NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY UTTAR PRADESH, LUCKNOW

Evaluation Scheme & Syllabus

For

Master of Technology
Mechanical Engineering
First Year

(Effective from the Session: 2022-23)

NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
(AN AUTONOMOUS INSTITUTE)

Master of Technology
Mechanical Engineering
EVALUATION SCHEME
SEMESTER -I

S. N	Course Code	Subject	Periods			Evaluation Schemes				End Semester		Total	Credit
		Theory	**L**	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	AMTME0101	Simulation Modelling and Analysis	3	0	0	20	10	30	-	70	-	100	3
2	AMTME0102	Design of Experiments	3	0	0	20	10	30	-	70	-	100	3
3	AMTCC0101	Research Process and Methodology	3	0	0	20	10	30	-	70	-	100	3
4		Departmental Elective – I	3	0	0	20	10	30	-	70	-	100	3
5		Departmental Elective – II	3	0	0	20	10	30	-	70	-	100	3
6	AMTME0151	simulation Modelling and Analysis lab	0	0	4	-	-		20	-	30	50	2
7	AMTME0152	Industry 4.0 Lab	0	0	4	-	-		20	-	30	50	2
		Total	15	0	8	-	-		-	-	-	600	19

Departmental Elective-I	AMTME0111	Geometric Design & Rapid Prototyping
	AMTME0112	Advanced Heat & Mass Transfer
	AMTME0113	Renewable Energy System
	AMTME0114	Reliability, Maintenance Management & safety
Departmental Elective-II	AMTME0115	Turbo Machines
	AMTME0116	Advanced Mechanical Vibrations
	AMTME0117	Operations Research
	AMTME0118	Advanced I.C. Engines

Abbreviation Used:-
L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., PE: Practical End Semester Exam.

NOIDA INSTITUTE OF ENGG. & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR
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Master of Technology
Mechanical Engineering
EVALUATION SCHEME
SEMESTER -II

S. N	Course Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
		Theory	L	T	P	CT	TA	Total	PS	TE	PE		
1	AMTME0201	Digital Manufacturing and Automation	3	0	0	20	10	30	-	70	-	100	3
2	AMTME0202	Composite Materials	3	0	0	20	10	30	-	70	-	100	3
3		Departmental Elective-III	3	0	0	20	10	30	-	70	-	100	3
4		Departmental Elective-IV	3	0	0	20	10	30	-	70	-	100	3
5		Departmental Elective-V	3	0	0	20	10	30	-	70	-	100	3
6	AMTME0251	Automation and Mechatronics Lab	0	0	4	-	-	-	20	-	30	50	2
7	AMTME0252	Composite Materials Lab	0	0	4	-	-	-	20	-	30	50	2
8	AMTME0253	Seminar-I	0	0	2	-	-	-	50	-	-	50	1
		Total	15	0	10	-	-	-	-	-	-	650	20

Departmental Elective-III	AMTME0211	Advanced Finite Element Analysis
	AMTME0212	Modern Manufacturing Technology
	AMTME0213	Advanced Welding Technology
	AMTME0214	Computational Fluid Dynamics
Departmental Elective-IV	AMTME0215	Advanced Mechanics of Solids
	AMTME0216	Optimization Techniques
	AMTME0217	Artificial Intelligence and Machine Learning(AIML)
	AMTME0218	Management Information System
Departmental Elective-V	AMTME0219	Flexible Manufacturing System
	AMTME0220	Machine Vision
	AMTME0221	Rapid Manufacturing and Tooling
	AMTME0222	Hybrid Vehicle Technology

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M. TECH FIRST YEAR

Course Code	**AMTME0101**	**L T P**	**Credit**
Course Title	**Simulation, Modelling & Analysis**	**3 0 0**	3

Pre-requisites: Basic of Mechanical Engineering, Electrical Engineering, Differentiation, Integration

Course objective:

1	Students will learn about the need of simulation and different statistical model.
2	Students will learn about Queue model.
3	Students will learn about random number generation.
4	Students will learn about different features of MATLAB
5	Students will learn about Bond graph

Course Contents / Syllabus

UNIT-I	**Introduction**	**09 hours**

Introduction: Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation. General Principles: Concepts in discrete event simulation. Models in Simulation: Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Binomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution, Exponential Growth & Decay model, Logistic model.

UNIT-II	**Queuing Models and Random Numbers**	**8hours**

Queueing Models: Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues.

Random Number Generation: Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers

Random Variate Generation: Inverse transform technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique

UNIT-III	**Input Modelling and Validation**	**09 hours**

Input Modelling And Validation: Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.

UNIT-IV	**Introduction to Simulation software**	**08 hours**

Introduction to different simulation software, Selection of simulation software, Simulation packages, MATLAB, Basic operation in MATLAB.

UNIT-V	**Application of MATLAB**	**08 hours**

Solving problem related Mechanical Vibration, Thermal, Kinematic of Mechanism, Optimization etc.

Textbooks:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2. Simulation Model Design& execution by Fishwich, Prentice Hall.
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol.
2. MATLAB for Mechanical Engineers by **Rao V Dukkipati**, Fairfield University

Course outcome:

Course	**Modelling Simulation and Analysis**	
1	Students will be able to analyse different statistical model.	**K3**
2	Students will be able toanalyse a queue model and find server utilization	K3
3	Students will be able to generate the random number and random variate based on distribution.	K2
4	Students will be able to verify and validate a model.	K4
5	Students will be able to simulate mechanical system using simulation software.	K4

M. TECH FIRST YEAR

Course Code	**AMTME0102**	**L T P**	**Credit**
Course Title	**Design of Experiments**	**3 0 0**	3

Pre-requisites: Basics of statics

Course objective:

1	The course objective is to learn how to plan, design and conduct experiments efficiently and effectively
2	The objective is to analyze the resulting data to obtain objective conclusions.
3	The objective of the Taguchi's method is to produce high quality product at low cost to the manufacturer
4	The objective of Signal-to-noise ratio is a measure used in science and engineering that compares the level of a desired signal to the level of background noise.

Course Contents / Syllabus

UNIT-I	**Introduction**	**09 hours**

Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments. Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level.

UNIT-II	**Experimental design**	**8hours**

Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs

UNIT-III	**Analysis and Interpretation Methods**	**09 hours**

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data

UNIT-IV	**Experiment Design Using Taguchi's Orthogonal Arrays**	**08 hours**

Types of Orthogonal Arrays, selection of standard orthogonal arrays, linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs

UNIT-V	**Signal to Noise Ratio**	**08 hours**

Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the –better-type, Larger-the-better type. Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy

Textbooks:

D.C. Montgomery, Design and Analysis of Experiments, Wiley India, 5th Edition, 2006, ISBN – 812651048-X.

Madhav S. Phadke, Quality Engineering Using Robust Design, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632,1989, ISBN: 0137451679

Reference Books Robert H. Lochner, Joseph E. Matar, Designing for Quality - an Introduction Best of Taghuchi and Western Methods or Statistical Experimental Design, Chapman and Hall, 1990, ISBN – 0412400200

Philip J. Ross, Taguchi Techniques for Quality Engineering: Loss Function, Orthogonal Experiments, Parameter and Tolerance Design, McGraw-Hill, 2nd Edition, 1996, ISBN: 0070539588

Course outcome: After the successful completion of the course, the students will be able to:

CO1	Define the basic terms as used and the process of developing strategic plans for experimentation in scientific and engineering research projects	K2
CO2	Evaluate the performance of the research investigations based on factorial designs.	K3,K4
CO3	Analyse alternative designs for experimentation and carry out output analysis for quality improvement projects	K3,K4
CO4	Evaluate the performance of the research investigations based on Taguchi's Orthogonal Array	K4

M. TECH FIRST YEAR			
Course Code	AMTCC0101	L T P	Credit
Course Title	Research Process & Methodology	3 0 0	3

Course objective:

1	To understand the concept / fundamentals of research and their types
2	To understand the methods of research design and steps of research process
3	To understand the methods of data collection and procedure of sampling techniques
4	To analyse the data, apply the statistical techniques and understand the concept of hypothesis testing
5	To understand the types of research report and technical writing.

Pre-requisites: Basics of Statistics

Course Contents / Syllabus

UNIT-I	Introduction to Research	8 hours

Definition, objective and motivation of research, Types and approaches of research, Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Research methods versus Methodology, significance of research, criteria of good research.

UNIT-II	Research Formulation and Design	8 hours

Research process and steps involved, Definition and necessity of research problem. Importance and objective of Literature review, locating relevant literature, Reliability of a source, writing a survey and identifying the research problem, Literature Survey, Research Design, Methods of research design.

UNIT-III	Data Collection	8 hours

Classification of Data, accepts of method validation, Methods of Data Collection, Collection of primary and secondary data, sampling, need of sampling, sampling theory and Techniques, steps in sampling design, different types of sample designs, ethical considerations in research.

UNIT-IV	Data Analysis	8 hours

Processing Operations, Data analysis, Types of analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis Testing, Data processing software (e.g. SPSS etc.), statistical inference, Chi-Square Test, Analysis of variance (ANOVA) and covariance, Data Visualization – Monitoring Research Experiments,hands-on with LaTeX.

UNIT-V	Technical writing and Reporting of Research	8 hours

Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing, citation of Journals and Impact factor, Types of Indexing-SCI/SCIE/ESCI/SCOPUS/DBLP/Google Scholar/UGC-CARE etc. Significance of conferences and their ranking, plagiarism, IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, reproducibility and accountability.

