential transformation, Jacobians. Lagrange – Euler - Elementary treatment
Trajectory Planning: Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion.

Unit 5 Robot Actuators, Sensors, Programming & Application 10

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison Position sensors – potentiometers, resolvers, encoders – Velocity sensors, tactile sensors, Proximity sensors. Robot applications- Assembly, Spray painting, Loading &unloading, Inspection and material handling

Prescribed Textbooks:

1. M. P. Groover, Automation, Production systems and CIM. Pearson Edu 2004. ISBN-10: 9789332572492, ISBN-13: 978-9332572492
2. Niku Saeed B., Introduction to Robotics: Analysis, systems, Applications, PHI New Delhi. ISBN-10: 0130613096.

Reference Books:

1. M.P. Groover, Industrial Robotics. TMH 2003. ISBN-10: 007024989X
2. Saha, S.K., Introduction to Robotics, Second Edition McGraw Hill New Edition 2014. ISBN: 9789332902800
3. Fu KS, Robotics. McGraw Hill. 2014. ISBN: 9780071822282

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC5BT.1	2	2	1	1	-	-	-	-	-	-	-	1	1
24AMEC5BT.2	3	3	2	2	-	-	-	-	-	-	-	2	2
24AMEC5BT.3	2	2	1	1	-	-	-	-	-	-	-	1	1
24AMEC5BT.4	3	3	2	2	-	-	-	-	-	-	-	2	2
24AMEC5BT.5	2	2	1	1	-	-	-	-	-	-	-	1	1

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Renewable Energy Resources
Category: PE
Year: III
Semester: I
Course Code: 24AMEC5CT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To grasp the role and potential of new and renewable source
2. To provide on insight the types and working principles of solar energy collectors.
3. To gain Knowledge as of solar energy storage and Wind Energy.
4. To familiarize the concepts of Biomass & Geothermal energy.
5. To become conversant with Ocean energy and direct energy conversion.

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the basics of solar radiation and its instruments.
2. Summarize the types of solar collectors and their applications.
3. Summarize the types of energy storage systems and working of wind mills and their applications.
4. Summarize the concepts of Bio-Mass energy and Geothermal resources.
5. Summarize the concepts of Ocean thermal energy conversion plants, wave energy, tidal energy and different direct energy conversion systems.

Unit 1 Principles Of Solar Radiation 13

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Unit 2 Solar Energy Collection 11

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Unit 3 Solar Energy Storage and Wind Energy 13

Solar Energy: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications-solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

Unit 4 Bio-Mass 12

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Unit 5 Tidal, Wave, Hydro and Direct Energy Conversion Systems 13

OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, and principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, MHD generators, MHD accelerator, MHD Engine, power generation systems. Fuel cells – working principles of hydrogen fuel cell, phosphoric acid fuel cell, alkaline fuel cell, selection of fuels - and operating conditions.

Prescribed Textbook:

1. Non-Conventional Energy Sources /G.D. Rai Khanna Publisher, ISBN-10 : 9788174090737

Reference Books:

1. Renewable Energy Sources/ Twidell & Weir 3rd edition Routledge publisher (2015)
2. Non-Conventional Energy Resources, B.H.Khan, McGrawHIll, 2015
3. Principles of Solar Energy/ Frank Krieth & John F Kreider.
4. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals" SAE International, 2004.
5. Non-Conventional Energy/ Ashok V Desai/ Wiley Eastern

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC5CT.1	2	2	1	2	-	-	-	-	-	-	-	1	2	1
24AMEC5CT.2	2	2	1	2	-	-	-	1	-	-	-	1	1	1
24AMEC5CT.3	2	2	1	2	-	-	-	1	-	-	-	1	2	1
24AMEC5CT.4	2	2	1	2	-	-	-	1	-	-	-	1	1	1
24AMEC5CT.5	2	2	1	2	-	-	-	1	-	-	-	1	2	1

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Mechanical Vibrations
Category: PE
Year: III
Semester: I
Course Code: 24AMEC5DT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To Introduce fundamental concepts of vibration analysis, focusing on Single Degree Freedom (SDOF) systems and their solutions.
2. To Develop understanding of forced vibration, resonance, and damping effects in Single Degree Freedom systems, including vibration isolation.
3. To Explore the dynamics of Two Degree Freedom (TDOF) systems and their application in vibration absorbers and coupled systems.
4. To Familiarize Multi Degree Freedom (MDOF) systems, methods for formulating equations of motion, and vibration analysis techniques.
5. To Explain vibration measurement tools, transducers, and exciters used in experimental vibration analysis

Course Outcomes:

At the end of the course, the student will be able to

1. Define, Understand and Solve problems related to undamped and damped free vibrations in Single Degree Freedom systems using classical and energy methods.
2. Analyze forced vibrations in Single Degree Freedom systems under various excitation forces, apply and evaluate the concepts of transmissibility and isolation.
3. Analyze forced vibrations in Single Degree Freedom systems under various excitation forces, apply and evaluate the concepts of transmissibility and isolation.
4. Formulate equations of motion, and perform modal analysis of free and forced vibrations. Apply vibration measurement tools to select appropriate exciters for vibration testing.
5. Explain and evaluate the damping characteristics in vibrating systems, including the effects of viscous damping, Coulomb damping, and damping in whirling of shafts.

Unit 1 Single Degree Freedom Systems 14

Single Degree Freedom Systems: Introduction to vibrations, free and damped vibrations, natural frequency and equation of motion. Undamped free vibration, energy method, equivalent systems and torsional systems. Viscous damping, under damped, critically damped and over damped systems. Coulomb damping and equivalent damping coefficient. Forced vibrations, resonance and simple numerical problems.

Unit 2 Forced vibrations of Single Degree Freedom Systems 13

Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

Unit 3 Two Degree Freedom Systems 13

Two Degree Freedom Systems: Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

Unit 4 Multi Degree Freedom Systems 12

Lagrangian method for formulation of equation of motion Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

Unit 5 Vibration measurement and Applications 14

Transducers: variable resistance transducers, Piezoelectric transducers, electro dynamic transducers and linear variable differential transformer transducer; Vibration pickups: vibrometer, accelerometer, velometer and phase distortion; Frequency-measuring instruments; Vibration exciters- Mechanical exciters and electro dynamic shaker.

Prescribed Textbook:

1. Singiresu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018. ISBN-13:978-0132128193

Reference Books:

1. G.K.Groover, Mechanical Vibrations, Nemchand& Bro, 8/e, 2009. ISBN-13:978-8185240565
2. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, 1986. ISBN-13:978-0070413429
3. Mechanical Vibrations by VP Singh, Dhanpat Rai & Co. (P) Ltd ISBN-13 : 978-8177004014
4. Mechanical Vibrations by W. T. Thomson, Prentice Hall Press

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC5DT.1	3	3	2	2	-	-	1	-	1	-	1	2	3
24AMEC5DT.2	2	3	2	2	-	-	1	-	1	-	1	3	3
24AMEC5DT.3	3	3	2	2	-	-	1	-	1	-	1	3	3
24AMEC5DT.4	2	3	2	3	-	-	1	-	1	-	1	2	3
24AMEC5DT.5	3	2	2	2	-	-	1	-	1	-	1	3	3

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Machining Processes Lab
Category: PC
Year: III
Semester: I
Course Code: 24AMEC51L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:

1. To provide practical knowledge of lathe operations such as facing, turning, step turning, taper turning, threading, and knurling.
2. To develop skills in production machining and hole-making processes using Capstan Lathe and Radial Drilling Machine.
3. To understand the working principles and applications of reciprocating machine tools such as Shaper and Slotter for surface and keyway machining.
4. To impart hands-on experience in milling operations, including slot milling and gear cutting using indexing mechanisms.
5. To familiarize with grinding and tool sharpening processes using Cylindrical/Surface Grinding and Tool & Cutter Grinding machines for achieving dimensional accuracy and surface finish.

Course Outcomes:

At the end of the course, the student will be able to

1. Apply lathe machining techniques to perform facing, plain turning, step turning, taper turning, threading, and knurling operations to obtain required dimensions.
2. Operate Capstan Lathe and Radial Drilling Machine to carry out sequential production operations such as drilling, reaming, tapping, and batch component manufacturing.
3. Demonstrate and select appropriate parameters for machining flat surfaces, slots, and keyways using Shaper and Slotting machines
4. Execute milling operations including slot milling and spur gear cutting using indexing heads and suitable cutters.
5. Assess grinding wheel selection, grinding parameters, and tool angles while performing cylindrical grinding and cutting tool sharpening to achieve required surface finish and accuracy.

