J. S. University, Shikohabad

M. Tech

(Mechanical Engineering Branch)

Scheme

&

Syllabus

[Effective from the session 2021-22]

SEMESTER-I

S. No.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTME- 11	Simulation, Modeling & Analysis	3	0	0	3	20	10	70	--	--	100
2	MTME -12	Operations Research	3	0	0	3	20	10	70	--	--	100
3		Departmental Elective- I	3	0	0	3	20	10	70	--	--	100
4		Departmental Elective- II	3	0	0	3	20	10	70	--	--	100
5	MTMR-11	Research Methodology and IPR	3	0	0	2	20	10	70	--	--	100
6	MTME -011P	Simulation Modeling & Analysis Lab	--	--	3	2	--	--	--	20	30	50
7	MTME -012P	Operations Research Lab	--	--	2	2	--	--	--	20	30	50
8	MTAC-11	Audit course 1	2	-	-							50*
		Total				18						**600**

Departmental Elective–I	MTME 011	CAD/CAM
	MTME012	Mathematical Modeling of Manufacturing Processes
	MTME013	Renewable Energy System

Departmental Elective–II	MTME 016	Advanced Mechanical Vibrations
	MTME 017	Advanced I.C. Engines
	MTME 018	Vehicle Body Engineering & Safety

SEMESTER-II

S. No.	**Subject Code**	**Name of the Subject**	**Periods**			**Credit**	**Evaluation Scheme**					**Subject Total**
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTME-021	Computer Integrated Manufacturing (CIM)	3	0	0	3	20	10	70	--	--	100
2	MTME -022	Advanced Mechanics of Solids	3	0	0	3	20	10	70	--	--	100
3		Departmental Elective- III	3	0	0	3	20	10	70	--	--	100
4		Departmental Elective- IV	3	0	0	3	20	10	70	--	--	100

5		Departmental Elective-V	3	0	0	3	20	10	70	--	--	100
6	MTME - 021P	Computer Integrated lab Manufacturing (CIM) Lab	--	--	3	2	--	--	--	20	30	50
7	MTME - 022P	Mini-Project with Seminar	--	--	2	1				50		50
8	MTAC-21	Audit-2	2 -	--	-	0	--	--	--	--	--	50*
		Total		-	-	**18**						**600**

Departmental Elective–III	MTME 201	Advanced Welding Technology
	MTME-202	Industrial Automation and Robotic
	MTME-203	Industrial Optimization Techniques

Departmental Elective–IV	MTME 211	Total Quality Management
	MTME 212	Advanced Mechanical Design
	MTME-213	Modelling And Simulation Of Dynamic Systems

Departmental Elective-V	MTME 221	Modern Manufacturing Process
	MTME-222	Automation And Robotics
	MTME-223	Machine Vision

SEMESTER-III

S. No.	**Subject Code**	**Name of the Subject**	**Periods**			**Credit**	**Evaluation Scheme**					**Subject Total**
			L	**T**	**P**		**Theory**			**Practical**		
							CT	**TA**	**ESE**	**TA**	**ESE**	
1		Programme Elective-V	0	0	6	3	20	10	70	--	--	100
2		Open Elective	3	0	30	3	20	10	70	--	--	100
3	MTME-031	Phase-I Dissertation			20	10				100	300	400
		Total		-	-	**16**						**600**

Programme Elective-V	MTME 031	Design of Solar and Wind System
	MTME 032	Advanced Mathematical Methods in Engineering
	MTME-033	Composite Materials

Open Elective	MTOE 031	Business Analytics
	MTOE-032	Industrial Safety
	MTOE-033	Operations Research
	MTOE-034	Cost Management of Engineering Projects
	MTOE-035	Composite Materials
	MTME 036	Waste to Energy

SEMESTER-IV

S. No.	Subject Code	Name of the Subject	Periods			Credit	Evaluation Scheme					Subject Total
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTME-041	Dissertation Phase-II	--	--	32	16	--	--	--	200	400	600
		Total		-	-	**16**						**600**

S. No.	Sem.	Paper Code	Audit course Paper Title		Credit
	I		**Audit course-1**	**Theory**	NC
1		MTAC-11	English for Research Paper Writing		
2		MTAC-12	Sanskrit for Technical Knowledge		
3		MTAC-13	Disaster Management		
4		MTAC-14	Constitution of India		
	II		**Audit course-2**	**Theory**	NC
1		MTAC-21	Value Education		
2		MTAC-22	Stress Management by Yoga		
3		MTAC-23	Personality Development through Life Enlightenment Skills		
4		MTAC-24	Pedagogy Studies		

[MTME-011] SIMULATION, MODELLING & ANALYSIS

L-T-P
3-0-0

Objective: The objective of the course is to teach methods and techniques for achieving an effective transformation from requirements and business drivers to technology and product design. The ability to create simulation models of various types. Provide basic knowledge of simulation system principles. Find conclusions from analysis of simulation results.

Course Outcomes:

The students will be able to	
CO1	Understand mathematical concepts of numerical methods like random variables, correlations.
CO2	Understand linear and nonlinear system and also understand role of simulation in models.
CO3	Familiar with different simulation techniques likes Monte Carlo, numerical computation techniques.
CO4	Identify and apply the simulation model in mechanical system and other mechanical problems.
CO5	Understand role of simulation in manufacturing system

SYLLABUS

UNIT-I

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, time advance algorithm, manual simulation using event scheduling, basis properties and operations.

UNIT-II

Models In Simulation: Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process,

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 $G/G/1/\infty/\infty$ queues, server utilization in $G/G/C/\infty/\infty$ queues, server utilization and system performance, costs in queuing problems, Larkovian models.

UNIT-III

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

UNIT-IV

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

UNIT-V

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

BOOK

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.

[MTME-012] OPERATIONS RESEARCH

L-T-P
3-0-0

Objective: The central objective of operations research is optimization, i.e., "to do things best under the given circumstances.". The process of doing this involves a lot of data collection and analysis of possible outcomes. The process of optimization involves a critical analysis of all the available options and selecting the highly relevant ones.

Course outcomes:

The students will be able to	
CO1	This course help to understand to identify the problems and how to resolve optimized.
CO2	Solve the complex problems with the linear optimization models .
CO3	Understand and identify queuing problems and solve theses discrete and continuous time Markov models.
CO4	Understand ABC analysis

SYLLABUS

UNIT-I

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

UNIT-II

Linear Optimization Models: Complex and revised simplex algorithms; Duality theorems, sensitivity analysis; Assignment, transportation and transshipment models; Traveling salesman problem as an Assignment problem; Integer and parametric programming; Goal programming.

UNIT-III

Game Problems: Mini-max criterion and optimal strategy; Two person zero sum game; Games by simplex dominance rules. 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-IV

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-V

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

BOOKS

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

[MTMR-013] Research Process and Methodology

L-T-P
3-0-0

Objective:

- To familiarize the meaning, objectives and sources of research
- To acquaint the student with the importance and methods of literature review/research ethics
- To impart the knowledge of data collection and analysis of data
- To understand the procedure for Hypothesis testing and writing Research proposals.

Course Outcomes

The students will be able to	
CO1	Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
CO2	Identify appropriate research topics, research problem and parameters.
CO3	Analyze the data collected and conduct research in a more appropriate manner.
CO4	Have basic awareness of data analysis-and hypothesis testing procedures.

SYLLABUS

UNIT-I

Introduction to Research and Problem Definition

Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem.