Course outcome: Upon completion of the course, the student will be able to:

CO 1	Know the concept / fundamentals for different types of research	K_2
CO 2	Apply relevant research Design technique	K_3
CO 3	Use appropriate Data Collection technique	K_3
CO 4	Evaluate statistical analysis which includes various parametric test and non-parametric test and ANOVA technique	K_5

CO 5	Prepare research report and Publish ethically.	K_6

Text books

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE 2005.
3. Deepak Chawla, NeenaSondhi, Research Methodology, Vikas Publication

Reference Books

1. Donald Cooper & Pamela Schindler, Business Research Methods, TMGH, 9th edition
2. Creswell, John W, Research design: Qualitative, quantitative, and mixed methods approach sage publications, 2013

M. TECH FIRST YEAR

Course Code	**AMTME0151**	**L T P**	**Credits**
Course Title	**Simulation, Modelling & Analysis Lab**	**0 0 4**	**2**

Course objectives:

1	To impart the fundamental knowledge on using various analytical tools like ANSYS, FLUENT, etc., for Engineering Simulation.
2	To know various fields of engineering where these tools can be effectively used to improve the output of a product.
3	To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Pre-requisites:

Students should have basic knowledge of Engineering.

S. No	**LIST OF EXPERIMENTS** (Total Eight to be performed)
1	Study of simulation software Like ARENA, MATLAB.
2	Simulation of translational and rotational mechanical systems
3	Simulation of Queuing systems
4	Simulation of Manufacturing System
5	Generation of Random number
6	Modelling and Analysis of Dynamic Systems
7	Simulation mass spring damper system
8	Simulation of hydraulic and pneumatic systems.
9	Simulation of Job shop with material handling and Flexible manufacturing systems
10	Simulation of Service Operations

Course outcomes: After completion of this course students will be able to

CO 1	The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.	K2
CO 2	Use of these tools for any engineering and real time applications.	K2
CO 3	Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems with confidence when it matters to use these tools in their employment.	K3

M. TECH FIRST YEAR			
Course Code	**AMTME0152**	**L T P**	**Credit**
Course Title	**Industry 4.0 LAB**	**0 0 4**	**2**

Course objectives:

1	Students will be able to understand and implement the concepts of Industry 4.0
2	To make students understand and implement the concepts of Industrial IOT.
3	To familiarize students with concepts of Robotics, AI/ML and AR/VR Technology.
4	To make students understand and implement the concepts Additive Manufacturing and Reverse Engineering.

Pre-requisites:

Students should have basic knowledge of Engineering.

S. No	**LIST OF EXPERIMENTS** (Total Eight to be performed)
1	Study of a Smart Factory setup based on Industry 4.0
2	Study of Sensing and Actuating systems used in Industrial IOT
3	Familiarization with concept of IoT, Arduino/Raspberry Pi and perform necessary software installation
4	Develop an IoT based smart lock system for Motor cycle/Car
5	Creating a model using Augmented Reality (AR/VR Technology)
6	Study of Natural Language Processing including Syntactic, Semantic, Discourse and Pragmatic Processing.
7	Machine Learning Project using Python for Linear Regression analysis of fuel consumption
8	Operating a Robot to perform Pick and place operation using a structured program
9	Design and Simulate the task of Pick the pencil from the magazine and draw rectangle & Square
10	Development of a designed model with given parameters on FDM RP System
11	Development of a designed model with given parameters on SLA RP System
12	Generating point cloud data(3D model) of mechanical components using 3D Scanning Technology

Course outcomes: After completion of this course students will be able to

CO 1	Become familiar with the concept of Industry 4.0	K_2
CO 2	Understand and implement fundamentals of Industrial IOT	K_2
CO 3	Practically implement the concepts of Robotics, AI/ML and AR/VR Technology.	K_2
CO 4	Learn and implement the concepts Additive Manufacturing and Reverse Engineering.	K_2

M. TECH FIRST YEAR			
Course Code	**AMTME0111**	**L T P**	**Credit**
Course Title	**Geometric Design & Rapid Prototyping**	**3 0 0**	**3**

Course objective:

1	To impart knowledge on various Geometric Design & Rapid Proto Typing so that the students can apply them in engineering industry applications.
2	To gain understanding of modelling and design based on component geometry
3	To develop the knowledge on the design of various components.
4	To acquire knowledge and to solve problems associated with design and rapid prototyping and to update students on the latest technology to ensure computer aided manufacturing and design are maintained in good operating condition and at low maintenance cost.
5	To impart knowledge on prototyping systems as well as learn how to perform basic procedures on a system.

Pre-requisites:

Course Contents / Syllabus

UNIT-I	**Geometric Design- Introduction:**	**4 hours**

Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process.
Curves and Surfaces: Analytical, Synthetic curves with advantages, Disadvantages, Comparison with parametric curves, Geometric modelling curves and surfaces, Representation, Wire frame models, Parametric representations, Parametric curves and surfaces, Manipulations of curves and surfaces, DDA, Bresenham's /Mid point line, circle, ellipse algorithms.

UNIT-II	**Solid modelling:**	**12hours**

Solid models, Fundamentals of solid modelling, Different solid representation schemes, Half -spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Analytic solid modelling, Perspective, Parallel projection, Hidden line removal algorithms.

UNIT-III	**Rapid Prototyping- Introduction:**	**8hours**

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process.

UNIT-IV	**Rapid Prototyping Process**	**8 hours**

Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Photopolymerization (Stereolithography (SL), Microstereolithography, Powder Bed Fusion (Selective laser Sintering (SLS), Electron Beam melting (EBM)), Extrusion-Based RP Systems (Fused Deposition Modelling (FDM)), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC)), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD)

UNIT-V	**CAD/CAM**	**8 hours**

CAD model preparation, Data interfacing: formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.

Course outcome: **After completion of this course students will be able to**

CO 1	Explain the concepts and underlying theory of modelling and the usage of models in different engineering applications.	K1,K2
CO 2	Create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications.	K3, K4

CO 3	Understand and use techniques for processing of CAD models for rapid prototyping.	
CO 4	Understand and use techniques for processing of CAD Understand and apply fundamentals of rapid prototyping techniques.	K3, K4, K5
CO 5	Use current state-of-the-art CAD/CAM technology in research.	K3,K4

Text Books& Reference Books:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Computer Aided Engineering & Design Jim Browne New ATC International
5. The Engineering Database D.N. Chorafas and S.J. Legg Butterworths
6. Principles of CAD J Rooney &P Steadman Longman Higher Education
7. CAD/CAM H P Groover and E W Zimmers Prentice Hall
8. Computer Integrated Design and Manufacture D Bedworth, M Henderson & P Wolfe MacGraw Hill Inc.

M.TECH FIRST YEAR			
Course Code	**AMTME0112**	**L T P**	**Credit**
Course Title	**Advanced Heat and Mass Transfer**	**3 0 0**	**3**

Course objective:

1	To understand the fundamental concepts of conduction and its applications
2	To understand the applications of fins and study the design of fins
3	To understand and demonstrate the principles of radiation and heat transfer phenomenon through radiation
4	To study and identify the phenomenon in convection heat transfer
5	To understand the basic concepts of mass transfer and its applications

Pre-requisites:

Basic knowledge of Engineering Mechanics
Basic knowledge of Engineering Mathematics
Reviews of basic laws of Conduction, Convection and Radiation

Course Contents / Syllabus

UNIT-I	**Conduction**	**8 hours**
One dimensional steady state conduction with variable thermal conductivity and with internal distributed heat source, Local heat source in non-adiabatic plate, Thermocouple conduction error		
UNIT-II	**Extended Surfaces**	**8 hours**
Extended Surfaces-Review, Optimum fin of rectangular profile, straight fins of triangular and parabolic profiles, Optimum profile, Circumferential fin of rectangular profile, spines, design considerations. 2D steady state conduction, semi-infinite and finite flat plates, Temperature fields infinite cylinders and in infinite semi-cylinders, spherical shells, Graphical method, relaxation technique. Unsteady state conduction, Sudden changes in the surface temperatures of infinite plates, cylinders and spheres using Groeber's and Heisler charts for plates, cylinders and spheres suddenly immersed in fluids.		
UNIT III	**Radiation**	**8 hours**
Review of radiation principles, Diffuse surfaces, and the Lambert's cosine law. Radiation through non-absorbing media, Hottel's method of successive reflections, Gebhart's unified method, Poljak's method. Radiation through absorbing media, Logarithmic decrement of radiation, Apparent absorptive of simple shaped gas bodies, Net heat exchange between surfaces separated by absorbing medium, Radiation of luminous gas flames.		
UNIT-IV	**Convection**	**8 hours**
Convection: Heat transfer in laminar flow, free convection between parallel plates, forced internal flowthrough circular tubes, fully developed flow, Velocity and thermal entry length, solutions with constant wall temperature and with constant heat flux, Forced external flow over a flat plate, two-dimensional velocity and temperature boundary layer equations, Karman Pohlhousen approximate integral method. Heat transfer in turbulent flow, Eddy heat diffusivity, Reynold's analogy between skin friction and heat transfer, Prandtl-Taylor, Von Karman and Martineli's analogies, Turbulent flow through circular tubes.		
UNIT V	**Mass Transfer**	**8 hours**
Mass Transfer: Definition, Examples, Fick's law of diffusion, Fick's law as referred to ideal gases, Steady-state Isothermal Equi-molal counter diffusion of ideal gases, Mass diffusivity, Gilliland's equation, Isothermal evaporation of water and its subsequent diffusion into dry air, Mass transfer coefficient, Numerical problems.		