List of experiments: **12 Weeks**

1. Perform Facing, Plain Turning and Step Turning Operations on a Lathe
2. perform Taper Turning by Compound Rest Method, External Thread Cutting and Knurling on Lathe.
3. perform Facing, Plain Turning, drilling, reaming, and tapping to produce multiple identical components.
4. Set up the Radial Drilling Machine and perform drilling, and tapping operations on a given workpiece
5. Machine a flat horizontal surface on the given workpiece using a Shaper Machine.
6. Cut an internal slot or keyway on the given workpiece using a Slotting Machine.
7. Cut spur gear teeth on the given workpiece using a Milling Machine with the indexing head.
8. Grind the external cylindrical surface of the given workpiece to the required dimension using a Cylindrical Grinding Machine.
9. Grind and sharpen a single-point cutting tool to the specified tool angles using a Tool and Cutter Grinding Machine.
10. Perform Boring Operation on Lathe.
11. Perform Spot Facing Operation on Drilling Machine.

NOTE: Any 10 out of 11 experiments can be conducted.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC51L.1	3	2	1	2	3	-	-	1	1	-	2	3	2
24AMEC51L.2	3	2	2	2	3	-	-	2	1	-	2	3	3
24AMEC51L.3	3	3	2	2	3	-	-	2	1	-	2	3	2
24AMEC51L.4	3	2	2	2	3	-	-	2	1	-	2	3	3
24AMEC51L.5	3	2	1	2	3	-	-	1	1	-	2	3	2

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: I.C. Engines Lab
Category: PC
Year III
Semester: I
Course Code: 24AMEC52L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:

1. To impart knowledge on working principles of various thermal equipment's like compressors, IC Engines, Boilers etc.,
2. To study the working principle of IC engines, performance and characteristics in terms of heat balancing, economical speed variations, air fuel ratio etc.,

Course Outcomes:

At the end of the course, the student will be able to

1. Calculate the performance of 4-Stroke Diesel and Petrol engine.
2. Calculate the Engine friction of 4-Stroke Multi cylinder Engine and Air/Fuel ratio and Volumetric efficiency of I.C. Engines.
3. Calculate the heat balance of the IC Engines.
4. Calculate the efficiencies and performance characteristics of the engines.
5. Study the boilers and identify of the engine parts.

List of Experiments **12 Weeks**

1. Draw the Valve / Port Timing Diagrams of an I.C. Engines
2. Performance Test on a 4 -Stroke Diesel Engines
3. Performance Test on a 4-Stroke Petrol engine
4. Performance Test on a 4-Stroke Multi cylinder Petrol engine
5. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
6. Retardation and motoring test on 4- stroke engine
7. Heat balance sheet on four stroke single cylinder diesel engine.
8. Heat balance sheet on four stroke single cylinder petrol engine.
9. Heat balance sheet on four stroke multi cylinder petrol engine.
10. Performance Test on Reciprocating Air – Compressor Unit
11. Dismantling / Assembly of Engines to identify the parts and their position in an engine.
12. Performance test on refrigeration test rig.
13. Viscosity of the oil through saybolt viscometer apparatus
14. (a) Calorific value of fuel using bomb calorimeter.
    (b) Flash and fire point by Cleveland open cup apparatus.

Study Experiment

1. Study of Boilers

Note: Any 10 out of 14 Experiments can be conducted.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC52L.1	3	2	3	1	-	1	1	2	2	1	2	3	2
24AMEC52L.2	3	3	3	1	-	1	1	2	2	1	2	3	2
24AMEC52L.3	3	2	3	1	-	1	1	2	2	1	2	3	2
24AMEC52L.4	3	3	3	1	-	1	1	2	2	1	2	3	2
24AMEC52L.5	2	1	2	1	-	2	1	2	2	1	2	2	2

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Refrigeration & Air Conditioning Lab
Category: PC
Year: III
Semester: I
Course Code: 24AMEC54L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:

1. To understand the principles of vapor compression refrigeration system.
2. To gain the knowledge on various components of vapor compression refrigeration system and its thermodynamic cycle
3. To familiarize with the properties of various refrigerants used in the commercial refrigeration and air conditioning units and their effect on environment.
4. To understand the principle of Air-conditioning system and usage of Psychometric Chart.
5. To understand human comfort conditions and estimate the effect of various cooling and heating loads in an air-conditioning system.

Course Outcomes:

At the end of the course, the student will be able to

1. Calculate the COP of Vapour compression refrigeration test rig.
2. Solve the COP value of the Domestic refrigerator and diagnose the troubles encountered.
3. Demonstrate the knowledge of various refrigerants-filling procedure-quantity of refrigerant used.
4. Solve the COP value of the Split Air conditioner and diagnose the troubles encountered.
5. Estimate the Tonnage of Air conditioning.

List of Experiments: **12 Weeks**

1. Demonstration of various components of Vapor compression refrigeration system cut models and calculate its COP.
2. Demonstration of various components of Domestic Refrigerator in working condition and calculate its COP.
3. Trouble shooting of the Domestic refrigerator like leakage of refrigerant, failure of thermostat, failure of compressor motor, failure of insulation, etc.,
4. Study of various refrigerants used in the various refrigeration and air conditioning units.
5. Study of refrigerant filling procedure in various refrigeration and air conditioning units used commercially.
6. Demonstration of Brazing operation in refrigeration and air conditioning systems.
7. Knowing the quantity of refrigerants filled in the domestic refrigeration and air conditioning units. Knowing the price of refrigerants and their suppliers' details.
8. Demonstration of various components of Domestic Split Air-conditioner in working condition and calculate its COP.
9. Trouble shooting of the Domestic Split Air-conditioner like leakage of refrigerant, failure of thermostat, failure of compressor motor, failure of condenser fan, failure of evaporator blower, failure of air filtering element, etc.,
10. Estimation of cooling loads for a room based on the area of room, no. of occupants in the room and no. of electrical Gadgets present in the room. (Analytical)
11. Determining the tonnage of air conditioner. (Analytical)
12. Study on clean air technology.

NOTE: Any 10 out of 12 experiments to perform.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC54L.1	3	3	3	2	-	-	-	-	-	-	1	1	1
24AMEC54L.2	3	3	3	3	-	-	-	-	-	-	1	1	1
24AMEC54L.3	2	2	2	2	-	-	-	-	-	-	1	1	1
24AMEC54L.4	3	3	2	3	-	-	-	-	-	-	1	1	1
24AMEC54L.5	3	3	3	3	-	-	-	-	-	-	1	1	1

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: MATLAB for Mechanical Engineers
Category: SEC
Year: III
Semester: I
Course Code: 24AMEC55S
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	2	2

Course Objectives:

1. To introduce students to MATLAB environment, basic programming constructs, and matrix operations for solving fundamental mechanical engineering problems.
2. To enable students to develop structured MATLAB programs and visualize engineering data effectively.
3. To apply numerical methods in MATLAB for solving complex mechanical engineering problems.
4. To develop mathematical models and simulate mechanical systems using MATLAB and Simulink.
5. To apply advanced MATLAB toolboxes for optimization, analysis, and real-world mechanical engineering applications

Course Outcomes:

At the end of the course, the student will be able to

1. Apply basic MATLAB programming concepts and matrix operations to solve fundamental mechanical engineering problems.
2. Develop structured MATLAB programs and visualize engineering data using 2D and 3D graphical tools.
3. Implement numerical methods in MATLAB to analyze and solve mechanical engineering mathematical models.
4. Model and simulate mechanical systems using MATLAB and Simulink for dynamic system analysis.
5. Utilize advanced MATLAB toolboxes for optimization, data analysis, and real-world mechanical engineering applications.

Unit 1 Fundamentals of MATLAB and Programming Basics 3T + 6L

Introduction to MATLAB environment, MATLAB desktop, command window, editor, workspace, Variables, constants, and data types, Vectors and matrices – creation and operations, Mathematical operations and built-in functions, Relational and logical operators, Input/output commands, Script files and function files, Control statements: if, else, switch, Looping statements: for, while.

Mechanical Applications: Simple engineering calculations – stress, strain, velocity, acceleration computations.

Unit 2 Advanced Programming and Data Visualization 3T + 6L

User-defined functions, Nested functions, Arrays and matrix manipulation, String operations, 2D plotting – plot(), subplot(), fplot(),3D plotting – mesh(), surf(), contour(),Graph customization (labels, legends, grids), Data import/export (Excel, CSV files),Debugging techniques.

Mechanical Applications: Plotting stress-strain curves, load-deflection graphs, temperature distribution plots.