UNIT-II

Research Design

Research design, Methods of research design, research process and steps involved, Literature Survey

UNIT-III

Data Collection

Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research

UNIT-IV

Data Analysis and interpretation

Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results

UNIT-V

Technical Writing and reporting of research

Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism

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. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013.

[MTME-011P] SIMULATION, MODELLING & ANALYSIS LAB

L-T_P
0-0-3

Objective:
The objectives of a simulation, modeling, and analysis lab include providing hands-on learning experience and developing skills in designing and validating simulations/models, fostering problem-solving abilities, supporting industry needs, conducting research, and promoting interdisciplinary collaboration.

The students will be able to	
CO1	Improved understanding of simulation software like ARENA and MATLAB and their applications in different fields.
CO2	Ability to generate random numbers and use them in simulations.
CO3	Improved problem-solving and decision-making abilities through the use of simulation and modeling techniques.
CO4	Better understanding of the impact of different factors on system performance and the ability to make data-driven decisions.

LIST OF PRACTICALS
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. Modeling 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

[MTME-012P]OPERATIONS RESEARCH LAB

L-T-P
0-0-3

Objective: The objectives of an Operations Research lab are to provide hands-on experience to students in using optimization techniques to solve real-world problems and to prepare students for research and development careers in industries that rely on Operations Research techniques.

The students will be able to	
CO1	Improved understanding of various optimization techniques used in Operations Research.
CO2	Improved understanding of various optimization techniques used in Operations Research.
CO3	Ability to use various software tools to implement and solve optimization problems.
CO4	Improved research and development capabilities in Operations Research.

LIST OF PRACTICALS

1. Using queuing theory method to solve a given facility design problem.
2. Writing a program to solve a sequencing problem.
3. Using Monte Carlo simulation to solve a given problem.
4. Solving a given product mix problem.
5. Optimizing weight of a given truss or any machine element.
6. To optimize operational time by using Genetic Algorithm method.
7. To optimize system reliability by using simulated annealing method.
8. Optimization of maintenance time by using artificial neural network method.
9. Optimization of transport cost by using transportation problem.
10. Optimization of life cycle costing.

SEMESTER-I
DEPARTMENTAL ELECTIVE–I

[MTME-011] CAD/CAM

L-T-P
3-0-0

Objective: The purpose of CAD is to optimize and streamline the designer's workflow, increase productivity, improve the quality and level of detail in the design, improve documentation communications and often contribute toward a manufacturing design database. Develop a general understanding of fundamental CAD/CAM concepts; learning how to use commercial CAD/CAM software for engineering design; and Learned how CAD/CAM can be used in the different stages of design and manufacture of a product.

Course Outcomes:

The students will be able to	
CO1	Create the different wireframe primitives using parametric representations.
CO2	create surface primitives using parametric modeling
CO3	Create the different solid primitives using the different representation schemes.
CO4	apply geometric transformations on the created wireframe, surface and solid models

SYLLABUS

UNIT-I
Mathematical Elements, CAD, Solid modeling methods, Database structures for CAD, CSG formulation, B-rep and wire frame methods, Intersection surface generation methods, Boundary file generation methods, Feature based modeling systems, Surface modeling, B-splines, Coons and Bezier surfaces, NURBS and surface patches, fitting surfaces for arbitrary digested points, Offset surfaces, Fillet surfaces, Sewn surfaces.

UNIT-II
Features recognition from the databases, IGES, STEP, PDES, and DXF data exchange formats, Graphic standards for CAD/CAM such as GKS, PHIGS and VDI.

UNIT-III
Concurrent engineering integration of manufacturing principles and analytical principles in design, Manufacturing information generation from CAD data, Planar sectioning, Penalty functions, cavity milling, Optimization of cutter path, Effect of tool profile geometry, Methods for multi-axis machining,

UNIT-IV
Methods for software design for CAD/CAM system, use of software libraries, Development of software package for a specific problem as part of course using software libraries.

UNIT-V
Introduction to automation, CAM/CIM, Part programming, Interpolator & Control.

BOOK

1. Computer Graphics D Hearn & M P Baker Prentice Hall
2. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramanian Tata McGraw-Hill
3. Mathematical Elements for Comp. Graphics D F Rogers and J A Adams McGraw-Hill International
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 Mac Graw Hill Inc.

[MTME-012]]MATHEMATICAL MODELING OF MANUFACTURING PROCESSES

Course Objective : Students undergoing this course are expected to

1. Develop an understanding of mathematical modeling and its applications.
2. Learn the principles of manufacturing processes and their modeling.
3. Analyze the behavior of materials during manufacturing processes.
4. Explore the optimization and simulation of manufacturing processes.
5. Develop skills in using mathematical models to improve manufacturing processes.

Subject Code	MATHEMATICAL MODELING OF MANUFACTURING PROCESSES	L:T:P	Credits
BTME-075		3:0:0	03

Course Outcome : Student will be able to

CO1	Understand the fundamentals of manufacturing processes, mathematical models And their solutions
CO2	Understand unconventional and conventional machining, their discrete-time linear, non-linear models and solutions
CO3	Analyze the mechanism of forming and heat transfer in welding
CO4	Apply the principles of casting, powder metallurgy, coating and additive Manufacturing
CO5	Understand the fundamental of heat treatment, micro/nano manufacturing and Processing of non-metallic materials.

SYLLABUS

UNIT-I

Introduction to Manufacturing processes; Materials Processing; Types and Properties of Engineered Materials; Evaluation of Properties of Manufactured Products; Statistical and data-driven modelling approach; Overview of mathematical modeling, types of mathematical models and methods to solve the same. Physics of manufacturing processes; Solid-state deformation (Elasticity and Plasticity) and residualstresses;solid-statephasetransformationandrecrystallization;meltingandsolidification;CoupledSystems

UNIT-II

Conventional machining; Orthogonal cutting; Tool geometry; chip formation; force components; heat generation; tool life; mathematical modelling approach; solution of problems; Introduction to discrete-time linear and non-linear models. Non-conventional machining; Principal and mechanism of different processes; Parametric analysis of heat transfer, material removal, and surface finish.

UNIT-III

Metal forming; Mechanics of bulk metal forming; mechanics of sheet metal forming; heat transfer and deformation; Welding; Fusion welding; Welding-heat source modeling,

temperature distribution, effect of surface- active elements, modes of metal transfer in welding; Solid-state welding; Solidification and microstructure; Residual stress and distortion.

UNIT-IV

Casting and powder metallurgy; Cooling and Solidification; principle of powder metallurgy; Coating and additive manufacturing; Principle of surface and coating technology; Principle and development of additive manufacturing technologies

UNIT-V

Heat treatment; Fundamentals of heat treatment; Evaluation of microstructure properties and residualstressofdifferentmanufacturingprocesses.Micro/nanoscalemanufacturing;Down-scalingofconventional manufacturing processes, Change of properties, Micro-to-nano manufacturing; Packaging, finishing, micro joining and nano joining, micro casting, micro forming, micromachining. Processing of non-metallic materials; Principle of plastic processing and shaping of plastics, processing of non-metallic bio-materials; Principle of glass and ceramics processing and shaping of glass and ceramics.