Course outcome: **After completion of this course students will be able to**

CO 1	Understand both the physics and the mathematical treatment of the advanced topics pertaining to the modes of heat transfer	K2, K3

CO 2	Apply principles of heat transfer to develop mathematical models for uniform and non-uniform fins	K_3, K_4
CO 3	Employ mathematical functions and heat conduction charts in tackling two dimensional and three-dimensional heat conduction problems.	K_4, K_5
CO 4	Analyze free and forced convection problems involving complex geometries with properboundary conditions.	K_3, K_4
CO 5	Apply the concepts of radiation heat transfer for enclosure analysis.	K_4
CO 6	Understand physical and mathematical aspects of mass transfer.	K_1, K_2
Text Books		
(1) Principals of Heat Transfer/Frank Kreith/Cengage Learning		
(2)Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012		
(3)Heat Transfer/RK Rajput/S.Chand		
ReferenceBooks		
(1) Introduction to Heat Transfer/SK Som/PHI		
(2) Engineering Heat & Mass Transfer/Mahesh Rathore/Lakshmi Publications		
(3)Heat Transfer / NecatiOzisik / TMH		
(4)Heat Transfer / Nellis& Klein / Cambridge University Press / 2012		

M. TECH FIRST YEAR

Course Code	**AMTME0113**	**L T P**	**Credit**
Course Title	**Renewable Energy System**	**3 0 0**	**3**

Course objective:

1	To make students understand the concept of renewable and non- renewable energy resources.
2	To make students able to understand the applications of solar energy, its storage and its utilization.
3	To make students understand biogas generation, and hydro-electric generation and its impact on environment.
4	To make students able to identify wind energy as an alternate source of energy and to know about how it can be trapped.
5	To make students aware of the Concept of integration of conventional and non-conventional energy resources and systems.

Pre-requisites:

Basic knowledge of thermal Engineering.

Course Contents / Syllabus

UNIT-I	**Introduction**	**8 hours**

Introduction: Energy and Development; Energy demand and availability; Energy crisis; Conventional and Nonconventional energy; Renewable and Non-renewable energy resources; Environmental impacts of conventional energy usage; Basic concepts of heat and fluid flow useful for energy systems.

UNIT-II	**Solar Energy Systems**	**8 hours**

Solar Energy Systems: Solar radiations data; Solar energy collection, Storage and utilization; Electro Chemical Storage, (Li-ion, Li-Po, Lead Acid, salt water) factors affecting energy storage, solar storage options, Solar water heating; Solar air heating; Solar Power generation; Refrigeration and Air-conditioning.

UNIT III	**Micro and Small Hydro Energy Systems**	**8 hours**

Micro and Small Hydro Energy Systems: Resource assessment of micro and small hydro power; Micro, mini and small hydro power systems; Pump and turbine; Special engines for low heads; Velocity head turbines; Hydrams; Water-mill; Tidal power.

UNIT-IV	**Bio-mass Energy Systems**	**8 hours**

Bio-mass Energy Systems: Availability of bio mass, agro, forest, animal, municipal and other residues; Optimization of bio-mass utilization, Bio mass conversion technologies; Cooking fuels; Biogas; producer gas; Power alcohol from biomass; Power generation.

UNIT V	**Wind Energy Systems&Integrated Energy Systems**	**8 hours**

Wind Energy Systems: Wind data; Horizontal and vertical axis windmills; Wind farms; Economics of wind energy.

Integrated Energy Systems: Concept of integration of conventional and non-conventional energy resources and systems; Integrated energy system design and economics.

Course outcome: **After completion of this course students will be able to**

CO 1	Perceive the concept of renewable and non-renewable energy resources.	K2, K3
CO 2	Recognize various methods of solar energy collection and conversion along-with its storage.	K_3, K_4
CO 3	Apply the knowledge of biogas generation and hydro-electric generation, also their impact on the environment.	K_4, K_5

CO 4	Categorize various windmills and their utilization based on their characterization.	K_3, K_4
CO 5	Integrate conventional and non-conventional energy resources and systems for betterment of society.	K_4

Text Books

1. Energy Efficient Buildings in India Mili Majumdar Tata Energy Research Institute
2. Renewable Energy Systems Simmoes Marcelo Godoy CRC Press
3. Renewable Energy Resources John Twidell Taylor and Francis

ReferenceBooks

1. Renewable Energy Sources and Their Environmental Impact Abbasi & Abbasi PHI
2. Solar Energy – Principles of Thermal Collection and Storage by S P Sukhatme
3. Solar Engineering of Thermal Processes by J ADuffie and W A Beckman
4. Principles of Solar Engineering by D Y Goswami and J F Kreider
5. Introduction to Sustainable Engineering by R L Rag and Leks

M. TECH FIRST YEAR

Course Code	AMTME0114	L T P	Credit
Course Title	Reliability, Maintenance Management & Safety	3 0 0	3

Course objective:

1	To make students able to understand the concept of reliability, its components and techniques used to enhance it.
2	To make students perceive the knowledge of maintainability, availability, and failure, along with its effect on quality.
3	To get students able to integrate the concept of maintenance planning and replacement, along with the concept of inspection.
4	To make students able to use various monitoring techniques, and its impact on reliability.
5	To make students make aware of various safety aspects and hazards associated in plant

Pre-requisites:

Basic knowledge of Industrial engineering

Course Contents / Syllabus

UNIT-I	Reliability Engineering	8 hours

Reliability Engineering: System reliability - series, parallel and mixed configuration, Block diagram, rout-of-n structure, solving problems using mathematical models. Reliability improvement and allocation-Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability, Optimization, Reliability – Cost trade off, Prediction and analysis, Problems.

UNIT-II	Maintainability, Availability & Failure Analysis	8 hours

Maintainability, Availability & Failure Analysis: Maintainability & Availability – Introduction, formulae, Techniques available to improve maintainability & availability, trade off among reliability, maintainability & availability, simple problems, Defect generation – Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis, TA, FMEA, FMECA.

UNIT III	Maintenance Planning and Replacement	8 hours

Maintenance Planning and Replacement: Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions – Optimal interval between preventive replacements of equipment subject to breakdown, group replacement. Maintenance systems, Fixed time maintenance, Condition based maintenance, operate to failure, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency, non-destructive inspection, PERT & CPM in maintenance, Concept of terro technology.

UNIT-IV	Condition Monitoring	8 hours

Condition Monitoring: Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies, Examples of monitoring and diagnosis, Control structure for machine

diagnosis.		
UNIT V	**Safety Aspects**	**8 hours**
Safety Aspects: Importance of safety, Factors affecting safety, Safety aspects of site and plant, Hazards of commercial chemical reaction and operation, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial safety.		
Course outcome: **After completion of this course students will be able to**		
CO 1	Perceive the concept of reliability, its components and techniques used in it.	K2, K3
CO 2	Incorporate maintainability, availability, and failure in quality.	K_3, K_4
CO 3	Integrate maintenance planning, replacement, and inspection to quality.	K_4, K_5
CO 4	Make use of various monitoring techniques used.	K_3, K_4
CO 5	Get knowledge on various safety aspects and hazards associated in various industries.	K_4

Text Books

1.Concepts in Reliability Engineering L.S. Srinath Affiliated East West Press

2.Maintainability and Reliability Handbook Editors: Ireson W.A. and C.F. Coombs McGraw Hill Inc.

3.Failure Diagnosis and Performance Monitoring L.F. Pau Marcel Dekker

ReferenceBooks

1.Industrial Maintenance Management S.K. Srivastava S. Chand & Co Ltd.

2.Management of Industrial Maintenance Kelly and M.J. Harris Butterworth and Co.

3.Maintenance, Replacement and Reliability A.K.S. Jardine Pitman Publishing

4.Engineering Maintainability: How to Design for Reliability and Easy Maintenance B.S. Dhillon Prentice Hall of India

5.Industrial Maintenance Management S.K. Srivastava S. Chand & Co Ltd.

M. TECH FIRSTYEAR			
Course Code	**AMTME0115**	**L T P**	**Credit**
Course Title	**Turbo Machines**	**3 0 0**	**3**

Course objective:

1	To study the basics of turbomachinery
2	To study the energy transfer in nozzles and the design of steam turbine blades
3	To study the fundamentals and design of centrifugal compressors
4	To study the fundamentals and design of axial flow compressors
5	To study and analyse the design of axial flow gas turbine

Pre-requisites:

Basic knowledge of Engineering Mechanics
Basic knowledge of Engineering Mathematics
Reviews of basic laws of thermodynamics
Reviews of basic laws of fluid mechanics

Course Contents / Syllabus

UNIT-I	**Fundamentals of Turbo Machines**	**8 hours**

Classifications, Applications, Thermodynamic analysis, Isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross-sectional areas, Unsteady flow in turbo machines

UNIT II	**Steam Nozzles**	**8 hours**

Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of backpressure of analysis. Designs of nozzles. Steam Turbines: Impulse turbines, Compounding, Work done and Velocity triangle, Efficiencies, Constant reactions, Blading, Design of blade passages, Angle and height, Secondary flow. Leakage losses, Thermodynamic analysis of steam turbines

UNIT-III	**Gas Dynamics**	**8 hours**

Fundamental thermodynamic concepts, isentropic conditions, mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, Detached shocks, Aerofoil theory. Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach-numbers, Pre whirl, Performance.

UNIT IV	**Axial Flow Compressors**	**8 hours**

Flow Analysis, Work and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT V	**Axial Flow Gas Turbines**	**8 hours**

Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction.
Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, Off design performance.