Unit 3 4T + 8L

Roots of equations (bisection, Newton-Raphson using MATLAB), Linear algebraic equations, Gauss elimination, LU decomposition), Interpolation and curve fitting, Numerical differentiation, Numerical integration (Trapezoidal, Simpson's rule), Ordinary Differential Equations (ODE45 solver)

Mechanical Applications: Vibration analysis, heat transfer problems, beam deflection, dynamic system modelling.

Unit 4 **4T + 8L**

Mathematical modelling basics, Transfer functions, Laplace transform in MATLAB, Introduction to Simulink, Block diagram modelling, Simulation of mechanical systems, Mass-spring-damper system, DC motor modelling, PID controller design.

Mechanical Applications: Control of mechanical systems, dynamic response analysis, system stability.

Unit 5 Advanced Tools and Mechanical Engineering Case Studies **4T + 8L**

Optimization toolbox, Curve fitting toolbox, Symbolic math toolbox, Image processing basics, Finite Element Method basics in MATLAB, Data analysis and signal processing, Mechanical case studies-Vibration signal analysis, Thermal analysis, Fatigue life prediction, Composite material modelling.

Prescribed Textbook:

1. MATLAB: A Practical Introduction to Programming and Problem Solving" by Stormy Attaway

Reference Books:

1. MATLAB an Introduction with Applications by Rao V. Dukkipati.
2. Numerical Methods with MATLAB: Implementations and Applications" by Gerald W. Recktenwald.
3. MATLAB Programming for Engineers" by Stephen J. Chapman.
4. Simulink: Dynamic System Simulation for MATLAB" by Tobias & Hao.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC55S.1	3	2	1	1	3	-	-	1	1	-	2	2	-
24AMEC55S.2	3	2	2	1	3	-	-	2	2	-	2	3	1
24AMEC55S.3	3	3	2	2	3	-	-	1	1	-	2	3	2
24AMEC55S.4	3	3	3	2	3	1	-	2	1	1	2	3	3
24AMEC55S.5	3	3	3	3	3	1	-	2	2	1	3	3	3

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Gender Sensitization
Category: MC
Year: III
Semester: I
Couse Code: 24AAUD51T
Branch/es: Common to all branches

Lecture Hours	Tutorial Hours	Practice Hours	Credits
2	0	0	-

Course Objectives:

1. To enable students to understand the gender related issues, and foster humane attitude,
2. To familiarize them about constitutional safeguards for gender equality.
3. To expose students to debates on the politics and economics of work-related discrimination.
4. To help students reflect critically on gender violence.
5. To make them understand gender identities and gender relations as part of culture.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand the basic concepts of gender and its related terminology.
2. Identify the biological, sociological, psychological and legal aspects of gender.
3. Understand how gender discrimination prevails in our society and how to counter it.
4. Analyze the gender division of labor and its relation to politics and economics.
5. Appraise how gender-role beliefs and sharing behavior are associated with more well-being

Unit 1 Understanding Gender **6**

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male.

Unit 2 Gender Roles And Relations **6**

Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles- Gender Roles and Relationships Matrix-Missing Women-Sex Selection and its Consequences- Declining Sex Ratio-Demographic Consequences-Gender Spectrum.

Unit 3 Gender And Labour **7**

Division and Valuation of Labor-Housework: The Invisible Labor- “My Mother doesn‘t Work”. “Share the Load”- Unrecognized and Unaccounted work -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

Unit 4 Gender-Based Violence **7**

The Concept of Violence- Types of Gender-based Violence- Human Rights Perspective-Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence

Unit 5 Gender And Culture **6**

Gender and Films-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature-Gender Development Issues-Gender Sensitive Language- Just Relationships

Prescribed Textbooks:

1. A. Suneetha, Uma Bhrugubanda, et al. Towards a World of Equals: A Bilingual Textbook on Gender‖, Telugu Akademi, Telangana, 2015.
2. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity. UK Paperback Edn. March 1990

Reference Books:

1. Wtatt, Robin and Massood, Nazia, Broken Mirrors: The dowry Problems in India, London: Sage Publications, 2011.
2. Datt, R. and Kornberg, J.(eds), Women in Developing Countries, Assessing Strategies for Empowerment, London: Lynne Rienner Publishers, 2002.
3. Brush, Lisa D., Gender and Governance, New Delhi, Rawat Publication, 2007.
4. Singh, Direeti, Women and Politics World Wide, New Delhi, Axis Publications, 2010 5.
5. Raj Pal Singh, Anupama Sihag, Gender Sensitization: Issues and Challenges (English, Hardcover), Raj Publications, 2019.
6. A.Revathy& Murali, Nandini, A Life in Trans Activism(Lakshmi Narayan Tripathi). The University of Chicago Press, 2016.

Online Learning Resources:

1. Understanding Gender chrome-extension:
   https://kdpelmjpfafjppnhbloffcjpeomlnpah/https://www.arvindguptatoys.com/arvindgupta/kamlagender1.pdf
   https://onlinecourses.swayam2.ac.in/nou24_hs53/preview
2. Gender Roles and Relations:
   https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity/what-are-gender-roles-and-stereotypes
   https://www.verywellmind.com/understanding-gender-roles-and-their-effect-on-our-relationships-7499408
   https://onlinecourses.swayam2.ac.in/cec23_hs29/preview
3. Gender and Labour:
   https://www.economicsobservatory.com/what-explains-the-gender-division-of-labour-and-how-can-it-be-redressed
   https://onlinecourses.nptel.ac.in/noc23_mg67/preview
4. Gender-Based Violence:
   https://eige.europa.eu/gender-based-violence/what-isgenderbasedviolence?language_content_entity=en
   https://www.worldbank.org/en/topic/socialsustainability/brief/violence-against-women-and-girls
   https://onlinecourses.swayam2.ac.in/nou25_ge38/preview
5. Gender And Culture:
   https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/
   https://sociology.iresearchnet.com/sociology-of-culture/gender-and-culture/
   https://archive.nptel.ac.in/courses/109/106/109106136/

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC55S.1	-	-	-	-	-	-	3	-	1	-	-	-	-
24AMEC55S.2	-	-	-	-	-	-	3	-	1	-	-	-	-
24AMEC55S.3	-	-	-	-	-	-	3	-	1	-	-	-	-
24AMEC55S.4	-	-	-	-	-	-	3	-	1	-	-	-	-
24AMEC55S.5	-	-	-	-	-	-	3	-	1	-	-	-	-

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Heat Transfer
Category: PC
Year: III
Semester: II
Course Code: 24AMEC61T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To impart the basic laws of conduction, convection, radiation heat transfer and their applications
2. To provide knowledge about heat flow in various systems.
3. To familiarize the convective heat transfer concepts.
4. To understand the principles of phase change processes and radiation heat transfer.
5. To make conversant about heat transfer in various heat exchangers

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the modes of heat transfer
2. Apply the knowledge of conduction heat transfer for various geometry.
3. Calculate heat transfer rates in forced and free convection.
4. Calculate the heat transfer rates during phase change process and radiation.
5. Evaluate the performance of the heat exchangers

Unit 1 Introduction to conduction heat transfer 8

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Boundary and initial conditions.

Unit 2 One dimensional steady state & transient heat conduction 14

One Dimensional Steady State Heat Conduction: In homogeneous slabs, hollow cylinders, Critical radius of insulation-Extended surface (fins) Heat Transfer – Long Fin, Short Fin with insulated tip. Unsteady State Heat Transfer Conduction: Transient heat conduction-lumped system analysis and use of Heisler charts.

Unit 3 Convective heat transfer 16

Convective Heat Transfer: Forced Convection: External Flows-Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for flow over-flat plates, cylinders. Internal Flows: -Division of internal flow through concepts of Hydrodynamic and Thermal entry lengths – Use of empirical relations for horizontal pipe flow. Free Convection: -Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for plates and cylinders in horizontal and vertical orientation.

Unit 4 Heat transfer with phase change & Radiation 17

Heat transfer with phase change: Boiling- Pool boiling – Regimes, condensation – film wise and dropwise condensation-simple problems.

Radiation Heat Transfer: – Thermal radiation – Emission characteristics - laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields

Unit 5 Heat Exchangers 08

Heat Exchangers: Classification of heat exchangers – Overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

Prescribed Textbook:

1. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer. New Age International, 5th Ed.2017, ISBN13: 978-1781831038.