BOOKS AND REFERENCES

1. A Ghosh and A K Mallik: Manufacturing Science,East-WestPressPvtLtd,2ndEd.,2010.
2. DA Brandt, J C Warner: MetallurgyFundamentals,Goodheart-Willcox,2009.
3. C Lakshmana Rao and Abhijit P Deshpande: Modelling of Engineering Materials, Ane Books Pvt. Ltd., New Delhi, India,2010.
4. J. Chakrabarty: Theory of plasticity,3rdEds,Elsevier India, 2009.
5. NormanYZhou:MicrojoiningandNanoioining,Woodheadpublishing,2008
6. RW Messler: Principles of WeldingJohnWileyandSons,1999.
7. J T Blackand Ronald A Kohser: De Garmo's Materials &processes inManufacturingWiley-India,2010.
8. VK Jain: Advanced Machining Processes, Allied Publishers, Mumbai, 2002.
9. Yi Qin: Micro-manufacturing Engineering and Technology, Elsevier, 2015.
10. JZhangand Yeon Gil Jung: Additive Manufacturing: Materials, Processes, Quantifications and Applications, Elsevier, 2018.
11. JA Dantzig and M Rappaz: Solidification,C R Spress, 2009.
12. J.N. Kapur, Mathematical Models in Biology and Medicine, East-West Press Private limited.
13. Leah, Edelste in, Keshet, Mathematical Models in Biology, SIAM publications.
14. J.D. Murray, Mathematical BiologyVol.I,II,3rdedition, Springer publications.

[MTME-013] RENEWABLE ENERGY SYSTEM

L-T-P
3-0-0

Objectives: The subject aim to provide with a solid foundation for developing the use of renewable energy systems in society. The study is suitable for those who wish to work with renewable energy systems.

Course Outcomes:

The students will be able to	
CO1	Understand major concepts of wind energy. Calculate air parameters at different conditions, impact of installation height, wind power and average wind power.
CO2	Calculate the major parameters of sun movement, solar radiation, and tracking systems
CO3	Know the operation and comparative analysis of different concentrating solar power systems.
CO4	Understand the concept of integrated energy system.

SYLLABUS

UNIT-I

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: Solar radiations data; Solar energy collection, Storage and utilization; Solar water heating; air heating; Power generation; Refrigeration and Air-conditioning; Solar Energy system Economics.

UNIT-III

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

UNIT-IV

Bio mass Energy Systems: Availability of bio mass-agro, forest, animal, municipal and other residues; Bio mass conversion technologies; Cooking fuels; Biogas; producer gas; Power alcohol from biomass; Power generation; Internal engine modifications and performance; system economics.

UNIT-V

Wind Energy Systems: Wind data; Horizontal and vertical axis wind mills; 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.

BOOKS

1. Energy Efficient Buildings in India Mili Majumdar Tata Energy Research Institute
2. Understanding Renewable Energy Systems Volker Quaschning -
3. Renewable Energy Systems Simmoes Marcelo Godoy CRC Press
4. Renewable Energy Resources John Twidell Taylor and Francis
5. Renewable Energy Sources and Their Environmental Impact Abbasi & Abbasi Prentice Hall of India.

SEMESTER-I
DEPARTMENTAL ELECTIVE–II

[MTME-015] ADVANCED MECHANICAL VIBRATIONS **L-T-P 3-0-0**

Objectives : The aim of the subject is to review single-degree-of-freedom and n degree-of-freedom vibration to teach how to characterize the dynamic behaviour of a structure in terms of its modal parameters (e.g. natural frequencies), to introduce concepts of digital signal processing and important data acquisition considerations, to teach time vs. frequency domain analysis ,to teach how analytical and experimental dynamic models of a structure can be obtained and how these models can be used (e.g. troubleshooting, etc) ,to introduce impact hammer and shaker excitation techniques and modal testing procedures, to introduce modern vibration data acquisition software and hardware .

Course Outcomes

The students will be able to	
CO1	To understand the fundamentals of Vibration Theory
CO2	To be able to mathematically model real-world mechanical vibration problems
CO3	To use computer software programs to investigate and understand vibration problems.
CO4	Model single- and multi-degree of freedom systems.

SYLLABUS
UNIT-I **Introduction:** Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations **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-II **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-III **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-IV **Non-linear Vibrations:** Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations.

BOOKS

1. Theory and practice of Mechanical Vibrations J.S. Rao and K. Gupta New Age International
2. Mechanical Vibrations G.K. Groover Nem Chand & Brothers
3. Mechanical Vibration Practice V. Ramamurti Narosa Publications
4. Mechanical Vibrations V.P. Singh Dhanpat Rai & sons
5. Textbook of Mechanical Vibrations R.V. Dukkipati & J. Srinivas Prentice Hall of India

[MTME-018] VEHICLE BODY ENGINEERING & SAFETY **L-T-P 3-0-0**

Objectives : Categorize types of body styles and explain the construction of differe of vehicle body and vehicle air conditioning.

Course Outcomes

The students will be able to	
CO1	Illustrate the different types and components of car body.
CO2	Explain the concept, importance and testing of aerodynamics in car body design.
CO3	Illustrate the different types and components of bus and commercial body.
CO4	Explain different vehicle body materials with their merits and demerits.

SYLLABUS

UNIT-I

CAR BODIES: Car body-purpose-requirements-Types, Dimensional regulations-concept, driver's visibility concept- tests for visibility-Methods of improving visibility, space in cars-concept-methods of improving space, Safety- safety design, safety equipments for car, Car body construction components of car body-purpose of each component, Doors-types, window actuating mechanisms types-construction and working, Door locks-types, central locking-concept-working principle, general unitary body construction process.

UNIT-II

VEHICLE AERODYNAMICS: Aerodynamics-concept-Objectives-Vehicle drag-definition-types-effects, forces and moments acting on vehicle body-types-effects, various body optimization techniques for minimum drag. Wind tunnel testing-concept-types-test setup-testing process- Flow visualization techniques- scale model testing-Component balance to measure forces and moments.

UNIT-III

BUS AND COMMERCIAL VEHICLE BODIES: Types, Bus body layouts of each type, Bus Body Lay Out-Floor height-engine location-entrance and exit location-seating dimensions, Constructional details-Frame construction-types-Types of metal section used-Regulations, Double skin construction-concept, Conventional and Integral type construction-concept-merits-demerits, Commercial Vehicle body- Types- illustration of each type, Light commercial vehicle body- types-illustration of each type, Dimensions of driver's seat in relation to controls, driver's cabin design.

BODY MATERIALS: Body material -Requirements-Steel sheet, timber, plastics, GRP, CRP-properties of materials applications in vehicle body, Interior materials-requirements-types-applications, Glasses-types, laminated glass-concept-purpose, defrosting in glasses-concept-purpose.

UNIT-IV

BODY PAINTING: Painting-concept-objectives, elements of paint-resins-concept-function, pigment- concept-function, solvent- concept-function -Types, paint drying process-Types-drying principle of each type-merits demerits, composition &functions- primer paint- putty paint- surface-sealer - top coat, spray painting- Types, air spray painting-procedure, air less spray painting-procedure, electrostatic painting-procedure, New vehicle painting with a block diagram.

AUTOMOTIVE AIR CONDITIONING: Air conditioning- concept, humidity-concept, Automobile air conditioner-layout - functions of each component, refrigerant- metering devices-types, Expansion valve-construction and working, fixed orifice tube-construction and working, Refrigerant –Definition-types-Properties-effect on environment.