Course outcome: **After completion of this course students will be able to**

CO 1	Explain the working principles of turbomachines and apply it to various types of machines	K2
CO 2	Perform the preliminary design of steam nozzles	K4
CO 3	Determine the velocity triangles in turbo-machinery stages operating at	K3

	off-design conditions.	
CO 4	Analyse the design and calculate the design parameters for axial flow compressors.	K4
CO 5	Analyse the cascade design for axial flow gas turbines for various blades	K3, K4

Reference Books

(1) Principles of Turbo Machines/DG Shepherd / Macmillan

(2)Fundamentals of Turbomachinery/William W Perg/John Wiley & Sons

(3)Element of Gas Dynamics/Yahya/TMH

(4) Principles of Jet Propulsion and Gas Turbine/NJ Zucrow/John Wiley & Sons/Newyork

TextBooks

(1) Turbines, Pumps, Compressors/Yahya/TMH

(2)Practice on Turbo Machines/ G.Gopal Krishnan &D.Prithviraj/ Sci Tech Publishers, Chennai

(3)Theory and practice of Steam Turbines/ WJ Kearton/ELBS Pitman/London

M. TECH FIRSTYEAR			
Course Code	**AMTME0116**	**L T P**	**Credit**
Course Title	**Advanced Mechanical Vibrations**	**3 0 0**	**3**

Course objective:

1	Understand different types of vibration and mathematical analysis of single degree freedom system under free vibration and damped vibration.
2	Understand the analysis of two-degree freedom system under free, damped and forced vibrations and principle and working of different types of vibration absorbers.
3	Ability to carry out exact and numerical analysis of multi degree freedom system subjected to different types of vibration.
4	Understand the numerical methods to determine natural frequencies of the beam and bar under free and forced vibrations.
5	Understand the non-linear vibrating system under undamped and forced vibration.

Pre-requisites:

Basic knowledge of Industrial engineering

Course Contents / Syllabus

UNIT-I	Introduction	8 hours

Introduction: Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations

UNIT-II	Two-degree of Freedom Systems	8 hours

Two-degree of Freedom Systems: Principal modes of vibration, Spring coupled and mass coupled systems, forced vibration of an undamped close coupled and far coupled systems, Undamped vibration absorbers, Forced damped vibrations, Vibration isolation.

UNIT III	Multi-degree Freedom systems	8 hours

Multi-degree Freedom systems: Eigen-value problem, Close coupled and far coupled systems, Orthogonality of mode shapes, Modal analysis for free, damped and forced vibration systems, Approximate methods for fundamental frequency- Rayleigh's, Dunkerely, Stodola and Holzer method, Method of matrix iteration, Finite element method for close coupled and far coupled systems.

UNIT-IV	Continuous systems	8 hours

Continuous systems: Forced vibration of systems governed by wave equation, Free and forced vibrations of beams/ bars

Transient Vibrations: Response to an impulsive, step and pulse input, Shock spectrum

UNIT V	Non-linear Vibrations	8 hours

Non-linear Vibrations: Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations.

Course outcome: **After completion of this course students will be able to**

CO 1	Demonstrate the different types of vibration and analyse the mathematically the single degree freedom system under free vibration and damped vibration	K2, K3
CO 2	Apply the mathematical concept solve for the motion and the natural	K_3, K_4

	frequency for forced vibration of a two degree of freedom damped or undamped system.	
CO 3	Apply the mathematical analysis of multi degree freedom system subjected to different types of vibration to calculate natural frequency.	K_4, K_5
CO 4	Apply the numerical methods and calculate natural frequencies of the beam and bar under free and forced vibrations.	$K_{3,}$ K_4
CO 5	Compute the natural frequencies of non-linear vibrating system under undamped and forced vibration.	K_4

Text Books
Theory and practice of Mechanical Vibrations J.S. Rao and K. Gupta New Age International
Mechanical Vibrations G.K. Groover Nem Chand & Brothers
Mechanical Vibration Practice V. RamamurtiNarosa Publications
ReferenceBooks
Mechanical Vibrations V.P. Singh Dhanpat Rai & sons
Textbook of Mechanical Vibrations R.V. Dukkipati& J. Srinivas Prentice Hall of India

M. TECH FIRST YEAR

Course Code	**AMTME0117**	**L T P**	**Credit**
Course Title	**Operations Research**	**3 0 0**	**3**

COURSE OBJECTIVE

1	Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively.
2	Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry.
3	Skills in the use of Operations Research approaches and computer tools in solving real problems in industry.
4	Mathematical models for analysis of real problems in Operations Research.

Pre-requisites

Course content /syllabus

Unit-1	**Introduction**	**8 Hours**

Introduction: definition and scope of OR; Techniques and tools; Model formulation; general methods for solution; Classification of optimization problems; Optimization techniques.

Unit-2	**Linear Programming**	**8 Hours**

Linear Optimization Models: Complex and revised simplex algorithms; Duality theorems, sensitivity analysis; Assignment, transportation and transhipment models; Traveling salesman problem as an Assignment problem; Integer and parametric programming; Goal programming. Game Problems: Mini-max criterion and optimal strategy; Two-person zero sum game; Games by simplex dominance rules.

Unit-3	**Waiting Line Method**	**8 Hours**

Waiting Line Problems: Classification of queuing situations; Kendall's notation, Poisson arrival with exponential or Erlang service time distribution; Finite and infinite queues; Optimal service rates; Application of queuing theory to industrial problems.

Unit-4	**Dynamic Programming**	**8 Hours**

Dynamic Programming: Characteristic of dynamic programming problems (DPPs); Bellman's principle of optimality; Problems with finite number of stages; Use of simplex algorithm for solving DPPs.

Unit-5	**Non-linear Programming**	**8 Hours**

Non-linear Programming: One dimensional minimization method; Unconstrained optimization techniques; Optimization techniques characteristics of a constrained problem; Indirect methods; Search and gradient methods.

Course Outcomes: -After the successful completion of the course, the students will be able to:

1	understand the application of OR and frame a LP Problem with solution – graphical.	K2
2	build and solve Transportation, Assignment and Game Model problems using appropriate method.	K3
3	build and solve waiting line problems using appropriate method.	K3
4	solve simple problems of replacement and implement practical cases of decision making under different business environments.	K4
5	analyses the problems of unconstrained nonlinear programming. Knows the necessary and sufficient conditions for the solution of unconstrained problems.	K3

Text Books

1	Operations Research, H.A. Taha, Prentice Hall
2	Engg. Optimization, S.S. Rao, New Age Publication

Reference Books

1	Operations Research,Dr. D. S. Hira, Er. Prem Kumar Gupta
2	Schaum's Outline of Operations Research

M. TECH FIRST YEAR

Course Code	AMTME0118	L T P	Credit
Course Title	Advanced I.C. Engines	3 0 0	3

Course objective:

1	To explain and classify conventional, modern engine technologies of I. C. Engines.
2	To discuss and analyze various combustion phenomenon and different components of S.I. Engines and C.I. Engines.
3	To develop competence in performance analysis, optimization, and control of IC engines.
4	To provide an insight about fuels, alternatives fuels, effect of engine out emissions on environment and emission control methods.
5	To develop skill and acquire knowledge of modern engine technologies and develop smart future mobility solutions.

Pre-requisites:

Basic knowledge of Industrial engineering

Course Contents / Syllabus

UNIT-I	Introduction	8 hours

Introduction to different types of conventional and modern I.C. Engine, Valve arrangements, Actual cycles for engines.

UNIT-II	Combustion of engines	8 hours

Combustion in CI & SI engines, Knocking parameters, Combustion chambers construction

UNIT III	Testing and performance	8 hours

Testing and performance, Engine cooling & lubrication, Effects of Supercharging & Turbo charging, Boost control.

UNIT-IV	Fuels	8 hours

Fuels, Properties of fuels, Rating of fuels, Alternative fuels, Engine cooling & lubrication, Pollution due to engines, pollution control devices, Blue TEC.

UNIT V	Modern Technology	8 hours

Stratified-charged Engine, Marine & Aerospace engines, Mixed-cycle engines, HCCI Engines, GDI Technology, E-Turbocharger, Variable compression ratio engines, Hybrid Engines, Hydrogen and Fuel Cell Technology. Hybrid power train concepts and designs (series, parallel).

Course outcome: **After completion of this course students will be able to**

CO 1	Explain and demonstrate conventional and modern engine technologies.	K2, K3
CO 2	Explain and understand the gas exchange processes and motion of charge in the cylinder and its effects on combustion process in SI and CI engines.	K_3, K_4
CO 3	Analyze the performance, optimization, and control of I.C. engines.	K_4, K_5
CO 4	Express the fuels, alternatives fuels,emissions formation and their treatment.	K_3, K_4

CO 5	Explain and demonstrate modern engine technologies and develop smart future mobility solutions.	K_4

Text Books
I.C Engine Analysis & Practice by E.F Obert.
I.C Engine by Ganesan, Tata McGraw Hill Publishers.
A Course in International Combustion Engines, by Mathur& Sharma, DhanpatRai& Sons.
ReferenceBooks
I.C Engine, by R. Yadav, Central Publishing House, Allahabad
Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson

M. TECH FIRST YEAR

Course Code	AMTME0201	L T P	Credit
Course Title	Digital Manufacturing and Automation (DMA)	3 0 0	3

Course objective:

1	Understanding of the Development of CNC Technology and Industry 4.0
2	Learning about the CNC Programming, G & M Codes, CAM packages, Geometrical Design & 3-D printing.
3	To provide a detailed interpretation of Tooling for CNC Machines, Cutting tool materials, & Smart manufacturing.
4	Learning about Robotics and Material Handling Systems, Automated guided vehicle systems.
5	Learning about the Group Technology and FMS, Understanding and Learning about the CIM and DMA, Concurrent engineering.

Pre-requisites: Basics of Manufacturing

Course Contents / Syllabus

UNIT-I	Introduction to CNC Machine Tools:	6 hours

Development of CNC Technology-Principles and classification of CNC machines, Advantages & economic benefits, Types of control, CNC controllers, Characteristics, Interpolators, Applications, DNC concept. Industry 4.0

UNIT-II	CNC Programming:	8 hours

Co-ordinate System, Fundamentals of APT programming, Manual part programming-structure of part programme, G & M Codes, developing simple part programmes, Parametric programming, CAM packages for CNC machines-IDEAS, Unigraphics, Pro Engineer, CATIA, ESPIRIT, Master CAM etc., and use of standard controllers-FANUC, Heidenhain and Sinumeric control system. Geometrical Design. 3-D printing.