Reference Books:

1. Incropera, Fundamentals of Heat and Mass transfer. Wiley India, 8th Ed,2017 ISBN: 978-1-119-35388-1
2. J.P.Holman, Heat Transfer. TMH, 10th Ed. 2010, ISBN-13: 978-0073529363.
3. Arora and Domkunduwar/ A course in Heat and Mass transfer /Dhanpathrai and sons.2007, ISBN-13: 978- 8177000290
4. P.K.Nag, Heat Transfer. TMH, 3rd Ed. 2011, ISBN-13: 978-0070702530

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC61T.1	3	2	1	1	-	-	-	-	-	-	-	1	1
24AMEC61T.2	3	2	1	2	-	-	-	-	-	-	-	1	1
24AMEC61T.3	3	2	1	2	-	-	-	-	-	-	-	1	1
24AMEC61T.4	3	2	1	2	-	-	-	-	-	-	-	1	1
24AMEC61T.5	3	3	2	2	-	-	-	-	-	-	1	1	1

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Metrology and Measurements
Category: PC
Year: III
Semester: II
Course Code: 24AMEC62T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To explain the system of limits, fits &tolerances and design of gauges.
2. To identify the use of flatness and surface gauges.
3. To know the measurement of screw thread, Gear profiles.
4. To describe the Measurement of Displacement and Strain.
5. To illustrate the measuring process of Pressure, Force and Torque.

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the concepts of limits, fits, limit gauges and linear & angular measuring instruments
2. Explain the concepts of flatness and surface roughness measurements.
3. Describe the measurement of screw thread and Gear profiles.
4. Summarize the measuring process of Displacement and Strain
5. Summarize the measuring process of Pressure, Force and Torque

Unit 1 Limits and Fits 18

Limits fits and tolerances, hole basis and shaft basis system, interchangeability.

Linear and Angular Measurement: Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope.

Angular measurements: bevel protractor and angle dekkor, rollers and spheres used to determine the tapers.

Limit Gauges and Gauge Design: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No-Go gauges.

Unit 2 Screw Thread and Gear Measurement 09

Screw thread measurements: Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

Gear Measurement: Gear tooth terminology, measurement of gear elements-run out, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.
Coordinate Measuring Machine (CMM)- Construction and features.

Unit 3 Flatness and Surface Roughness measurement 09

Flatness Measurement: Measurement of flatness – straight edges – surface plates, optical flat and autocollimators.

Surface Roughness Measurement: Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R.M.S Value-Ra, Rz values, Methods of measurement of surface finish-profilograph, Talysurf.

Unit 4 Measurement of Displacement and Strain 09

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo-electric, inductive, capacitance, resistance, ionization and photoelectric transducers.

Measurements of Strain: Various types of electrical strain gauges, gauge factor, method of usage of resistance strain gauge for bending, compressive and tensile strains.

Unit 5 Measurement of Force, Torque and Pressure 12

Measurement of Force: Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.

Measurement of Torque: Torsion bar dynamometer and absorption dynamometer.

Measurement of Pressure: Standards and calibration, basic methods of pressure measurement - Bourdon tube & Diaphragm, dead weight gauges and manometers.

Prescribed Textbooks:

1. Engineering Metrology, R.K. Jain, Khanna Publishers, special edition 2022. ISBN-13: 978-8174091536
2. Basic Principles - Measurements and Control Systems. S. Bhaskar, Anuradha Publications, 2007. ISBN-13: 978-8189638900

Reference Books:

1. Mechanical Measurements, Beckwith, Marangoni, Linehard, PHI, 2013, ISBN-13: 978-9332518520
2. Metrology & Measurement, Anand K Bewoor & Vinay A Kulkarni, 15/e, McGrawHill, 2017. ISBN-13: 978-0070140004
3. Mechanical Measurements & Control, D.S. Kumar, Metropolitan Publishers, 5/e, 2015.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC62T.1	3	2	1	1	-	-	-	-	-	-	-	-	2
24AMEC62T.2	3	2	1	1	-	-	-	-	-	-	-	-	2
24AMEC62T.3	3	2	1	1	-	-	-	-	-	-	-	-	2
24AMEC62T.4	3	2	1	1	-	-	-	-	-	-	-	-	2
24AMEC62T.5	3	2	1	1	-	-	-	-	-	-	-	-	2

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: CAD/CAM
Category: PC
Year: III
Semester: II
Course Code: 24AMEC63T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To introduce the fundamentals of CAD/CAM, Computer Graphics and its Transformation.
2. To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication
3. Understand the importance of NC/CNC systems, machine tool structures, control techniques, and the fundamentals of CNC part programming including APT-based methods.
4. Understand the importance of Group Technology, Flexible Manufacturing System and Computer Aided Quality Control.
5. Understand the Computer-aided process planning and production planning systems, along with emerging trends such as reconfigurable, sustainable, and lean manufacturing.

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the fundamental concepts of CAD/CAM and computer graphics, including coordinate systems and geometric transformations.
2. Summarize and differentiate key geometric modeling techniques such as wireframe, surface, and solid modeling.
3. Write NC and CNC part programs using standard codes, canned cycles, compensation techniques, and APT-based programming for various machining operations.
4. Explain the significance of Group Technology, Flexible Manufacturing System and Computer-Aided Quality Control,
5. Summarize the concepts of computer-aided process planning methods, computer-integrated production planning systems, and emerging trends in modern manufacturing such as reconfigurable, sustainable, and lean manufacturing.

Unit 1 Introduction To Computer Graphics 08

Introduction to CAD and CAM- Elements of CAD-Computers in Industrial Engineering-Product Cycle-CAD/CAM.

Computer Graphics: Co-ordinate systems, Graphics package functions, 2D and 3D transformations, clipping, hidden line / surface removal color, shading.

Unit 2 Curve Representation 12

Geometric Modeling: Representation techniques, Parametric and non-parametric representation, various construction methods, wire frame modeling, synthetic curves and their representations, surface modeling, synthetics surfaces and their representations. Solid modeling, solid representation, fundamentals, introduction to boundary representations, constructive solid geometry representations. Introduction to CAD file formats – IGES and STEP files.

Unit 3 Numerical Control 12

Numerical Control: NC, NC Modes, NC Elements, NC Machine tools and their structure, Machining center (working Principle for 3 Axis) and features. Controls in NC, CNC systems, DNC systems

CNC Part Programming: Fundamentals, NC word, NC Nodes, Computed assisted part programming, APT programming (simple programs)

Unit 4 Group Technology, Flexible Manufacturing System 12

Group Technology & FMS: Part Family, Classification and Coding, advantages & limitations, Group technology machine cells, benefits. FMS: Introduction, components of FMS, material handling systems, Computer control systems, advantages.

Unit 5 Computer Integrated Production Planning 08

Computer Aided Processes Planning: Retrieval type and Generative type, benefits

Computer integrated production planning: Capacity planning, shop floor control, MRP-I, MRP- II, CIMS benefits.

Prescribed Textbook:

1. P. N. Rao, CAD/CAM: Principles and applications, 3/e, Tata McGraw-Hill, Delhi, 2017.

Reference Books:

1. Ibrahim Zeid, R.Siva Subramanian, CAD/CAM: Theory and Practice, 2/e, Tata McGraw-Hill, Delhi, 2009.
2. P. Radhakrishnan, S. Subramanyan& V. Raju, CAD/CAM/CIM, 3/e, New Age International Publishers, 2008.
3. Computer Aided Manufacturing, 3/e, Tien Chien Chang, Pearson, 2008.
4. Ibrahim Zeid, R.Siva Subramanian, CAD/CAM: Theory and Practice, 2/e, Tata McGraw-Hill, Delhi, 2009.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC63T.1	2	2	1	1	-	-	-	3	-	-	-	2	2
24AMEC63T.2	2	2	1	1	-	-	-	3	-	-	-	3	3
24AMEC63T.3	3	3	3	3	-	-	-	3	-	-	-	3	3
24AMEC63T.4	2	2	1	1	-	-	-	3	-	-	-	2	2
24AMEC63T.5	2	2	1	1	-	-	-	3	-	-	-	2	2

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Smart Manufacturing
Category: PE
Year: III
Semester: II
Course Code: 24AMEC6AT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To introduce the concepts, evolution, and significance of Smart Manufacturing and Industry 4.0 in modern production systems.
2. To provide exposure to data-driven manufacturing, including the use of analytics and artificial intelligence for intelligent decision-making.
3. To familiarize students with smart sensors, RFID, and blockchain technologies used in connected manufacturing environments
4. To present the principles of Digital Twin and simulation tools for virtual manufacturing and system optimization.
5. To create awareness of sustainable and green manufacturing practices and their role in future industrial systems.

Course Outcomes:

At the end of the course, the student will be able to,

1. Explain the structure and working of Smart Manufacturing systems, including Industry 4.0 and IIoT components.
2. Analyze manufacturing problems using data analytics and AI concepts to support maintenance and quality decisions.
3. Apply smart sensing, RFID, and blockchain concepts to real-world manufacturing and supply-chain scenarios.
4. Demonstrate the use of Digital Twin and simulation concepts for design validation and performance evaluation.
5. Assess the impact of sustainable and green manufacturing practices on energy efficiency and environmental performance.