BOOKS
1. Powloski J, “Vehicle Body Engineering”, Business Books Ltd., London 1989. 2. John Fenton, “Vehicle body layout and analysis”, Mechanical Engg. Publication ltd, London, 1982. 3. Kohli P. L, “Automotive Chassis & Body”, Papyrus Publishing House, New Delhi, 2010. 4. Wolf-Heinrich Hucho, “Aerodynamics of Road Vehicles” SAE International,USA,1998. 5. Robinson A.,Livesey W. A, “The Repair of Vehicle Bodies”, Butterworth - Heinemann Ltd,1989 6. Sumantran V. and Gino Sovram, “Vehicle Aerodynamics”, SAE International, USA, 1994. 7. John Fenton, “Vehicle Body Layout & Analysis”, Hutchinson, London, 1998.

[MTME-016] ADVANCED I.C. ENGINES

L-T-P
3-0-0

Objectives: To make the student understand

- engine operating parameters like fuel-air mixtures, temperature and cycles
- supercharging, turbo charging and flow through ports and valves
- Combustion process in SI engine and CI engine and emissions formation during the combustion cycle and their treatment.
- metering and flow of charge in SI engines
- modern trends in IC engines

Course Outcomes:

The students will be able to	
CO1	Design parameters like fuel-air mixtures and cycle analysis
CO2	Gas exchange processes and motion of charge in the cylinder and its effects on combustion process in SI and CI engines and control the pollutant formation
CO3	Flow in carburetor and Intake manifolds
CO4	Modern concepts like Lean burn, HCCI, GDI

SYLLABUS
UNIT-I Introduction to Different types of IC Engine Systems, Classification, Construction, Valve arrangements
UNIT-II Fuels, Properties of fuels, Rating of fuels, Alternative fuels, Fuel air cycle, Actual cycles, Combustion in SI engines, Combustion in CI engines, Effect of engine variables, Combustion chambers,
UNIT-III Carburation and fuel injection, Knocking, Engine cooling, Friction and lubrication, Supercharging, Turbocharging, Boost control, Testing and performance,
UNIT-IV Pollution due to engines. Design for SI and CI Engines.

BOOKS
1. Internal Combustion Engines: Applied Thermo sciences Ferguson Colin R John Wiley 2. Fundamentals of Internal Combustion Engines H.N. Gupta Prentice Hall 3. Internal Combustion Engines SK Agrawal New Age international 4. Engineering Fundamentals of the Internal Combustion Engine WW Pulkrabek Prentice Hall of India

SEMESTER-II

[MTME-021] COMPUTER INTEGRATED MANUFACTURING (CIM)

OBJECTIVES:

- Understand manufacturing concepts, including design, planning, scheduling, and quality control.
- Learn CAD/CAM software and their application in designing and manufacturing products.
- Gain hands-on experience through practical exercises, case studies, and projects.

The students will be able to	
CO1	Understand the development of CNC technology and its classification.
CO2	Use standard controllers such as FANUC, Heidenhain, and Sinumeric control systems.
CO3	Explain tool holders, tool assemblies, tool magazines, ATC mechanisms, and tool management.
CO4	Understand concurrent engineering principles, design and development environment, and advance modeling techniques in CIM.

SYLLABUS
UNINT-I **Introduction to CNC Machine Tools:** Development of CNC Technology-Principles and classification of CNC machines, Advantages & economic benefits, Types of control, CNC controllers, Characteristics, Interpolators, Applications, DNC concept.
UNIT-II **CNCProgramming:**coordinateSystem,FundamentalsofAPTprogramming,Manualpartprogramming,structureofpartprogramme,G&MCodes,developingsimplepartprogrammes,Parametric programming,CAMpackagesforCNCmachines,IDEAS,Unigraphics,ProEngineer,CATIA,ESPIRIT,MasterCAMetc.,anduseofstandardcontrollers-FANUC,HeidenhainandSinumericcontrol system.
UNIT-III **Tooling for CNC Machines:** Cutting tool materials, Carbide inserts classification; Qualified, semi-qualified and preset tooling, Cooling fed tooling system, Quick change tooling system, Tooling,systemformachiningcentreandturningcenter,toolholders,Toolassemblies,Toolmagazines,ATCmechanisms,Tool management. **Robotics and Material Handling Systems:** Introduction to robotic technology, and applications,Robotanatomy,materialhandlingfunction,Typesofmaterialhandlingequipment,Conveyersystems,Automatedguidedvehiclesystems,Automatedstorage/retrievalsystems,Work-in-processstorage,Interfacinghandlingand storage with manufacturing.
UNIT-IV **GroupTechnologyandFlexibleManufacturingSystem:**groupTechnology,partfamilies,Partsclassificationandcoding,Productionflowanalysis,MachineCellDesign,BenefitsofGroupTechnology,Flexiblemanufacturingsystems,Introduction,FMSworkstations,Computercontrolsystem,Planningfor FMS, Applications and benefits.
UNIT-V **Computer Integrated Manufacturing:** Introduction, Evaluation of CIM, 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.

BOOKS
1. Computer Numerical Control Machines P. Radah krishnan New Central Book Agency 2. CNCMachinesM.S.SehrawatandJ.S.NarangDhanpatRaiandCo.CNCProgrammingHandbookSmidPeterIndustrialPressInc. 3. Automation, Production systems and Computer M. P. Groover Prentice Hall of India Integrated Manufacturing 4. Computer Integrated Manufacturing Paul Ranky Prentice Hall of India

L-T-P

[MTME-022] ADVANCED MECHANICS OF SOLIDS **3-0-0**

Objective:

Understand the mathematical and physical foundations of the continuum mechanics of solids, including deformation and stress measures, elastic and plastic stress-strain relations, and failure criteria;

- To idealize a system or component for the purposes of stress analysis.
- To use appropriate numerical and analytical techniques to model the system.
- To interpret and draw appropriate conclusions from the results.

The students will be able to	
CO1	Learn about the elastic and plastic behavior of material and evaluate stress invariants, principal stresses and their directions.
CO2	Determine strain invariants, principal strains and their directions.
CO3	Develop constitutive relationships between stress and strain for linearly elastic solid.
CO4	Analyze theories of failure and design components for safe operation. Examine the properties of ideally plastic solid and apply the concepts of energy methods in solving structural problems.

SYLLBUS
UNIT-I Mathematical Preliminaries: Scalars, vectors and matrix variables, index notation and the related rules, Cartesian tensors and their algebra, coordinate transformation, transformation rules for the nth 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.
UNIT-II 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-Kirch off stress tensors and their properties.
UNIT-III 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-IV Constitutive Modeling: Thermodynamic principles, first and second law of thermodynamics, Generalized Hooke's law for isotropic materials, elastic constants and their relations, anisotropic, hyperelastic and viscroelastic material models, strain hardening, constitutive relations for elasto-plastic materials, flow and hardening rules.
UNIT-V **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 solutionstrategies.

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.

BOOKS

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.

[MTME—021P] COMPUTER INTEGRATED MANUFACTURING LAB **L-T-P**

Objectives: **3-0-0**

Computer Integrated Manufacturing (CIM) lab are to provide students with hands-on experience in various aspects of manufacturing, such as 3D modeling, CNC programming, robotics, and

CAD software design, while also preparing them for research and development careers in the field of CIM.

The students will be able to	
CO1	Improved understanding of 3D modeling using CAD software and its applications in the manufacturing industry.
CO2	Enhanced knowledge and skills in CNC programming on turning and milling machines, and simulation of CNC programming on CAM software.
CO3	Ability to study and demonstrate the use of robots in manufacturing and program basic robot functions.
CO4	Understanding of computer-controlled business functions and the role of CIM in the manufacturing industry.