UNIT-III	Tooling for CNC Machines:	6 hours

Cutting tool materials, Carbide inserts classification; Qualified, semi qualified and pre-set tooling, cooling fed tooling system, Quick change tooling system, Tooling system for machining centre and turning centre, tool holders, Tool assemblies, Tool magazines, ATC mechanisms, Tool management. Smart manufacturing.

UNIT-IV	Robotics and Material Handling Systems:	8 hours

Introduction to robotic technology, and applications, Robot anatomy, material handling function, Types of material handling equipment, Conveyer systems, Automated guided vehicle systems, Automated storage/retrieval systems, Work-in-process storage, Interfacing handling and storage with manufacturing.

UNIT-V	Group Technology and Flexible Manufacturing System:	12 hours

Group Technology-part families, Parts classification and coding, Production flow analysis, Machine Cell Design, Benefits of Group Technology, Flexible manufacturing systems- Introduction, FMS workstations, Computer control system, Planning for FMS, Applications and benefits.

Computer Integrated Manufacturing: Introduction, Evaluation of CIM and leading to Digital Manufacturing and Automation (DMA), CIM hardware and software, Requirements of computer to be used in CIM system, Database requirements, Concurrent Engineering-Principles, design and development environment, advance modelling techniques.

Course outcome: **Upon completion of the course, the student will be able to:**

CO 1	Understand the Development of CNC Technology- CNC controllers, Characteristics, Interpolators, Applications, DNC concept and Industry 4.0	K_2

CO 2	Learned about the CNC Programming, G & M Codes, CAM packages, Geometrical Design & 3-D printing.	K_3
CO 3	Use detailed interpretation of Tooling for CNC Machines, Cutting tool materials, & Smart manufacturing.	K_3
CO 4	Know about Robotics and Material Handling Systems, Robot anatomy, Conveyer systems, Automated guided vehicle systems, Interfacing handling and storage with manufacturing.	K_5
CO 5	Apply detailed interpretation of the GT and FMS, CIM, requirements of computer to be used in CIM and DMA, Concurrent engineering.	K_6

Text books

1. Computer Numerical Control Machines P. Radhakrishnan New Central Book Agency
2. CNC Machines M.S. Sehrawat and J.S. Narang Dhanpat Rai and Co.
3. CNC Programming Handbook Smid Peter Industrial Press Inc.

Reference Books

1. Automation, Production systems and Computer M.P. Groover Prentice Hall of India Integrated Manufacturing

2. Computer Integrated Manufacturing Paul Ranky Prentice Hall of India

M. TECH FIRST YEAR			
Course Code	**AMTME0202**	**L T P**	**Credit**
Course Title	**Composite Materials**	**3 0 0**	**3**

Course objective:

1	To understand Composite materials and its applications.
2	To understand the various types of composite materials
3	To know the processing techniques of composite materials
4	Determine stresses and strains in composites.
5	Understand the mechanical behaviour of laminated composite

Pre-requisites: The student should have knowledge of material science and strength of materials

Course Contents / Syllabus

UNIT-I	**Introduction to composites**	**8 hours**

Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Types of Reinforcements/fibres: Role and Selection or reinforcement materials, Types of fibres, Glass fibres, Carbon fibres, Aramid fibres, Metal fibres, Alumina fibres, Boron fibres, Silicon carbide fibres, Quartz and Silica fibres, Multiphase fibres, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential.

UNIT-II	**Classification of composites:**	**8 hours**

Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC);
Classification based on reinforcements: Fibre Reinforced Composites, Fibre Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

UNIT-III	**FABRICATION OF COMPOSITES**	**8 hours**

Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression moulding, resin-transplant method, pultrusion, pre-peg layer, Fibre-only performs, Combined Fibre-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films
Nano Composite: Introduction to Nano Composites, Processing of nano composites, industrial application of nano composites.

UNIT-IV	**Properties of Composites**	**8 hours**

Mechanical Properties -Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibres, Short fibre systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

UNIT-V	**Laminates**	**8 hours**

Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Antisymmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angleply Laminate. Orthotropic Laminate, Laminate Moduli, Hygrothermal Stresses

Course outcome: **After completion of this course students will be able to**

CO 1	Understand various matrices and reinforcements used in composites	K_2, K_3
CO 2	Know about polymer matrix composites, metal matrix composites, ceramic matrix composites and its manufacturing and applications	K3
CO 3	Introduce Fabrication techniques of composites	K3
CO 4	Determine stresses and strains in composites.	K4
CO 5	Understand the specifics of mechanical behaviour of layered composites compared to isotropicmaterials	K_4, K_5

Text books

R. M. Jones, Mechanics of Composite Materials, CRC Press

M. Mukhopadhyay, Mechanics of Composite Materials, University Press

I. S. Daniel and Ori Ishai, Engineering Mechanics of Composite Material, Oxford University Press

Reference Books

K K Chawla, Fibrous Materials, Cambridge University Press.

Thermal Analysis of Materials by R.F. Speyer, Marcel Decker.

Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India.

M. TECH FIRST YEAR			
Course Code	**AMTME0251**	**L T P**	**Credit**
Course Title	**Automation and Mechatronics Lab**	**0 0 4**	**2**

Course objective:

1	To acquire the knowledge on advanced algebraic tools for the description of motion
2	To develop the ability to analyze and design the motion for articulated systems
3	To develop an ability to use software tools for analysis and design of robotic systems.

List of Experiments

1	Learning about workpiece setting and coordinate setting on Vertical Milling machine.
2	Surface operation on Vertical Milling Machine.
3	Machining operation using canned cycle on Milling Machine.
4	Learning about workpiece setting and coordinate setting on Turning Center.
5	Performing Machining operation like Turning, Slotting, Facing.
6	Machining operation using canned cycle and Threading on Lathe machine.
7	Pick and Place Operation on Kuka Kr-10 robot.
8	Performing welding operation using Kuka Kr-10 robot.
9	Designing a controller (Arduino/ Raspberry)
10	Controller interfacing. ((Arduino/ Raspberry).

Course outcome: **After completion of this course students will be able to**

CO1	Set machine coordinate and perform machining operations.	K3
CO2	Program robot and perform operations on it.	K4
CO3	Design a controller (Arduino/ Raspberry) and programme it.	K3
CO4	Interface the controller with machine.	K4

M. TECH FIRST YEAR

Course Code	**AMTME0252**	**L T P**	**Credit**
Course Title	**Composite Materials Lab**	**0 0 4**	**2**

Course objective:

1	To understand the metal matrix composite.
2	To understand the various types of reinforcement.
3	To know the powder metallurgy techniques.
4	Determine stresses and strains in composites.
5	Understand the mechanical behaviour of laminated composite

List of Experiments

1	Preparation of Metal matrix Composites.
2	Preparation of surface composite by friction stir processing
3	Study of Tensile strength and young's modulus of MMCs.
4	Making of model on 3D printer by using glass fiber as a reinforcement material into a matrix material of nylon.
5	Preparation of composite by powder metallurgy techniques.
6	Study of Flexural strength of MMCs.
7	Study of Hardness of MMCs.
8	Impact strength analysis of MMCs
9	Preparation of Al-SiC composites by stir casting method.
10	Study of microstructure, hardness and density of Al-SiC composite

Course outcome: **After completion of this course students will be able to**

CO1	Prepare metal matrix composite.	K2
CO2	Demonstrate the friction stir processing.	K3
CO3	Demonstrate the powder metallurgy techniques.	K3
CO4	Determine stresses and strains in composites.	K2

M. TECH FIRST YEAR			
Course Code	**AMTME0211**	**L T P**	**Credit**
Course Title	**Advanced Finite Element Analysis**	**3 0 0**	**3**

Course Objectives: The students should be able to

1	Understand the fundamental concepts and different approaches used in Finite Element method.
2	Understand the application of plane stress- strain problem and use of the finite element method for axi-symmetric, heat transfer and fluid flow problems.
3	Understand the use of the basic finite elements for structural applications using truss, beam, frame and plane elements.
4	Understand and demonstrate the mesh generation used in FEA analysis for design and evaluation purpose.
5	Understand and command the practical application of finite element method to solve realistic engineering problems through the use of FEM packages software.

UNIT-I	**Introduction to Finite Difference Method**	**8HOURS**
Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches, Shape functions, Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements.		
UNIT-II	**Application to plane stress and plane strain problems**	**8 HOURS**
Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bending problems with isotropic and anisotropic materials, Structural stability, Other applications e.g., Heat conduction and fluid flow problems.		
UNIT-III	**Idealization of stiffness**	**8 HOURS**
Idealization of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems		
UNIT-IV	**Organization of the Finite Element programmer**	**8 HOURS**
Organization of the Finite Element programmer, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems		
UNIT-V	**FEM an essential component of CAD**	**8 HOURS**
FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.		

Course Outcomes: The students would be able to		
CO1	Apply the fundamental concepts and approaches to solve realistic engineering problems.	K_2, K_3
CO2	Apply the fundamental concepts of boundary conditions to global equation for axi-symmetric, heat transfer and fluid flow problems and solve those displacements, stress and strains induced.	K3
CO3	Apply the fundamental concepts of FEM for solving trusses, frames, plate structures, machine parts type realistic engineering problems.	K3
CO4	Apply the various mesh generation techniques for design and evaluation of realistic engineering problems.	K4

CO5	Develop proficiency in the application of the finite element method (modelling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.	K_4, K_5

Text Books	
1	The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
2	An Introduction to Finite Element Method J. N. Reddy McGraw Hill
3	Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
4	Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill
References Books:	
1	Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
2	Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India
3	Finite Element and Approximation O.C. Zenkiewicy& Morgan

M. TECH FIRST YEAR

Course Code	**AMTME0212**	**L T P**	**Credit**
Course Title	**Modern Manufacturing Technology**	**3 0 0**	**3**

Course objective:

1	To understand the non-traditional manufacturing process
2	To understand the concept of ultrasonic machining.
3	To describe the electrical discharge machining
4	To describe the electrochemical machining and hybrid machining
5	To understand the unconventional welding and forming.