Unit 1 **13**

Introduction to Smart Manufacturing: Definition, evolution and importance of Smart Manufacturing, Industry 4.0 and its impact on manufacturing, traditional vs. smart manufacturing, key technologies in Smart Manufacturing.

Cyber-Physical Systems and Industrial IoT (IIoT): Basics of Cyber-Physical Systems (CPS), IoT in manufacturing, smart sensors and actuators, industrial communication and network protocols – MQTT, OPC-UA, Modbus and Ethernet/IP in smart manufacturing systems.

Unit 2 **12**

Data Analytics and Artificial Intelligence in Manufacturing: Role of Big Data in Manufacturing, Machine Learning & Deep Learning for Smart Manufacturing, Predictive Maintenance and Anomaly Detection, Digital Twin Technology

Automation & Robotics in Smart Manufacturing: Industrial Automation: PLCs, SCADA, and DCS, Autonomous Robots and Cobots (Collaborative Robots), Additive Manufacturing (3D Printing), Case Studies of Smart Factories.

Unit 3 **13**

Cloud Computing and Edge Computing in Manufacturing: Introduction to Cloud Computing for Manufacturing, Edge and Fog Computing in Real-time Manufacturing Systems, Cloud-based Manufacturing Execution Systems (MES).

Smart Sensors, RFID, and Block chain in Manufacturing: Role of Smart Sensors and RFID in Inventory Management, Blockchain for Secure Supply Chains Smart Contracts and Decentralized Manufacturing Systems.

Unit 4 **12**

Digital Twin & Simulation in Manufacturing: Digital Twin technology and virtual prototyping, simulation software for Smart Manufacturing, NSCAD software exposure, augmented reality (AR) and virtual reality (VR) in Industry 4.0 applications.

Cybersecurity in Smart Manufacturing: Threats and risks in Smart Manufacturing, cybersecurity frameworks for industrial systems, best practices for securing IoT and IIoT devices.

Unit 5 **10**

Sustainable and Green Manufacturing: Energy Efficiency in Smart Manufacturing, Sustainable Supply Chain Management, Role of AI in Green Manufacturing

Case Studies and Future Trends: Case Studies of Leading Smart Manufacturing Companies, Emerging Technologies in Smart Manufacturing, Future of Industry 5.0 and Beyond

NOTE: A case study report on Industry with smart manufacturing techniques

Prescribed Textbook:

1. Industry 4.0, Smart Manufacturing, and Industrial Engineering: Challenges and Opportunities, ISBN-13: *978-1032753270,* CRC Press Taylor & Francis Group

Reference Books:

1. Introduction To Smart Manufacturing And Automation Dr. Rajkumar. E Namya Press (29 March 2024); 213, Vardan Hosue 7/28 Ansari Road Daryganj Delhi 110002.
2. Smart Manufacturing by Michael Deng (Author), Colin Koh Kindle Edition (2023)
3. Smart manufacturing by Kamalakar Mutalik The Righte order (2023)
4. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6AT.1	3	2	–	–	2	2	–	–	1	–	2	2	1
24AMEC6AT.2	3	3	2	2	2	–	–	–	–	–	2	3	2
24AMEC6AT.3	2	2	3	–	3	1	–	1	–	–	1	3	3
24AMEC6AT.4	2	2	3	3	3	–	–	–	1	–	2	3	2
24AMEC6AT.5	2	1	2	–	–	3	2	–	–	2	2	2	1

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Additive Manufacturing
Category: PE
Year: III
Semester: II
Couse Code: 24AMEC6BT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To familiarize techniques for processing of CAD models for rapid prototyping
2. To explain fundamentals of rapid prototyping techniques
3. To demonstrate appropriate tooling for rapid prototyping process
4. To focus Rapid prototyping techniques for reverse engineering
5. To train Various Pre – Processing, Processing and Post Processing errors in RP Processes

Course Outcomes:

At the end of the course, the student will be able to

1. Explain the fundamentals of prototyping, the need for rapid prototyping in product development, and differentiate RP from traditional prototyping and CNC machining techniques.
2. Describe and compare solid-based and liquid-based rapid prototyping systems such as SLA, SGC, FDM, and LOM with respect to their principles, materials, advantages, limitations, and applications.
3. Analyze powder-based and other advanced RP systems including SLS, LENS, EBM, 3DP, BPM, and SDM, and evaluate their suitability for different engineering applications.
4. Explain and apply the concepts of rapid tooling and reverse engineering, including tooling classifications, RE processes, scanning techniques, and geometric model development.
5. Identify and assess errors occurring in RP processes and demonstrate the application of RP technologies in design, tooling, reverse engineering, and medical engineering domains.

Unit 1 Introduction to rapid prototyping 09

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

Unit 2 Solid and Liquid Based RP Systems 09

Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications.
Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications.
Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications. Laminated Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications.

Unit 3 Powder Based RP Systems 10

Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

Other RP Systems: Three-Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and Applications. Ballastic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications. Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

Unit 4 Rapid tooling and Errors in RP processes and RP applications 12

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc.

RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Unit 5 Reverse engineering 06

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

Prescribed Textbook:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, Edition, World Scientific Publishers, 2003.

Reference Books:

1. Liou W. Liou, Frank W., Liou, Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development, CRC Press, 2007.
2. Pham D.T. and Dimov S.S., Rapid Manufacturing; The Technologies and Application of RPT and Rapid tooling, Springer, London 2001.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6BT.1	3	3	3	2	2	-	-	-	-	-	-	-	3
24AMEC6BT.2	3	3	3	2	2	-	-	-	-	-	-	-	3
24AMEC6BT.3	3	3	3	2	2	-	-	-	-	-	-	-	3
24AMEC6BT.4	3	3	3	2	2	-	-	-	-	-	-	-	3
24AMEC6BT.5	3	3	3	2	2	-	-	-	-	-	-	-	3

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Automobile Engineering
Category: PE
Year III
Semester: II
Course Code: 24AMEC6CT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To impart the knowledge on I C Engine, Automobile chassis and Body.
2. To familiarize different fuel systems and types of ignitions systems. .
3. To gain knowledge on Principles of Steering system and Suspension system.
4. To awareness about on wheels, Tyres and braking system.
5. To provide insight on Automobile electrical system and gain knowledge on Safety Systems used in automobiles

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the different parts and develop the automobile systems to analyze engine components
2. Identify the working of various parts in ignition system to apply the different vehicles and design the ignition and fuel injection systems.
3. Demonstrate how the steering and the suspension systems works, types of steering and suspension systems and its applications.
4. Recognize the different types of wheels and braking systems. Choose the suitable tyres and brakes for different applications.
5. Utilize different electrical systems in automobiles. Apply advanced electrical circuits. Create advanced Global Positioning System (GPS), Hybrid vehicle, Fuel Cell and Safety systems in automobiles.

Unit 1 Introduction to vehicle structure and engine components 14

Define automobile- types of automobile engines- Components of a four wheeler automobile – chassis and body – power unit –power transmission – rear wheel drive, front wheel drive, 4 wheel drive- engine construction- Specifications- Types - Oil pumps- Electric Oil Pumps, Variable Displacement Oil Pumps-Dry Sump Pumps -Oil Filters- Cartridge Oil Filters, Spin-On Oil Filters, Magnetic Oil Filters.

Unit 2 Ignition and fuel supply systems 12

Ignition system -Coil and Magneto - Spark plug - Distributor – Electronic ignition system -Simple Fuel system in diesel engine Simple Carburetor - Fuel pumps –Mechanical and Electrical fuel pumps- Mono point and Multi point Fuel injection systems– Unit Injector – Nozzle types –Single Point and Multi-Point Nozzles- Electronic Fuel Injection system (EFI) – Gasoline Direct Injection (GDI)

Unit 3 Steering and suspension system 11

Principle of steering -Steering Geometry- camber, castor, king pin inclination, toe-in and toe-out - wheel alignment - Steering linkages – Steering gearboxes- Rack and Pinion**,** Recirculating Ball**,** Worm and Nut - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.

Unit 4 Wheels, Tyres and Braking System 10

Function of Wheels and Tyres - Construction - Type and specification - Tyre wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders- Antilock braking system.

Unit 5 Electrical systems, advances and Safety Systems in automobile engineering 12

Battery-General electrical circuits- Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program (ESP), Traction Control System (TCS) - Global Positioning System (GPS), Hybrid vehicle, Fuel Cell.