LIST OF PRACTICLAS
1. 3D Modeling using CAD software.
2. CNC programming on turning.
3. CNC programming on milling.
4. Simulation of CNC programming on CAM Software
5. Study and demonstration on Robots.
6. Basic Robot Programming and Simulation.
7. Study of computer controlled business functions.
8. Study of interfacing requirements in CIMS.
9. Generation of any surface using any CAD software.
10. Design/ Thermal Analysis by CAD Software.

SEMENSTER –II
DEPARTMENT ELECTIVE-III
[MTME-201] ADVANCED WELDING TECHNOLOGY

L-T-P
3-0-0

Objectives: The objective of this course is to learn various concepts related to welding, its application. To have practical purview of various welding process, welding standards, advanced welding process.

Course outcomes

The students will be able to	
CO1	Explain metal transfer mechanism and classify different types of welding process on the basis of heat sources.
CO2	Explain the mechanism of modern welding process and their Parameters and control.
CO3	Explain different Non Destructive Testing methods for welds.
CO4	Explain different Inspection codes for weldments.

SYLLABUS
UNIT-I **Welding Metallurgy:** 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:** Principles of sound weld design, Welding joint design, Welding defects; Testing of weldament, Material joining characteristics, Welding positions, Allowable strength of welds under steady loads, Weld throat thickness; Weld quality, Discontinuities in welds, their causes and remedies and quality conflicts.
Modern Trends in Welding: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.
Mechanisation in Welding: Mechanisation of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanisation of I beams (arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating tables positioners), Manufacture of welding longitudinal welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.
Robotics in Welding: 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.

BOOKS
1. Advanced Welding Processes Nikoda co & Shansky MIR Publications 2. Welding Technology and Design VM Radhakrishnan New Age International 3. Source Book of Innovative welding Processes M.M. Schwariz Americal 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

[MTME-202] INDUSTRIAL AUTOMATION AND ROBOTICS

L-T-P
3-0-0

Objectives: This course provides theoretical and practical aspects of implementing automation in industry. This course offers learning of pneumatics/ hydraulics systems, electrical controls and Programmable logic controllers.

Course outcomes

The students will be able to	
CO1	understand the role of automation systems for the smart factory;
CO2	Manage the design of simple automation systems in terms of both discrete and continuous control understands the communication technologies for industrial systems.
CO3	Identify the role of industrial robots in the factory, why and where they should be used in the production systems.
CO4	Understand and master the new trends in industrial robotics, like collaborative robotics.

SYLLABUS
Introduction to Automation: Automation production system, Mechanization and automation, Types of automation, Automation strategies, Mechanical, electrical, hydraulic and Pneumatic automation devices and controls, Economics of automation. **High Volume Manufacturing Automation:** Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multi model and mixed model production lines.
Programmable Manufacturing Automation: CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations. **Flexible Manufacturing Automation:** Introduction to Group Technology, Grouping methods, Cell Design, Flexible manufacturing system. **Assembly Automation:** Assembly systems, Automatic transfer, feeding and orienting devices, Flexible assembly systems, Performance evaluation and economics of assembly systems.
Robotics: Review of robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, End Effectors, Robot kinematics, Object location, Homogeneous transformation, Direct and inverse kinematics, Manipulator motions, Robot drives, actuators and control, Drive systems, Hydraulic, Pneumatic Electrical DC and AC servo motors and stepped motors, Mechanical transmission method- Rotary-to-rotary motion conversion, Robot motion and path planning control and Controllers, Robot sensing, Range sensing, Proximity sensing, touch sensing, Force and torque sensing etc., Robot vision, Image representation, Image recognition approaches.
Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications.

BOOKS
1. Automation, Production System & Computer Integrated Manufacturing Groover Prentice Hall India
2. Principles of Automation & Automated Production Process Malov and Ivanov Mir Publication
3. Automation in Production Engineering Oates and Georgy Newness -
4. Stochastic Models of Manufacturing Systems Buzacott& shanty Kumar Prentice Hall India
5. Robotics K.S. Fu, R.C. Gonzalez, C.S.G. Lee McGraw Hill
6. Robotics J.J. Craig Addison-Wesely
7. Robot Engineering: An Integrated Approach R.D. Klafter, t.a. Chmielewski and M. Negin Prentice

[MTME-203] INDUSTRIAL OPTIMIZATION TECHNIQUES

L-T-P
3-0-0

Objectives: The objective of this course is to familiarize the graduate engineers with techniques in linear programming, sequencing and network analysis, theory of games and Queuing models, Dynamic Programming and Simulation and Inventory control and Replacement Models. It aims to equip the students with standard concepts and tools from previously gained knowledge to an advanced level that will enable them to tackle more advanced level of Optimization techniques and applications that they would find useful in their disciplines

Course outcomes

The students will be able to	
CO1	Remember the concept of simultaneous equations, apply for evaluating mathematical programming problems to evaluate optimal solution
CO2	Understand the concept of extreme to create, critical path and analyzing for application in Engineering.
CO3	Remember the concept of matrices, maxima and minimize to evaluate the value of the game and create the model.
CO4	Analyze the concept of simulation in different ways by simulation techniques methods.

SYLLABUS
Linear Programming: Historical development of optimization, engineering application of optimization, formulation of design problems as a mathematical programing problem. Graphical method of solution, Simplex method, Dual Simplex method and its application in engineering. **Transportation and Assignment:** Introduction, Mathematical formulations, optimal solution of transportation model. Assignment problems: mathematical formulation, solution of Assignment models (Hungarian method), variation of the Assignment problem, the travelling sales man problem and their application in Engineering.
Sequencing and Network Analysis: Introduction of sequencing, General assumptions, n Jobs through 2 machines, n jobs through 3 machines, n jobs through m machines, 2 jobs through m machines and their applications in Engineering. **Network Analysis:** Introduction, Network logic (Network or arrow diagram), Rules for drawing network diagrams, time analysis, forward and backward computation CPM and PERT, and their applications in Engineering.
Theory of Games and Queueing Models: Introduction, 2 person zero sum games, Maximin and minimax principle, game with saddle point and without saddle point, Principle of dominance, Rectangular games, graphical solution of 2 x n or m x 2 games. **Queuing model:** Introduction, Application of Queuing model, generalized Poisson queuing model, single server models and multiple channel Queuing model and their applications in Engineering. **Dynamic Programming and Simulation:** Introduction Formulation of Dynamic Programming Problem, Dynamic Programming Algorithm, Forward recursions, Capital Budgeting Problem, Cargo-loading Problem. Solution of LPP by DPP.

Simulation: Introduction, definition and types of simulation, need for Simulation advantage and disadvantage, application of simulation, simulation procedure, Monte Carlo simulation and their applications in Engineering.

Inventory Control and Replacement Models: Introduction, types of inventories, Inventory cost, Deterministic and probabilistic (nondeterministic) inventory models and their application in engineering.