Pre-requisites:

Course Contents / Syllabus

UNIT-I	**Introduction:**	**7 hours**
Need of Non-Traditional Machining Processes, ClassificationBased on Energy, Mechanism, source of energy, transfer media and process, Process selection Based on Physical Parameters, shapes to be machined, process capability and economics,Overview of all processes.		
UNIT-II	**Ultrasonic Machining**	**8 hours**
Ultrasonic Machining: Principle- Transducer types, Concentrators, Abrasive Slurry ProcessParameters, Tool Feed Mechanism, Advantages and Limitations, Applications. Abrasive Jet Machining: Process- Principle, Process Variables – Material Removal Rate, Advantages and Limitations, Applications. Water Jet Machining: Principle, Process Variables, Advantages and Limitations, PracticalApplications, Abrasive water jet machining process.		
UNIT-III	**Electrical Discharge Machining**	**8hours**
Electrical Discharge Machining: Mechanism of metal removal, DielectricFluid, Flushingmethods, Electrode Materials, Spark Erosion Generators, Electrode Feed System, Material Removal Rate, ProcessParameters, Tool Electrode Design,Tool wear Characteristics of Spark Eroded Surfaces-Advantages and Limitations, Practical Applications. Electrical Discharge Wire Cut and Grinding: Principle, Wire Feed System, Advantages and Limitations – Practical applications, Electron Beam Machining, plasma arc machining, laser beam machining		
UNIT-IV	**Chemical, Electrochemical and Hybrid Machining Process**	**8 hours**
Chemical Machining Process: material removal mechanism, process parameters, applications. Electrochemical Machining process: Material Removal Mechanism, process parameters, applications, Hybrid machining process: principle of unconventional hybrid machining process, electrochemical grinding, electrochemical spark machining.		
UNIT-V	**Advanced Welding and forming Techniques**	**8 hours**
Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding. Principle of high energy rate forming, explosive forming, electrohydraulic forming, electromagnetic forming, incremental forming processes.		

Course outcome: **After completion of this course students will be able to**

CO 1	understand the concepts of modern manufacturing technology	K1,K2
CO 2	Apply the concept of mechanical processes such as ultrasonic	K3, K4

	machining, AJM,WJM	
CO 3	Understand the concept of electrochemical machining process.	
CO 4	Understand the concept of unconventional welding processes.	K3, K4, K5
CO 5	Apply the concept of unconventional metal forming process.	K3,K4

Books:

1. P.C Pandey And H.S. Shan, "Modern Machining Process", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 2007.
2. V.K. Jain, "Advanced Machining Process", Allied Publishers Pvt Limited 200.
3. Amitabha Bhattacharyya, "New Technology", The Institution of Engineers, India
4. HMT Bangalore, "Production Technology", Tata Mc Graw–Hill Publishing Company Limited, New Delhi, 2006.
5. Hassan El – Hofy "Advanced machining Processes" MC Graw-Hill, 2005.

M. TECH FIRST YEAR

Course Code	**AMTME0213**	**L T P**	**Credit**
Course Title	**Advanced Welding Technology**	**3 0 0**	**3**

Course objective:

1	To impart knowledge on various advanced welding processes so that the students can apply them in engineering industry applications.
2	To gain understanding of heat flow and temperature distribution on weld components based on weld geometry
3	To develop the knowledge on the design of welded joints and the quality control of weldments.
4	To acquire knowledge and to solve problems associated with failure and to update students on the latest technology to ensure welded structure are maintained in good operating condition and at low maintenance cost.
5	To impart knowledge on robotic welding systems as well as learn how to perform basic procedures on a system.

Pre-requisites:

Course Contents / Syllabus

UNIT-I	**Welding Metallurgy:**	**4 hours**

Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys, Weld testing standards, Hydrogen embrittlement, Lamellar tearing, residual stresses and its measurement, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials

UNIT-II	**Weld Design & Quality Control:**	**12 hours**

Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, stainless steel, cast iron, and aluminium and titanium alloys, Weld testing standards, Hydrogen embrittlement, Lamellar tearing, residual stresses and its measurement, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.

UNIT-III	**Modern Trends in Welding:**	**8 hours**

Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.

UNIT-IV	**Repair Welding and Reclamation:**	**8 hours**

Engineering aspects of repair, aspects to be considered for repair welding, techno-economics, repair welding procedures for components made of steel casting and cast iron, half bead, temper bead techniques, usage of Ni base filler metals. Types of wear, wear resistant materials, selection of materials for various wear applications; reclamation surfacing techniques, selection of welding process for reclamation

UNIT-V	**Robotics in Welding:**	**8 hours**

Robot design and applications in welding, Programming of welding robots, tolerances for assemblies for robot welding, New generation of welding robots, Self-alignment by current arc variation, Robots for car body welding, Microelectronic welding and soldering,

Efficiency of robotics in welding.		
Course outcome: **After completion of this course students will be able to**		
CO 1	Identify and understand the concepts of welding	K1,K2
CO 2	Analyze peak temperatures, HAZ stresses and to prevent distortions	K3, K4
CO 3	Analyze and predict the life of weld joints subjected to fatigue and evaluate the effect of stress concentration on fatigue life of such joints.	K4
CO 4	Selection of repair welding and apply techno-economics for practical problems.	K3, K4, K5
CO 5	Use appropriate safety precautions while programming and operating the robot system	K3,K4

Books:

1. Advanced Welding Processes Nikodaco&Shansky MIR Publications
2. Welding Technology and Design VM Radhakrishnan New Age International
3. Source Book of Innovative welding Processes M.M. SchwarizAmerican Society of Metals (Ohio)
4. Advanced Welding Systems, Vol. I, II, III J. CornuJaico Publishers
5. Manufacturing Technology (Foundry, Forming and Welding) P.N. Rao Tata McGraw Hill
6. Welding principles and practices by Edward R. Bohnart, Mc. Graw Hill Education, 2014.
7. Welding and Welding technology, Richard L little, Mc. Graw Hill Education
8. Welding processes and Technology – Dr.ParmarRS
9. Welding processes and Technology – O.P Khanna
10. Foundry, Forming and Welding, P.N.Rao 2nd Edition TMH

M. TECH FIRST YEAR

Course Code	AMTME0214	L T P	Credit
Course Title	Computational Fluid Dynamics (CFD)	3 0 0	3

Course objective:

This course enables students to

1. To provide brief introduction of Computational Fluid Dynamics enriched with the analysis of fluid mechanics and heat transfer related problems.

Course Contents / Syllabus

UNIT-I	INTRODUCTION	8 hours

Introduction, Conservation equation, Mass Momentum and Energy equations, Convective form of the equation and general description.

UNIT-II	Boundary and initial conditions	8 hours

Clarification into various types of equation, Parabolic, Elliptic, Boundary and initial conditions, Overview of numerical methods

UNIT-III	Finite difference methods	8 hours

Finite difference methods; Different means for formulating finite difference equations, Taylor series expansion, Integration over element, Local function method; Finite volume methods; Central, upwind and hybrid formulations and comparison for convection-diffusion problem, Treatment of boundary conditions; Boundary layer treatment; Variable property, Interface and free surface treatment, Accuracy of F.D. method.

UNIT-IV	Solution of finite difference equations	8 hours

Solution of finite difference equations; Iterative methods; Matrix inversion methods, ADI method, Operator splitting, Fast Fourier Transform applications

UNIT-V	Phase change problems	8 hours

Phase change problems, Rayleigh-Ritz, Galerkin and Least square methods; Interpolation functions, One- and two-dimensional elements, Applications. Phase change problems; Different approaches for moving boundary; Variable time step method, Enthalpy method.

	Course Outcome:	
CO1	Understand the various governing equations related to CFD.	K2
CO2	Apply boundary condition & initial conditions.	K3
CO3	Apply Finite Difference and Finite Volume methods in CFD modelling	K3
CO4	Evaluate the performance of fluid dynamics model.	K3
CO5	Understand the various governing equations related to CFD.	K4

Name of Authors/ Books / Publisher

1	Computational Methods for Fluid Dynamics
2	Principles of Heat Transfer
3	Radiative Heat Transfer
4	Computational Fluid Dynamics

M. TECH FIRST YEAR			
Course Code	**AMTME0215**	**L T P**	**Credit**
Course Title	**Advanced Mechanics of Solids**	**3 0 0**	**3**

Course objective:

This course enables students to

2.	Solve advanced solid mechanics problems using classical methods
3.	Understand behaviour of machine and structure under various loading conditions
4.	Understand hardening rules and different elastic constant relations for materials like isotropic, anisotropic, hyper elastic and viscoelastic
5.	Understand boundary value problem which is applicable not only in solid mechanics but also in heat transfer, fluid mechanics and acoustic diffusion
6.	Understand principle of virtual work and time dependent problem
7.	The course also aims at creation of an environment in which the students are encouraged to solve problems on advanced solid mechanics and in this way to improve their solving skills.

Course Contents / Syllabus

UNIT-I	**INTRODUCTION**	**8 hours**

Mathematical Preliminaries: Scalars, vectors and matrix variables, index notation and the related rules, Cartesian tensors and their algebra, coordinate transformation, transformation rules for the *n*th order tensors, elements of tensor calculus and the related theorems (divergence, Stokes' and Green's), principal value theorem, eigenvalues and eigenvectors, invariants of a 2nd order tensor.

Kinetics of Deformation: Types of forces (point, surface and body), traction vector, state of stress at a point, Cauchy's relation and its proof, conservation of linear and angular momentum, stress equilibrium equations, symmetry of stress tensor, stress transformation, principal stresses and the associated planes, 3D Mohr's circle representation, planes of maximum shear, octahedral planes, hydrostatic and deviatoric stress, first and second Piola-Kirchoff stress tensors and their properties.