Safety System: Air bag restraint system, voice warming system, seat belt system, anti-theft system.

Prescribed Textbook:

1. A Textbook of Automobile Engineering –R.K.Rajput, Laxmi Publication(P) LTD, 2012, ISBN-81-70089913,9788170089919

Reference Books:

1. Kirpal Singh, Automobile Engineering –Vol.1, standard publisher's distributors, 14th Ed.2019 & 2021. ISBN-13: 9788180142420, ISBN-10: 8180142426
2. Kirpal Singh, Automobile Engineering –Vol.2, standard publisher's distributors, 14th Ed.2020 & 2021. ISBN-13: 9788180142062, ISBN-10: 818014206X.
3. R.B. Gupta, Automobile Engineering, Satya Prakashan (Deepak Handa) Publications. 2020 11th edition. ISBN-13: 978-9351923114 and ISBN-10: 9351923118

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6CT.1	2	2	2	2	-	-	1	-	1	-	1	2	1
24AMEC6CT.2	2	2	2	2	-	-	1	-	1	-	1	2	1
24AMEC6CT.3	2	2	2	2	-	-	1	-	1	-	1	2	1
24AMEC6CT.4	2	2	2	2	-	-	1	-	1	-	1	2	1
24AMEC6CT.5	2	2	2	2	-	-	1	-	1	-	1	2	1

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Design of Transmission Systems
Category: PE
Year: III
Semester: II
Course Code: 24AMEC6DT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To explain the various elements involved in a transmission system.
2. To explain the design procedures of different types of joints.
3. To do Design the system based on the input and the output parameters.
4. To produce working drawings of the system involving pulleys, gears, clutches and brakes.
5. To design concepts of IC engine parts like Pistons, connecting rod and crank shaft.

Course Outcomes:

At the end of the course, the student will be able to

1. Design and select suitable flexible power transmission elements and analyze the load conditions, and performance requirements.
2. Design procedure for keys and cotter joints.
3. Analyze and design different types of gears by evaluating their efficiency, ensuring reliable performance in mechanical power transmission systems.
4. Create speed reducers and multi-speed gearboxes by developing structural and ray diagrams, selecting appropriate gear combinations for various mechanical applications
5. Design the different IC engine parts subjected to different loads.

Unit1 Flexible power transmission systems 13

Design of flexible power transmission systems: Flat belts and pulleys, V-belts and pulleys, chain drives and wire ropes.

Unit 2 Design of Keys, Cotter and Knuckle Joints 12

Keys: Design of sunk, saddle, Kennedy and Woodruff keys.
Joints: Design of socket and spigot joint, sleeve and cotter joint, gib and cotter joint, and knuckle joint.

Unit 3 Helical, bevel and worm gears 13

Parallel helical gears – kinematics, tooth proportions, force analysis, stresses in helical gear teeth, Lewis strength equation and design of helical gears, crossed helical gears. Straight bevel gears – force analysis, stresses and design of bevel gears. Worm gearing – kinematics, forces, friction, efficiencies and design considerations.

Unit 4 Design of gear boxes 12

Design of speed reducers, design of multi-speed gear boxes for machine tools, structural and ray diagrams.

Unit 5 Design of IC engine components 13

Design of friction clutches – single plate and multi plate clutches. Design of brakes – shoe brake, band brake and disc brake. Design considerations for flywheels.

Prescribed Textbook:

1. Mechanical Engineering Design, Joseph Edward Shigley and Charles, R. Mischke, McGraw –Hill International Editions, 2000. ISBN 13: 9780073659398.

Reference Books:

1. Design Data: Data Book of Engineers by PSG College-Kalaikathir Achchagam – Coimbatore, ISBN-13: 9788192735504
2. Gear Handbook: The Design, Manufacture and Application of Gears, ISBN-13. 978-0070179035
3. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill, 2001 , ISBN-13. 978-9339221126
4. Robert L. Norton, Machine Design: An Integrated Approach, 6th Edition, Pearson Education, 2022. ISBN-13: 9780135214800.
5. P. Kannaiah, Machine Design, Scitech Publications, 2010. ISBN-13: 9788183711517.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6DT.1	3	3	3	2	3	-	-	1	1	2	2	3	3
24AMEC6DT.2	3	3	3	3	3	--	-	1	1	1	2	3	3
24AMEC6DT.3	3	3	3	3	3	-	-	1	1	1	2	3	3
24AMEC6DT.4	3	3	3	3	3	-	-	1	1	2	2	3	3
24AMEC6DT.5	3	3	3	3	3	-	-	1	1	2	2	3	3

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Modern Machining Processes
Category: PE
Year: III
Semester: II
Course Code: 24AMEC6ET
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To acquire basic knowledge on the latest technologies being used in manufacturing industries as part of modernization of industries.
2. To learn about the importance of basic principles of Manufacturing Systems and also, they will know about the differences between conventional and un-conventional machining process with the help of various advanced manufacturing techniques like USM, AJM, ECG, ECH, ECD, ECM, EDM, PAM, EBM ,LSB and PAM.

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the concept of need for the MMP and working of USM processes with its process parameters.
2. Understand the working of AJM, WAJM and WJM processes with its process parameters.
3. Understand the working of ECM, ECG, ECH and ECD processes with its process parameters.
4. Understand the working of EDM, EDG and WEDM processes with its process parameters.
5. Understand the working concepts of EBM, LBM, PAM process processes with its process parameters.

Unit 1 Introduction To MMP- USM 11

Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.

Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments.

Unit 2 Mechanical Processes 10

Abrasive jet machining, water jet machining and abrasive water jet machining – basic principles, equipment, process variables, mechanics of material removal, MRR, applications in micro & precision engineering and limitations.

Unit 3 Electro – Chemical Processes 10

Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Simple problems for estimation of metal removal rate. Fundamentals of chemical machining, principle, advantages and applications.

Unit 4 Thermal Metal Removal Processes – I 11

General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM principles, and applications.

Unit 5 Thermal Metal Removal Processes -II **11**

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

Prescribed Textbook:

1. M. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi (2002) ISBN 81-7764-294-4.

Reference Books:

1. Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York (1987) - ISBN 0824773527
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi (1980). ISBN 978-0070965539

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6ET.1	3	2	2	3	1	2	-	-	-	-	-	-	2
24AMEC6ET.2	3	3	3	3	1	2	-	-	-	-	-	-	2
24AMEC6ET.3	3	2	3	3	1	2	-	-	-	-	-	-	2
24AMEC6ET.4	3	3	3	3	1	2	-	-	-	-	-	-	2
24AMEC6ET.5	3	3	3	3	1	2	-	-	-	-	-	-	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Operations Research
Category: PE
Year: III
Semester: II
Couse Code: 24AMEC6FT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To enable the students to the nature and scope of various decision making situations within business contexts, understand and apply operations research techniques to industrial applications
2. To learn the fundamental techniques of Operations Research and to choose a suitable OR technique to solve problem

Course Outcomes:

At the end of the course, the student will be able to

1. Solve the Linear Programming Problems using Graphical, Simplex and Artificial Variable Techniques
2. Solve the Transportation, Assignment
3. Solve the problems of Game Theory
4. Analyze the waiting lines in real life situations
5. Apply the inventory models related to market and Dynamic Programming technique for complex problems

Unit 1 **16**

Development – Definition – applications. Linear Programming Problem Formulation – Graphical solution – Simplex method – Big-M method, Duality Principle

Unit 2 **16**

Transportation Problem: Formulation, initial basic feasible solutions using North-West Corner Method, Least Cost Method and Vogel's Approximation Method, optimal solution, unbalanced transportation problem and degeneracy.

Assignment Problem: Formulation, optimal solution and variants of assignment problem.

Unit 3 **12**

Theory Of Games: Introduction – Minimax - Maximin – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – m X 2, 2 X n & m x n games - Graphical method, Dominance principle

Unit 4 **08**

Waiting Lines: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite queue length models

Unit 5 **12**

Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks. Dynamic Programming: Introduction – Bellman's Principle of optimality – Applications of dynamic programming shortest path problem – linear programming problem

Prescribed Textbook:

1. Er. Prem Kumar Gupta and Dr. DS Hira, Operations Research, S Chand Publisher, ISBN – 13 9788121902816

Reference Books:

1. S.D. Sharma, Operations Research, Kedarnath and Ramnath Publications
2. Taha, Introduction to Operations Research. PHI

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6FT.1	3	2	1	2	-	-	1	-	-	-	-	1	2
24AMEC6FT.2	3	2	1	2	-	-	1	-	-	-	-	1	2
24AMEC6FT.3	3	2	1	2	-	-	1	-	-	-	-	1	2
24AMEC6FT.4	3	3	2	2	-	-	1	-	-	-	-	1	1
24AMEC6FT.5	3	2	1	2	-	-	1	-	-	-	-	1	1

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EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Computational Fluid Dynamics
Category: PE
Year: III
Semester: II
Course Code: 24AMEC6GT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Prerequisites: Fluid Mechanics, Heat Transfer and Engineering Mathematics.