Replacement models: Introduction, definition, Replacement of items that deteriorate, Replacement of items that fail suddenly, Equipment Renewal Problem, Individual and Group Replacement policies & their applications in Engineering

BOOKS

1. H.A. Taha: Operations Research – An Introduction, Macmillan Publishing Company, Inc., New York.
2. K. Swarup, P.K. Gupta, M. Mohan: "Operations Research", Sultan Chand and Sons, New Delhi.
3. P.K. Gupta, D.S. Hira: "Operations Research" – An Introduction, S. Chand & Company Limited, New Delhi.
4. S.S. Rao: "Optimization Theory and Applications", Wiley Eastern Ltd., New Delhi.
5. J.K. Sharma: "Operations Research: Theory and Applications", Mac Millan India Ltd.

SEMESTER-II
DEPARTMENT ELECTIVE-IV

L-T-P
3-0-0

MTME 211: TOTAL QUALITY MANAGEMENT

Objective: The course aims to impart knowledge on quality management principles, tools, techniques and quality standard for real life applications.

Course outcomes:

The students will be able to	
CO1	Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2	Apply the Quality Function Deployment, Taguchi principles, Total Productive Maintenance and Failure Mode and Effect Analysis concepts to solve industrial problems.
CO3	Evaluate the performance measures using various quality and management tools
CO4	Practice the various quality systems in industry.

SYLLABUS
UNIT-I **Introduction and Components of TQM:** Concept and Philosophy of TQM, Value and Quality assurance, Total Quality Control, Quality policy, Team-work and participation, Quality cost measurement, Quality Circle, Customer/Supplier integration, Education and training.
UNIT-II **Tools and Techniques of TQM:** Statistical method in quality control, Process control chart, Acceptance sampling plan, Statistical Productivity control (SPC)
UNIT-III **Reliability:** Failure analysis, System reliability and redundomy
UNIT-IV **TQM implementation:** Steps in promoting and implementing TQM in manufacturing industries, Industrial Case studies.
UNIT-V **ISO 9000 Quality Systems:** Concepts, designation Standards, Quality system documentation, Quality manual, Quality procedures and work inspection.

BOOKS
1. Total Quality Control F. Ammandev Tata McGraw Hill
2. Total Quality Management Besterfield, et. al. Prentice Hall of India
3. Total Quality Management: Text and Cases B. Janakiraman& RK Gopal Prentice Hall of India
4. What is Total Quality Control? K. Ishikawa Prentice hall
5. Total Quality Management: The Route to Improving Performance J.S. Oakland Butterworth Heineman Oxford
6. Out of Crisis W.E Dming Centre of Advance Engineering Study, Cambridge

MTME-212: ADVANCED MACHINE DESIGN

L-T-P
3-0-0

Objectives: The overall objective of this course is to learn how to analyze the motions of mechanisms, design mechanisms to have given motions, and analyze forces in machines.

Course outcomes:

The students will be able to	
CO1	Attain the ability to apply the fundamental knowledge of machine design in synthesis, analysis, design and development of components/machines using modern engineering tools.
CO2	find out cost-effective solutions to real life problems and to prepare technical reports.
CO3	Employ modern engineering management and financial tools to cater to the needs of the community
CO4	Inculcate creativity and passion to develop innovative solutions to engineering problems.

SYLLABUS
UNIT-I **Introduction:** Concepts related to kinematics and mechanisms, Degrees of freedom, Grubler's Criteria, Transmission and Deviation angles, Mechanical advantage.
UNIT-II **Kinematic Synthesis:** Type, number and dimensional synthesis, Spacing of accuracy points, Chebyshev polynomials, Motion and function generation, Graphical synthesis with two, three and four prescribed motions and points, The complex number modeling in kinematic synthesis, The Dyad, Standard form, Freudentein's equation for three point function generation coupler curves, Robert's law, Cognates of the slider crank chain.
UNIT-III **Path Curvature Theory:** Fixed and moving centrode, Inflection points and inflection circle circle, Euler'-savary Equation, Bobillier's and Hartsman construction.
UNIT-IV **Dynamic Force Analysis:** Introduction, Inertia force in linkages, Kineto static analysis by superposition and matrix approach, Time response of mechanisms, Force and moment balancing of linkages.
UNIT-V **Spatial Mechanism:** Introduction to 3-dimensional mechanisms, Planar Finite, Rigid body and spatial transformation, Analysis of spatial mechanisms.

BOOKS
1. Fundamentals of applied Kinematics D.C. Tao Addison Wesley
2. Kinematic Synthesis of Linkages R. Hartenberg and Denavit McGraw Hill
3. Kinematic Analysis and Synthesis of Mechanisms A.K. Mallik and A. Ghosh CRC Press
4. Theory of Mechanisms A.K. Mallik and A. Ghosh East west Press
5. Kinematics and Dynamics of Plane Mechanisms J. Hirschern McGraw Hill, NY

MTME-213: MODELLING AND SIMULATION OF DYNAMIC SYSTEMS

L-T-P
3-0-0

Objectives: Construct bond graphs for the type of systems mentioned above, simplify and analyze the bond graph according to causality conflicts, and from a given bond graph without conflicts.

Course outcomes:

The students will be able to	
CO1	Define, describe and apply basic concepts related to modeling and simulation.
CO2	Use conservation laws and constitutive relationships and other physical relations to model mechanical, electrical and flow systems, and combinations of these.
CO3	Find dynamic response and transfer function using various tools for system modeling.
CO4	Model and simulate mechanical and electrical systems using the computer tools Simulink.

SYLLABUS
UNIT-I **Introduction to modeling and simulation:** Introduction to modeling, Examples of models, modeling of dynamic system, Introduction to simulation, MATLAB as a simulation tool, Bond graph modeling, causality, generation of system equations,
UNIT-II **Bond graph modeling of dynamic system:** Methods of drawing bond graph model- Mechanical systems & Electrical systems; some basic system models Mechanical systems, Thermal systems, hydraulic systems, pneumatic systems and electrical systems.
UNIT-III **System models of combined systems:** Linearity and non-linearity in systems combined rotary and translator system, electro mechanical system, hydro mechanical system. **Dynamic Response and System Transfer Function:** Dynamic response of 1st order system and 2nd order system, performance measures for 2nd order system, system transfer function, transfer function of 1st and 2nd order system Block diagram algebra, signal flow diagram, state variable formulation, frequency response and bode plots.
UNIT-IV **Simulation and simulation applications:** Simulation using SIMULINK, examples of simulation problems- simple and the compound pendulum, planner mechanisms, validation and verification of the simulation model, parameter estimation methods, system identifications, introduction to optimization.

BOOKS
1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2nd Edition. Academic press 2000 2. Robert L. Woods, Kent L. Lawrence, “Modeling and simulation of dynamic systems”, Person, 1997. 3. Brown, Forbes T. “Engineering System Dynamics”, New York, NY: CRC, 2001. ISBN: 9780824706166. 4. Pratab.R " Getting started with MATLAB" Oxford university Press 2009

SEMESTER-II
DEPARTMENT ELECTIVE-V

[MTME -221] MODERN MANUFACTURING PROCESSES

L-T-P
3-0-0

Objective:

The course aims

- To impart the knowledge of basic methodology of metal cutting.
- To educate the student about the structure, working, forces involved in single point and multipoint cutting tools.
- To understand the concepts of tool life, machinability, wear, influence of heat.
- To design the jigs and fixtures required for machine tools.