UNIT-II	**Kinematics of Deformation**	**8 hours**

Kinematics of Deformation: Material and spatial co-ordinates, Eulerian and Lagrangian description of motion; deformation and displacement gradients, Green-Lagrange and Almansi strain tensor; Cauchy's small strain tensor and the rotation tensor, geometrical interpretation of strain components and sign convention, principal strains and directions, strain invariants, octahedral strain, maximum shear strain, volumetric strain, strain compatibility equations.

UNIT-III	**Constitutive Modelling**	**8 hours**

Constitutive Modelling: Thermodynamic principles, first and second law of thermodynamics, Generalized Hooke's law for isotropic materials, elastic constants and their relations, anisotropic, hyper elastic and viscoelastic material models, strain hardening, constitutive relations for elasto-plastic materials, flow and hardening rules.

UNIT-IV	**Boundary Value Problems**	**8 hours**

Boundary Value Problems in Linear Elasticity: Field equations and boundary conditions, Navier equations, Beltrami-Michell stress compatibility conditions, 2D approximations (plane stress and plane strain) and solution strategies.

UNIT-V	**Variational Principles in Solid Mechanics:**	**8 hours**

Variational Principles in Solid Mechanics: Elements of variational calculus, extremum of a functional, Euler-Lagrange equation and its application, types of boundary conditions, principle of virtual work, Principle of total potential energy and complementary potential energy, Ritz method, time-dependent problems and Hamilton's principle for continuum.

	Course Outcome:	
CO1	Students who successfully complete this course obtains advanced information on Advanced Mechanics of Solids and will be able to	K2
CO2	Solve mechanics problem using matrix, vector and use element of tensor calculus.	K3
CO3	Learn about the elastic and plastic behaviour of material and evaluate stress invariants, principal stresses and their directions	K3
CO4	Determine strain invariants, principal strains and their directions	K3
CO5	Understand the theory of elasticity including strain/displacement, Hooke's law for isotropic material, elastic constants and their relationships	K4

Name of Authors/ Books / Publisher	
1	Sadd, M.H., "Elasticity Theory Applications and Numerics", Elsevier Academic Press.
2	Boresi, A.P., Sidebottom, O. M., "Advanced Mechanics of Materials", 5th Ed., John Wiley and Sons
3	Singh, A.K., "Mechanics of Solids", PHI Learning Private Limited
4	Timoshenko, S.P., and Goodier, J.M., "Theory of Elasticity", 3rd Ed., McGraw Hill
5	Srinath, L.S., "Advanced Mechanics of Solids",Tata McGraw Hill Education Private Limited
6	Fung, Y.C., "Foundations of Solid Mechanics", Prentice Hall Inc.

M. TECH FIRST YEAR			
Course Code	**AMTME0216**	**L T P**	**Credit**
Course Title	**Optimization Techniques**	**3 0 0**	**3**

Course Objectives: The students should be able to

1	To introduce various optimization techniques i.e. classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2	Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
3	To explain the concept of Dynamic programming and its applications to project implementation.
4	To introduce various Advanced optimization techniques i.e. integer and geometric programming, genetic algorithm and simulated annealing

UNIT – I	Introduction	8 HOURS
Introduction and Classical Optimization Techniques: Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems. Classical Optimization Techniques: Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints, Kuhn – Tucker conditions.		
UNIT-II	**Linear Programming**	**8 HOURS**
Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm. Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.		
UNIT-III	**Unconstrained Nonlinear Programming**	**8 HOURS**
Unconstrained Nonlinear Programming: One dimensional minimization. methods, Classification, Fibonacci method and Quadratic interpolation method Unconstrained Optimization Techniques: Univariant method, Powell's method and steepest descent method.		
UNIT-IV	**Dynamic programming**	**8 HOURS**

Dynamic programming: Evolutionary algorithms: Genetic Algorithm, concepts of multiobjective optimization, Markov Process, Queuing Models		
UNIT-V	**Advanced optimization techniques**	**8 HOURS**
Advanced optimization techniques: integer and geometric programming, genetic algorithm, simulating annealing, optimization software's.		

Course Outcomes: The students would be able to		
CO1	describe the need of optimization of engineering systems	K2
CO2	understand optimization of mechanical systems and formulate the optimization problems.	K3
CO3	apply classical optimization techniques, linear programming, simplex algorithm, transportation problem	K3
CO4	apply unconstrained optimization and constrained non-linear programming and dynamic programming	K4
CO5	Understand the advanced optimization techniques.	K3

Text Book	
1	Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2	H. S. Kasene& K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004
REFERENCE BOOKS:	
4	George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operations research 3rd edition, 2003.
5	H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
6	Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt. Ltd, New Delhi, 2005.

M. TECH FIRST YEAR

Course Code	**AMTME0217**	**L T P**	**Credit**
Course Title	**Artificial Intelligence and Machine Learning (AIML)**	**3 0 0**	**3**

Course objectives:

1	To introduce the basic concepts, theories and techniques of Artificial intelligence.
2	To introduce basic concepts and applications of Machine learning.
3	Help students to learn the application of AI / Machine learning

Pre-requisites:

Students should have basic knowledge computers, general engineering and mathematics.

Course Contents / Syllabus

UNIT-I	**FUNDAMENTALS OF AI**	**8 hours**

- Introduction to AI, History of AI, Intelligent Systems, Types of Intelligence
- Applications and Research Areas of AI
- Agents and Environments

UNIT-II	**SEARCH TECHNIQUES AND KNOWLEDGE REPRESENTATION**	**8 hours**

- State Space Search, Types of search -BFS, DFS, Bidirectional Search, Heurisitc search - Hill Climbing, Beam Search Best First, A* search algorithm.
- Knowledge Representation, Relational knowledge, Knowledge representation as logic, Semantic Network, Frame based knowledge.

UNIT-III	**SCOPE OF AI**	**8 hours**

- Natural Language Processing
- Expert Systems
- Fuzzy Logic Systems
- Neural Networks

UNIT-IV	**INTRODUCTION TO MACHINE LEARNING**	**10 hours**

- Introduction to Machine learning systems.
- Supervised Learning, Unsupervised Learning and Deductive Learning.
- Artificial Neural Networks

UNIT-V	**Applications**	**8 hours**

- Image and face recognition,
- Object recognition,
- Speech Recognition besides Computer Vision,
- Automation and Robotics

Course outcome: **After completion of this course students will be able to**

CO 1	Learn the fundamentals of AI with engineering perspectives.	K_2
CO 2	Understand concept of knowledge representation and predicate logic and transform the real-life information in different representation.	K_2
CO 3	Understand state space and its searching strategies.	K_2
CO 4	Understand machine learning concepts and range of problems that can be handled by machine learning.	K_2

CO 5	Understand the concepts of face, object, speech recognition and automation & robotics.	K_2

Text &Reference books

1. Elaine Rich, K. Knight, "Artificial Intelligence", 2/E, TMH, 1991.
2. Andrew C., Staugaard Jr., Robotics and AI: "An Introduction to Applied Machine Intelligence", Prentice Hall ,1987.
3. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", 2/E, Prentice Hall, 2003.
4. K. Boyer, L. Stark, H. Bunke, "Applications of AI, Machine Vision and Robotics" World Scientific Pub Co. , 1995.
5. I. Bratko, "Prolog Programming for Artificial Intelligence", 3/E, Addison-Wesley, 2001.
6. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2003.

M. TECH FIRST YEAR

Course Code	**AMTME0218**	**L T P**	**Credit**
Course Title	**Management Information System**	**3 0 0**	**3**

Course objective:

1	To make students Identify and understand the role of MIS in business and management.
2	To Define problems pertaining to conceptual information and detailing information of a system design.
3	To make students Evaluate and differentiate various information systems and their economics.
4	Students will be able to understand the strategic and project planning and role of Information system in decision making.
5	To make students integrate information system to ERP, and other Enterprise-wide systems along-with ethics.

Pre-requisites: The student should have knowledge of Manufacturing science

Course Contents / Syllabus

UNIT-I	**Introduction to Flexible manufacturing system**	**8 hours**

Introduction; Meaning and definition of management information systems (MIS); Systems approach;Role of MIS in facing increasing complexity in business and management.
Conceptual information systems design;Problem Definition; setting system objectives; Establishingsystem constraints; Determining information needs; Determining information sources; Developingalternative conceptual designs; Documenting the conceptual designs.

UNIT-II	**Detailing information systems design**	**8 hours**

Detailing information systems design; Informing and involving the organization; Project management ofMIS; Identifying dominant and tradeoff criteria; Subsystem definition and sources.

UNIT-III	**Evaluation of information systems**	**8 hours**

Evaluation of information systems; Basic information systems; Financial information systems;Production and operations information systems; Marketing information systems; Personal informationsystem etc.

UNIT-IV	**Information systems for decision making**	**8 hours**

Information systems for decision making; Programmed and non-programmed decisions; Components ofdecision support systems, Strategic and project planning.

UNIT-V	**Enterprise-wide information systems**	**8 hours**

Enterprisewide information systems; Integration with ERP systems; Real-time organizations;Integration with external organizations; Virtual organizations; data warehousing; Data mining; OLAP(Online Analytical Processing) Systems, Business analytics. Issues in ethics, crime, and security.