Course Objectives:

1. To introduce the basic concepts and applications of Computational Fluid Dynamics (CFD).
2. To understand the governing equations of fluid flow and their classifications.
3. To develop knowledge of basic discretization and grid generation techniques used in CFD.
4. To familiarize students with basic CFD solution algorithms and boundary conditions.
5. To provide exposure to CFD software tools and engineering applications of CFD.

Course Outcomes:

At the end of the course, the student will be able to

1. Explain the basic concepts and applications of Computational Fluid Dynamics.
2. Understand the governing equations and basic discretization methods used in CFD.
3. Identify suitable grid generation techniques for computational modeling.
4. Apply basic CFD solution algorithms and boundary condition concepts.
5. Use CFD software tools for analyzing simple engineering fluid flow problems.

Unit 1 Introduction **12**

Introduction to Computational Fluid Dynamics, applications of CFD in engineering, fluid flow governing equations, finite control volume, basic concepts of compressible and incompressible flows. Introduction to finite difference and finite volume methods, explicit and implicit methods, basic concepts of stability and convergence.

Unit 2 Governing Equations and Discretization **10**

Conservation equations of mass, momentum and energy, conservation and non-conservation forms, classification of partial differential equations – elliptic, parabolic and hyperbolic equations. Basic discretization concepts.

Unit 3 Numerical Methods and Grid Generation **12**

Basic finite difference approximations, explicit and implicit schemes, one-dimensional and two-dimensional discretization concepts. Need for grid generation, structured and unstructured grids, grid quality and basic grid generation techniques.

Unit 4 CFD Solution Techniques **12**

Pressure-velocity coupling methods, SIMPLE and PISO algorithms, boundary conditions in CFD, convergence criteria and error analysis. Introduction to CFD software tools and preprocessing/postprocessing techniques.

Unit 5 CFD Applications **10**

Applications of CFD in fluid flow and heat transfer problems, flow through pipes and ducts, external flow over bodies, heat exchangers and aerospace applications. Introduction to parallel computing and industrial case studies.

Prescribed Textbook:

1. John .D. Anderson "Computational Fluid Dynamics", McGraw Hill

Reference Books:

1. J Blazek, "Computational Fluid Dynamics: Principles and Applications" Elsevier.
2. Chow CY," Introduction to Computational Fluid Dynamics", John Wiley, 1979
3. Hoffmann, K.A: Computational Fluid Dynamics for Engineers, Engineering Education System, Austin, Tex., 1989

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6GT.1	3	2	1	-	-	-	-	-	-	-	2	2	1
24AMEC6GT.2	3	3	2	1	1	-	-	-	-	-	2	2	2
24AMEC6GT.3	3	2	2	1	2	-	-	-	-	-	2	2	3
24AMEC6GT.4	3	3	2	1	3	-	-	1	-	-	2	2	3
24AMEC6GT.5	3	3	2	2	3	1	-	1	1	-	3	3	3

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Finite Element Methods
Category: PE
Year: III
Semester: II
Course Code: 24AMEC6HT
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To learn basic principles of finite element analysis procedure.
2. To gain knowledge of the concepts of Nodes and elements
3. To know the theory and characteristics of finite elements that represent engineering structures.
4. To apply finite element solutions to structural, thermal, and dynamic problems.
5. To develop the knowledge and skills to evaluate finite element analyses and apply design analysis Effectively.

Course Outcomes:

At the end of the course, the student will be able to

1. Identify mathematical models to solve common engineering problems by applying the finite element method and able to solve one dimensional problem like bars.
2. Derive element matrices to analyze the stresses in beams and truss
3. Analyze the plain stress, plain strain and axis-symmetric problems by formulating FE characteristic equations for two dimensional elements.
4. Analyze the Curved boundary elements using iso-parametric elements & heat transfer problems by formulating the FE characteristic equations
5. Identify how the finite element method expands beyond the structural domain, for problems involving dynamics and Torsion problems

Unit 1 Introduction to finite element methods 15

Introduction to FEM: Introduction to finite element methods for solving field problems, applications, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Potential energy and equilibrium, Formulation of Finite Element Equations.

One dimensional Problems: Finite element modelling of ID bar elements coordinates and shape functions. Pascal's Triangle, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

Unit 2 1D Analysis of Trusses and Beam 12

Analysis of trusses: Stiffness Matrix for 1D truss element, Stress Calculations and Problems with maximum of three elements.

Analysis of beams: Element Stiffness Matrix and Load vector for 1 D beam element, Hermite shape functions and simple problems.

Unit 3 2D Analysis 10

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, Stresses.

Finite element modeling of axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

Unit 4 Quadrilateral Elements & Thermal Analysis 12

Quadrilateral Elements: Isoparametric, Sub parametric and Super parametric elements, Modelling of 4 noded and 8 noded quadrilateral elements and simple problems. Numerical Integration.

Steady state heat transfer analysis: One dimensional analysis of composite slab and fin.

Unit 5 Dynamic analysis 10

Dynamic analysis: Analysis of a 1D uniform shaft subjected to torsion – Simple problems

Dynamic analysis: Formulation of finite element model, element – mass matrices, evaluation of Eigen values and Eigen vectors for a bar and shaft.

Prescribed Textbook:

1. Introduction to Finite Element in Engineering, T. Chandraputla, Ashok Belegundu, Pearson Publications, 4/e, 2011.

Reference Books:

1. An introduction to the Finite Element Method, J N Reddy, McGraw – Hill, New York, 1993.
2. The Finite Element Methods in Engineering, Elsevier Butterworth -Heinemann, S.S.Rao, 2/e, 2011

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC6HT.1	3	3	3	3	-	-	1	-	-	-	2	2	3
24AMEC6HT.2	3	3	3	3	-	-	1	-	-	-	1	3	2
24AMEC6HT.3	3	3	3	3	-	-	1	-	-	-	-	2	2
24AMEC6HT.4	3	3	3	3	-	-	1	-	-	-	-	1	1
24AMEC6HT.5	3	3	3	3	-	-	1	-	-	-	-	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Heat Transfer Lab
Category: PC
Year III
Semester II
Course Code: 24AMEC61L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:

1. To gain insight various equipment undergoing different modes of heat transfer.
2. To impart the knowledge of heat exchangers.
3. To familiarize about transient heat conduction and heat pipe apparatus.
4. To provide practical knowledge on boiling and condensation equipment.

Course Outcomes:

At the end of the course, the student will be able to

1. Calculate the thermal conductivity of metal bar, insulating powder, lagged pipe and composite wall.
2. Calculate the fin efficiency, effectiveness and performance of heat exchangers.
3. Calculate convective heat transfer coefficient in free, forced convection and drop and film wise condensation.
4. Calculate the Stefan Boltzmann constant and emissivity of gray body.
5. Calculate the Critical heat flux for pool boiling.

List of experiments **12 Weeks**

1. Thermal Conductivity of metal (conductor)
2. Thermal conductivity of insulating powder through Concentric Sphere
3. Overall heat transfer co-efficient through Composite Slab
4. Heat transfer coefficient in natural convection
5. Heat transfer coefficient in forced convection
6. Heat transfer from pin-fin
7. Emissivity of a gray body through Emissivity apparatus
8. Stefan Boltzman constant determination.
9. Parallel and counter flow heat exchanger
10. Critical heat flux determination in pool boiling process.
11. Thermal conductivity of insulating material through lagged pipe apparatus
12. Heat transfer in drop and film wise condensation
13. Demonstration on Formulation of Non-Dimensional Parameters

Note: Any 10 out of 13 experiments can be conducted.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC61L.1	3	3	1	2	-	-	-	-	1	-	1	2	2
24AMEC61L.2	3	3	1	2	-	-	-	-	1	-	1	2	2
24AMEC61L.3	3	3	1	2	-	-	-	-	1	-	1	2	2
24AMEC61L.4	3	3	1	2	-	-	-	-	1	-	1	2	2
24AMEC61L.5	3	3	1	2	-	-	-	-	1	-	1	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Metrology & Measurements Lab
Category: PC
Year: III
Semester: II
Course Code: 24AMEC62L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course objectives:

1. To understand the measurement of various parameters of given work pieces by different instruments.
2. To understand the working of pressure gauge, LVDT, Strain gauge, transducers, thermocouples and RTD.