Course Outcomes:

The students will be able to	
CO1	Evaluate the speed, feed, depth of cut and their influence on surface roughness and performance measures, Metal removal rate, tool wear rate, machining time, energy, work done, heat distribution. To make acquainted the various unconventional manufacturing processes
CO2	Able to understand different types of composite material characteristics, types of micro & macro machining processes.
CO3	To know about the applications of advanced manufacturing processes
CO4	To make acquainted the various unconventional manufacturing processes

SYLLABUS

UNIT-I

Metal cutting: Need for rational approach to the problem of cutting metals-Observation in metal cutting, Energy considerations in machining, Modern theories in mechanics of cutting, Review of Merchant and Lee Shaffer theories, critical comparison, Measurement of cutting forces-Classification of cutting force dynamometers, Lathe tool dynamometer, Drill, Milling and grinding dynamometer, Heat distribution in machining-Effects of various parameters on temperature, Method of temperature measurement in machining, Hot machining, Cutting fluids.

UNIT-II

Tool Materials, Tool Life and Tool Wear & Wear Mechanisms: Essential requirements of tool materials, Developments in tool materials, ISO specifications for inserts and tool holders, Tool life, Conventional and accelerated tool life tests, Concepts of machinability and mach inability index, Economics of machining, Reasons for failure of cutting tools, Forms of wear, Chatter in machining, Chatters types, Mechanism of chatter based on force vs Speed graph, Mechanism of grinding, Various parameters affecting grinding process, Machinability data systems.

UNIT-III

Sheet Metal Forming & Special Forming Processes: Review of conventional processes, HERF techniques, Super plastic forming techniques, Principles and Process parameters, Advantages, applications and limitations of HERF techniques, Orbital forging, Isothermal forging, Hot and cold iso- static pressing, High speed extrusion, Rubber pad forming, Water hammer forming, Fine blanking.

UNIT-IV

Unconventional and special Welding Processes and Automation: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Automation in welding, Welding robots, Overview of automation of welding in aerospace, Nuclear, Surface transport vehicles and under water welding.

UNIT-V

Special Casting Processes & Recent Advances in Casting: Shell moulding, precision investment casting, CO2 moulding, Centrifugal casting, Die and continuous casting, Low pressure die casting, Squeeze casting, Full mould casting process, Layout of mechanized foundry, sand reclamation, Material handling in foundry, Pollution control in foundry, recent trends in casting, Computer aided design of casting.

BOOKS

1. Metal Cutting Principles M.C. Shaw Oxford Clarendon Press
2. Metal Cutting Theory and Practice Bhattacharya New Central Book Agency
3. Fundamentals of Metal Cutting and Machine Tools B.L. Juneja and G.S. Sekhon New Age International
4. Principles of Metal Cutting G. Kuppuswamy Universities Press
5. Fundamentals of Machining and Machine Tools D.G. Boothroy and W.A. Knight Marcel Dekker, NY
6. Fundamentals of Metal Casting H. Loper and Rosenthal Tata McGraw Hill

[MTME-222] AUTOMATION AND ROBOTICS

L-T-P
3-0-0

Objective: Gain an understanding of the theoretical background necessary to understand advanced robotic technologies and their specific applications.

Course outcomes:

The students will be able to	
CO1	Gain knowledge of basic mechanical designing, electrical wiring, robotic sensors and actuators, PCB design and communication protocols.
CO2	Demonstrate proficiency in design, construction, and operation of robotic systems.
CO3	Develop problem-solving skills by applying principles of robotics engineering to real-world problems.
CO4	Communicate effectively about robotics engineering technologies, their workings and Potential applications.

SYLLABUS

UNIT-I

Introduction to Robotics: To introduce students to Robotics Engineering as a discipline and expose them to the multifaceted world of robots. Types of robots, Degrees of freedom of robots, Robot configurations and concept of workspace, Overview of robot subsystems, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

UNIT-II

Rigid-body motions and twists: Rotations and angular velocities, Homogenous transformation matrices, Twists.

Formulation of Forward and Inverse kinematics: Forward kinematics in space frame and end-effector frame, Analytical and numerical inverse kinematics.

Velocity kinematics and statics: Manipulator Jacobian; Relationship between space and body Jacobian, Statics of open chains; Singularity analysis.

UNIT-III

Dynamics of open chain robot manipulators: Lagrangian formulation; Dynamics of single rigid body, Newton-Euler inverse dynamics, Dynamic of open chains, Constrained dynamics; Numerical algorithms for forward and inverse dynamics.

Robot subsystems: Sensors and Actuators; Image Processing and Computer Vision, Robotic Control Systems.

Introduction to Robo Analyzer: DH Parameters Visualization, Forward Kinematics; Inverse Kinematics; Forward Dynamics; Inverse Dynamics, Building Virtual Robot Module.

UNIT-IV

Robotics Applications and Project Work and Presentation: the advanced robotics applications, including automation systems, robotic arm design and control, robot-vehicle interaction, and collaborative robots, robotic inspection and safety considerations.

Objective of Project Work and Presentation: To apply the principles and concepts learned in the course to design a robotic system. Students will have to build and test a fully functional robotic system that meets the specific requirements. Finally, students will present their projects to the class.

BOOKS
1. S. K. Saha, “Introduction to Robotics”, Tata McGraw Hill Education Pvt. Ltd., New Delhi. 2. R. K. Mittal, I. J. Nagrath, “Robotics and Control”, Tata McGraw-Hill Publishing Company Ltd. 3. J. J. Graig, “Introduction to Robotics – Mechanics and Control”, 2nd edition, Pearson Education, Inc. 4. K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, “ROBOTICS – Control, Sensing, Vision, and Intelligence”, McGraw-Hill Book Company. 5. Saeed Niku, “Introduction to Robotics – Analysis, Control, Applications”, John Wiley & Sons. 6. Mohsen Shahinpoor, Harper and Row, “A Robot Engineering Textbook”, New York 7. Roboert J. Schilling, “Fundamentals of Robotics – Analysis & Control”, Prentice-Hall of India Pvt. Ltd. 8. S. R. Deb and S. Deb, “Robotics Technology and Flexible Automation”, Second Edition, Tata McGraw Hill Education Pvt, Ltd., New Delhi

[MTME-223] MACHINE VISION

L-T-P
3-0-0

Objective : The course aims to introduce students the fundamentals of image formation; To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications.

Course outcomes:

The students will be able to	
CO1	Identify basic concepts, terminology, theories, models and methods in the field of computer vision,
CO2	Describe known principles of human visual system,
CO3	Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition,
CO4	Suggest a design of a computer vision system for a specific problem

SYLLABUS
UNIT-I Image capture and digitization; Image transforms; Digital Fourier transform; Fast Fourier transform; Other transforms; Convolution; Image enhancement; Spatial methods; Frequency domain methods; Image restoration.
UNIT-II Geometric transformation; Image compression; error free and lossy compression; Edge detection; Hough transform; Region based segmentation; image feature / region representation and descriptors; Morphological operators.
UNIT-III Feature based matching; Baye's classification; Low level vision; Introduction to stereopsis, Shape from shading; Optical flow; Rule based picture segmentation; tutorial exercise will emphasize development and evaluation of image algorithms.

BOOKS
1. Image Processing, Analysis and Machine Vision Milan Sanka, Vaclav Hlavac and Roger Boyle Vikas Publishing 2. Digital Image Processing Kenneth &Castleman Prentice Hall India 3. Digital Image Processing Conzalez RC & P WintAddision Wesley 4. Digital Image Processing & Analysis Chandra and Mazumdar Prentice Hall India

SEMESTER-I/II
AUDIT 1 & 2

[MTAC-11]ENGLISH FOR RESEARCH PAPER WRITING

Objective: English for Research Paper Writing course is to improve students' ability to write effective research papers in English by teaching them key concepts in academic writing and providing them with practical skills and strategies to communicate their research effectively to a global audience.