Course outcome: **After completion of this course students will be able to**

CO 1	Define MIS and its involvement in Business and Management	K_2, K_3
CO 2	Discuss and define the problems related to design of conceptual and detailing information system.	K3
CO 3	Evaluate and differentiate various information system along with their economics and utilization.	K3
CO 4	Understand and implement information system for decision making.	K4
CO 5	Implement and utilize enterprise wise information system.	K_4, K_5

Text books& Reference Books
1. Management Information Systems O' Brien, J Tata McGraw Hill 2. Management Information Systems W.S. Jawedker Tata McGraw Hill 3. Management Information Systems S Sadagopan Prentice Hall of India 4. An Information System for Modern Management R.G. Mudrick Pearson 5. Management Information Systems M. Jaiswal Oxford University Press

M. TECH FIRST YEAR

Course Code	**AMTME0219**	**L T P**	**Credit**
Course Title	**Flexible Manufacturing System**	**3 0 0**	**3**

Course objective:

1	Student will learn the flexible manufacturing system.
2	Student will learn the data-based management system.
3	Student will understand the group technology.
4	Student will learn the coordinate measuring machine tool.
5	Student will understand the material requirement planning system.

Pre-requisites: The student should have knowledge of Manufacturing science

Course Contents / Syllabus

UNIT-I	**Introduction to Flexible manufacturing system**	**8 hours**

Introduction: Introduction to manufacturing system, different type of manufacturing system, volume variety relationship for understanding manufacturing system. Flexible Manufacturing System: Components of an FMS, types of system, where to apply FMS technology, FMS work stations. Material handling and storage system: Functions of the handling system, FMS layout configuration, Material handling equipment. Computer control system: Computer function, FMS data file, system reports planning the FMS, analysis method for FMS, application and benefits.

UNIT-II	**Distributed data processing in FMS**	**8 hours**

Distributed data processing in FMS: DBMS and their applications in CAD/CAM and FMS distributed systems in FMS –Integration of CAD and CAM - Part programming in FMS, tool data base - Clamping devices and fixtures data base.
Conveyors: AGVs – features of industrial robots - robot cell design and control- AS/RS

UNIT-III	**Group Technology**	**8 hours**

Group Technology: Part families, part classification and coding. Types of classification and coding system, Machine cell design: The composite part concept, types of cell design. Determining the best machine arrangement, benefits of group technology.
Just In Time and Lean Production: Lean Production and Waste in Manufacturing, just in time production system, automation, work involvement.

UNIT-IV	**Introduction of FMS**	**8 hours**

Introduction – composition of FMS– hierarchy of computer control –computer control of work centre and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.
Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database.

UNIT-V	**Production Planning and control systems**	**8 hours**

Production Planning and control systems: Aggregate Production Planning and the master production schedule, Material Requirements and Planning, capacity planning, shop floor control, inventory control, extensions of MRP CMM types: contact and non-contact inspection principles - programming and operation-in cycle gauging

Course outcome: **After completion of this course students will be able to**

CO 1	Understand the components of flexible manufacturing system	K_2, K_3
CO 2	Apply the concept of data-based management system for integration of CAD and CAM	K3

CO 3	Understand the concept of part family formation and cell design.	K3
CO 4	Understand the concept of automated material handling system	K4
CO 5	Understand the different module of MRP and CMM	K_4, K_5

Text books& Reference Books

1. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recentdevelopment", Elsevier Science, 1995.
3. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co., 1995.

M. TECH FIRST YEAR

Course Code	**AMTME0220**	**L T P**	**Credit**
Course Title	**Machine Vision**	**3 0 0**	**3**

Course objective:

1	Explaining the concepts of Physics behind Digital Image Processing.
2	Illustrating the Methods of Image Acquisition.
3	Applying the different knowledge in different types image Processing.
4	Developing knowledge of different types analysing the Captured Image.
5	Implementing at the idea about Machine Vision Applications.

Course Contents / Syllabus

UNIT-I	**INTRODUCTION**	**8 hours**

Human Vision – Machine vision and Computer Vision – Benefits of Machine Vision – Block Diagram and Function of Machine Vision System Implementation of Industrial Machine Vision System – Physics of Light – Interactions of Light – Refraction at a Spherical Surface – Thin Lens Equation.

UNIT-II	**IMAGE ACQUISITION**	**10 hours**

Scene Constraints – Lighting Parameters – Lighting Sources, Selection – Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection – Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras –Digital Camera Interfaces – Camera Computer Interfaces, Specifications and Selection – Geometrical Image Formation Models – Camera Calibration.

UNIT-III	**IMAGE PROCESSING**	**8 hours**

Machine Vision Software – Fundamentals of Digital Image – Image Acquisition Modes – Image Processing in Spatial and Frequency Domain – Point Operation, Thresholding, Greyscale Stretching – Neighbourhood Operations, Image Smoothing and Sharpening – Edge Detection – Binary Morphology – Colour image processing.

UNIT-IV	**IMAGE ANALYSIS**	**8 hours**

Feature Extraction – Region Features, Shape and Size Features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.

UNIT-V	**MACHINE VISION APPLICATIONS**	**8 hours**

Machine Vision Applications in Manufacturing, Electronics, Printing, Pharmaceutical, Textile, Applications in Non-Visible Spectrum, Metrology, Vision Guided Robotics – Field and Service Applications – Agricultural, and Bio Medical Field, Augmented Reality, Surveillance, Bio-Metrics.

Course outcome: **After completion of this course students will be able to**

CO 1	Explain the concepts of Physics behind Digital Image Processing.	K3
CO 2	Illustrate the Methods of Image Acquisition.	K2
CO 3	Apply the different knowledge in different types image Processing.	K3
CO 4	Develop knowledge of different types analysing the Captured Image.	K4
CO 5	Implement at the idea about Machine Vision Applications.	K4

Text books
1. Alexander Horn berg, “Hand Book of Machine Vision”, Wiley-VCH, 2006.
2. Davies E.R., “Machine Vision Theory, Algorithms and Practicalities”, Elsevier, 2005.
Reference Books
1. NelloZuech, “Understanding and Applying Machine Vision”, Marcel Decker, 2000.
2. Bruce Bachelor and Frederick Waltz, “Intelligent Machine Vision Techniques, Implementations and Applications”, Springer-Verlag, 2001.
3. Rafael C. Gonzales, Richard. E. Woods and Steven L. Eddins, “Digital Image Processing Using MATLAB”, McGraw Hill Education, 2014.
4. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Cengage Learning, 2014.
5. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, PHI Learning, 2011.
6. Chanda B. and Dutta Majumder D., “Digital Image Processing and Analysis”, PHI Learning, 2011.

M. TECH FIRST YEAR

Course Code	AMTME0221	L T P	Credit
Course Title	Rapid Manufacturing & Tooling	3 0 0	3

Course objective:

1	Able to know the fundamentals of RP Systems & its evolution and the Process in RP and association of RP Systems with 3D modelling & Mesh
2	Able to know the RP Systems, Process, Materials & Classifications
3	Able to know and working with Mesh File & their formats like STL format, 3MF format, OBJ formats. Conversion to Mesh files, their properties, operations, storage, inspections & defects
4	Able to know the applications of RP Systems in various Fields

Course Contents / Syllabus

UNIT-I	Introduction:	4 hours

Historical Developments, Fundamentals of RP Systems and its Classification on different basis, Rapid Prototyping Process Chains, 3D Modelling and Mesh Generation, Data Conversion and Transmission.

UNIT-II	RP Systems:	12 hours

Liquid Polymer Based Rapid Prototyping systems: SLA, Material Jetting, Solid Input Materials Based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM) and Fused Deposition Modelling Systems, Power Based Rapid Prototyping Systems: Selective Laser Sintering, Multi-Jet Fusion, Binder Jetting Systems.

UNIT-III	RP Database & Design Optimization:	8 hours

Rapid Prototyping Data Formats, STL Format, STL file problems, STL file repair, DfAM, Topology Optimization, Gcode for RP Systems

UNIT-IV	RP Applications:	8 hours

Development of dies for Moulding, RP Applications in developing prototypes of products, application in medical fields, Development of bone replacements and tissues, etc., RP materials and their biological acceptability.

Course outcome: **After completion of this course students will be able to**

CO 1	Understand the fundamentals of RP Technologies and process involvement in them	K1,K2
CO 2	Understand the methodology to manufacture the products using RP technologies and study their applications, advantages and case studies	K3, K4
CO 3	Understand the Design aspects and their respective challenges along with the resolution for them	K3, K4, K5
CO 4	Understand the various applications of various RP Systems with case studies & Materials	K3,K4

Text books

1. Rapid Prototyping: Principles an Applications: Chee Kai Chua, Kah Fai Leong, Chu Sing Lim
2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing: Brent Stucker, David W. Rosen, Ian Gibson

Reference Books

1. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling: Pham, Duc, Dimov, S.S.

2. Rapid Prototyping and Manufacturing: Fundamentals of Stereo Lithography: P. Jacobs
3. Rapid System Prototyping with FPGAs: Accelerating the Design Process: R.C. Cofer, Benjamin F. Harding
4. Rapid Prototyping of Digital Systems: Hamblen, James O., Hall, Tyson S., Furman, Michael D.

M. TECH FIRST YEAR

Course Code	AMTME0222	L T P	Credit
Course Title	**Hybrid Vehicle Technology**	3 0 0	3

Course objective:

1	Understand working of Electric Vehicles and recent trends.
2	Know-how & aptitude towards future trends in Hybrid Electric Vehicles
3	Understand the various energy storage devices
4	Understand the drive systems of hybrid vehicles
5	Understand energy management strategies

Course Contents / Syllabus

UNIT-I	Introduction:	4 hours

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

UNIT-II	Electric Propulsion unit	12 hours

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

UNIT-III	Energy Storage	8 hours

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

UNIT-IV	Sizing the drive system	8 hours

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

UNIT-V	Energy Management Strategies	8 hours

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

Course outcome: **After completion of this course students will be able to**

CO 1	Develop the electric propulsion unit and its control for application of electric vehicles.	K1,K2
CO 2	Analyze different power converter topology used for electric vehicle application.	K3, K4
CO 3	Identify the principles of energy storage in hybrid vehicles	K3, K4, K5
CO 4	Analyze the drive systems sizing.	K3,K4
CO5	Develop the strategies for engine management.	K4

Text books

Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
Reference Books
James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011