Course Outcomes:

At the end of the course, the student will be able to

1. Apply the procedures to measure length, width, depth and bore diameters by various linear instruments.
2. Measure external tapers and surface roughness by different instruments
3. Measure the thread parameters using Floating Carriage Thread micrometer and Tool makers Microscope
4. Examine and test on different types of instruments and transducers.
5. Learn and remember the working principle of different types of transducers

Metrology **6 Weeks**

1. Measurement of lengths, heights, diameters by Vernier calipers, micrometers etc.
2. Use of Gear Tooth Vernier calipers for checking the chordal addendum and chordal height of spur gear.
3. Thread measurement by Tool makers microscope.
4. Angle and taper measurements by Bevel protractor, Sine bars, etc.
5. Use of spirit level in finding the flatness of surface plate.
6. Thread measurement by two wire/ three wire method.
7. Surface roughness measurement by Talysurf instrument.

NOTE: All the experiments need to perform.

Measurements **7 Weeks**

1. Calibration of Pressure Gauges.
2. Calibration of Transducer for Temperature measurement.
3. Study and Calibration of LVDT Transducer for Displacement Measurement.
4. Calibration of Strain Gauge for the measurement of Strain.
5. Calibration of Thermocouple for Temperature Measurement.
6. Calibration of Capacitive Transducer for Angular Measurement.
7. Calibration of Resistance Temperature Detector for Temperature Measurement.
8. Study and Calibration of a Rotameter for flow measurement.
9. Study and Calibration of Photo and Magnetic Speed Pickups for the measurement of speed

NOTE: All the experiments need to perform.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC62L.1	2	3	1	2	2	-	1	-	2	1	1	2	2
24AMEC62L.2	2	3	1	2	2	-	1	-	2	1	1	2	2
24AMEC62L.3	2	3	1	2	2	-	1	-	2	1	1	2	2
24AMEC62L.4	3	3	-	3	3	-	-	-	-	-	-	2	2
24AMEC62L.5	3	3	-	3	3	-	-	-	-	-	-	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Computer Aided Engineering Lab
Category: PC
Year: III
Semester: II
Course Code: 24AMEC64L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course objectives:

1. To introduce the basics in modeling software
2. To enable the student to develop and to write the part programs for CNC Machines

Course Outcomes:

At the end of the course, the student will be able to

1. Develop a part model to visualize the components
2. Create NC code and automated tool paths for a given engineering component and machine the components

Part 1: CAD (Computer Aided Design): 03 Weeks

1. Introduction to CAD Software
2. Development of 3D machine components
3. Assembly of machine components

Part 2: Structural analysis: 05 Weeks

4. Analysis of a rectangular plate with a hole.
5. Analysis of a truss member under loading.
6. Analysis of a bracket plate with axial loading
7. Analysis of a bracket plate with eccentric loading
8. Static Analysis of Prismatic bar

Part 3: Thermal analysis: (Any two exercises) 02 Weeks

9. Analysis of a square plate considering conduction.
10. Analysis of a square plate considering conduction and convection.
11. Axisymmetric thermal analysis using ANSYS.
12. Thermal stress and thermal strain analysis using ANSYS

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC64L.1	3	3	3	3	3	-	2	2	2	-	2	2	2
24AMEC64L.2	3	3	3	3	3	-	2	2	2	-	2	2	2
24AMEC64L.3	3	3	3	3	3	-	2	2	2	-	2	2	2
24AMEC64L.4	3	3	3	3	3	-	2	2	2	-	2	2	2
24AMEC64L.5	3	3	3	3	3	-	2	2	2	-	2	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Soft Skills
Category: SEC
Year: III
Semester: II
Course Code: 24AENG61L
Branch/es: CE, ME, ECE, CSE, AIDS, AIML, CSE(AI), CSE(DS), CSE(AIML), CSE(ICB)

Lecture Hours	Tutorial Hours	Practical	Credits
1	0	2	2

Course Objectives:

1. To encourage all round development of the students by focusing on soft skills
2. To make the students aware of critical thinking and problem-solving skills
3. To enable appropriate communication in socio-cultural and professional contexts
4. To Enhance students' skills of making presentations confidently.
5. To suggest some measures to function effectively with heterogeneous teams

Course Outcomes:

At the end of the course the student will be able to

1. Express himself/herself fluently in societal and professional contexts.
2. Describe methods for building professional image
3. Evaluate the situation and take necessary decisions.
4. Make presentations assertively and confidently
5. Create a productive workplace atmosphere using social and work-life skills.

Unit 1 Soft Skills & Resume Preparation 6

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills, Structure, formats and styles of Resumes_ projecting one's strengths and skills - creative self-marketing—sample resumes - cover letter

Unit 2 Critical Thinking & Interview Skills 6

Active Listening – Observation - Analytical Thinking – Open-mindedness – Creative Thinking - Positive Thinking – Reflection Concept and process of Interviews - Body language - Answering strategies — FAQs

Unit 3 Problem Solving & Decision Making 9

Effective decision making in teams – Methods & Styles: -GD Skills: communicating views and opinions — discussing — intervening — agreeing and disagreeing —asking for and giving clarifications - substantiating one's views/points- arriving at a consensus on any given topic across a cross-section of individuals - modulation of voice and clarity - body language

Unit 4 Oral Presentations (Individual and Team) 9

Collection of data from various sources —planning, preparation and practice — attention grabbing strategies -transition — handling questions from audience. Appropriate use of visual aids — Using PowerPoint for presentations

Unit 5 Corporate Etiquette 6

Etiquette- Introduction, Concept, Significance - Corporate Etiquette - meaning, modern etiquette, benefits - Global and Local Culture Sensitivity - Gender Sensitivity - Etiquette in Interaction- Cell phone Etiquette - Dining Etiquette - Netiquette - Job Interview Etiquette - Corporate Grooming tips - Overcoming challenges

MINIMUM REQUIREMENTS: Advanced English Language Communication Skills Lab

Prescribed Text Books:

1. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, I K International Publishing House, 2018)
2. Advanced English Communication Skills Laboratory by Dr.Sudha Rani, Pearson Pub.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AENG61L.1	-	-	-		-	-	1	-	3	-	3	-	-
24AENG61L.2	-	-	-	-	-	-	1	-	3	-	3	-	-
24AENG61L.3	-	-	-	-	-	-	1	-	3	-	3	-	-
24AENG61L.4	-	-	-	-	-	-	1	-	3	-	3	-	-
24AENG61L.5	-	-	-	-	-	-	1	-	3	-	3	-	-

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

Title of the Course: Technical Paper Writing & Intellectual Property Rights
Category: MC
Year: III
Semester: II
Course Code: 24AMBA61T
Branch/es: Common to All Branches

Lecture Hours	Tutorial Hours	Practical	Credits
2	0	0	-

Course objectives:

1. To enable the students to practice the basic skills of research paper writing.
2. To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
3. To practice the basic skills of performing quality literature review
4. To help them in knowing the significance of real life practice and procedure of Patents.
5. To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks

Course Outcomes:

1. Identify key secondary literature related to their proposed technical paper writing
2. Explain various principles and styles in technical writing.
3. Use the acquired knowledge in writing a research/technical paper
4. Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, International Trademark etc.
5. Evaluate different forms of IPR available at national & international level and search of various forms of IPR by using modern tools and techniques.

Unit 1 Principles of Technical Writing 6

Principles of Technical Writing: styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language -highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

Unit 2 Research Paper Writing 6

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature- Problems and Framing Research Questions- Synopsis.

Unit 3 Process of research 6

Process of research: publication mechanism: types of journals- indexing-seminars- conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results-citation rules.

Unit 4 Introduction to Intellectual property: 6

Introduction, types of intellectual property, International organizations, agencies and treaties, importance of intellectual property rights Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit 5 Fundamentals of copy right law 6

Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international

copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

Prescribed Text Books:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013

Prescribed Text Books:

1. R. Myneni, Law of Intellectual Property, 9th Ed, Asia law House, 2019.
2. Prabuddha Ganguli, Intellectual Property Rights Tata Mcgraw Hill, 2001
   2. 3. P.Naryan, Intellectual Property Law, 3rd Ed, Eastern Law House, 2007

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMBA61T.1	3	2	2	2	1	2	-	-	-	1	-	-	-
24AMBA61T.2	2	3	3	2	2	1	-	-	-	-	-	-	-
24AMBA61T.3	3	2	3	2	2	1	1	-	-	-	-	-	-
24AMBA61T.4	2	3	2	2	2	1	1	-	-	-	-	-	-
24AMBA61T.5	2	2	2	1	3	1	1	-	-	1	1	-	-