Course outcomes:

The students will be able to	
CO1	Understand that how to improve your writing skills and level of readability
CO2	Learn about what to write in each section
CO3	Understand the skills needed when writing a Title

SYLLABUS
UNIT-I Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
UNIT-II Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
UNIT-III Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,
UNIT-IV skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions
UNIT-V useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

SUGGESTED STUDIES
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook. 4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

[MTAC-12] DISASTER MANAGEMENT

Objective: Disaster Management course is to provide students with knowledge and skills to understand, prevent, and respond to natural and human-made disasters, including disaster planning, mitigation, and recovery, and to develop critical thinking and problem-solving skills necessary to manage complex disaster situations.

Course outcomes:

The students will be able to	
CO1	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4	critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

SYLLABUS
UNIT-I Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.
UNIT-II Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.
UNIT-III Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics
UNIT-IV Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.
UNIT-V Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED STUDIES

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

[MTAC-13] SANSKRIT FOR TECHNICAL KNOWLEDGE

Objectives:

1.To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects
4. Enhancing the memory power
5. The engineering scholars equipped with Sanskrit will be able to explore
6. Huge knowledge from ancient literature

Course outcomes:

The students will be able to	
CO1	Understanding basic Sanskrit language
CO2	Ancient Sanskrit literature about science & technology can be understood
CO3	Being a logical language will help to develop logic in students

SYLLABUS
UNIT-I Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences
UNIT-II Order, Introduction of roots ,Technical information about Sanskrit Literature
UNIT-III Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematic

SUGGESTED STUDIES
1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi 2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication 3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

[MTAC-14] VALUE EDUCATION

Objective:

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course outcomes:

The students will be able to	
CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the overall personality

SYLLABUS
UNIT-I Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles. Value judgements
UNIT-II Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline
UNIT-III Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature
UNIT-IV Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

SUGGESTED STUDIES
1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

[MTAC-15] CONSTITUTION OF INDIA

Objective:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course outcomes:

The students will be able to	
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4	Discuss the passage of the Hindu Code Bill of 1956.

SYLLABUS
UNIT-I History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working, Philosophy of the Indian Constitution: Preamble Salient Features
UNIT-II Contours of Constitutional Rights & Duties: Fundamental Rights ,Right to Equality ,Right to Freedom, Right against Exploitation ,Right to Freedom of Religion ,Cultural and Educational Rights, Right to Constitutional Remedies ,Directive Principles of State Policy, Fundamental Duties.
UNIT-III Organs of Governance: Parliament, Composition ,Qualifications and Disqualifications ,Powers and Functions, Executive, President, Governor, Council of Ministers ,Judiciary, Appointment and Transfer of Judges, Qualifications ,Powers and Function
UNIT-IV Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy
UNIT-V Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

SUGGESTED STUDIES
1. The Constitution of India, 1950 (Bare Act), Government Publication. 2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015. 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

[MTAC-16] PEDAGOGY STUDIES

Objective:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Course outcomes:

The students will be able to	
CO1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SYLLABUS
UNIT-I Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.
UNIT-II Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.
UNIT-III Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.
UNIT-IV Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes
UNIT-V Research gaps and future directions, Research design ,Contexts

SUGGESTED STUDIES
1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261. 2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379. 3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher

education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

[MTAC-17] STRESS MANAGEMENT BY YOGA

Objective:

1. To achieve overall health of body and mind
2. To overcome stress

Course outcomes:

The students will be able to	
CO1	Develop healthy mind in a healthy body thus improving social health also
CO2	Improve efficiency

SYLLABUS
UNIT-I Definitions of Eight parts of yog. (Ashtanga)
UNIT-II Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan
UNIT-III Asan and Pranayam i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

SUGGESTED STUDIES
1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur 2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

[MTAC-18] PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Objective:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course outcomes:

The students will be able to	
CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neetishatakam will help in developing versatile personality of students.

SYLLABUS
UNIT-I Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom),Verses-29,31,32 (pride & heroism),Verses- 26,28,63,65 (virtue) ,Verses- 52,53,59 (dont's),Verses-71,73,75,78 (do's)
UNIT-II Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,Chapter 18-Verses 45, 46, 48.
UNIT-III Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68,Chapter 12 -Verses 13, 14, 15, 16,17, 18 ,Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39,Chapter18 – Verses 37,38,63

SUGGESTED STUDIES
1"Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata 2Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, 3Rashtriya Sanskrit Sansthanam, New Delhi.

[MTME -022P] MINI-PROJECT WITH SEMINAR

Objectives:

- To prepare students for the method of literature survey, realization of journal papers outcomes,
- expose them to the world of research and compilation/review of a research area of current era and prepare them for presentation of literature summary
- Presentation on advanced topics in the field of Mechanical Engineering.

Course outcomes:

The students will be able to	
CO1	Students will get an opportunity to work in actual industrial environment if they opt for internship.
CO2	In case of mini project, they will solve a live problem using software/analytical/computational tools.
CO3	Students will learn to write technical reports.
CO4	Students will develop skills to present and defend their work in front of technically qualified audience.

Syllabus Contents:

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

SEMESTER-III
PROGRAMME ELECTIVE-V
[MTME 031] DESIGN OF SOLAR AND WIND SYSTEM

Course Outcome:

The students will be able to	
CO1	Student should update about the technological status of implementation of NCES in India
CO2	Student should capable to analyze various techno economical obstacles in the commercial development of NCES in India
CO3	Student should capable to conceptually model and design general NCES systems and predict the long term performance.
CO4	Student should suggest and plan hybrid NCES solutions to conventional energy systems

SYLLABUS
UNIT-I Conventional sources of energy, Nuclear, Alternative energy sources, Solar Radiation-estimation, prediction & measurement, Solar energy utilization
UNIT-II Performance of Solar flat plate collectors, concentrating collectors, thermal storage,
UNIT-III Wind energy, Direct Energy conversion- PV, MHD,
UNIT-IV Fuel cells, thermionic, thermoelectric, Biomass, biogas, hydrogen, Geothermal.
UNIT-V Design and Analysis of a Solar-Wind Hybrid System

REFERENCES

- D.Y. Goswami, F. Kreith and J.F. Kreider, "Principle of Solar Engineering", Taylor and Francis, 2000
- Sukhatme S.P., "Solar Energy", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994
- Bansal and othes, "Non-Conventional Energy Sources"
- J.F. Kreider, F. Kreith, "Solar Energy Handbook", McGraw Hill, 1981
- J.A. Duffie and W.A. Beckman, "Solar Engineering of Thermal Processes", John Wiley, 1991.

[MTME 032] ADVANCED MATHEMATICAL METHODS IN ENGINEERING

Objectives: This course will enable the students

• To understand the technique of numerically computing for various accuracies in the modeling equations.

• To learn and use the fundamentals of most commonly occurring situations in the form of ODE's and PDE's for real life applications.

• To understand the concepts of probability and testing of hypothesis for a sample data and further general conclusion can be taken to the whole data using statistical methods.

Course Outcome:

The students will be able to	
CO1	Acquire the idea of significant figures, types of errors during numerical computation.
CO2	Develop the mathematical models of thermal system using ODE's and PDE's.
CO3	Learn the deterministic approach for statistical problems by using probability distributions.
CO4	Classify and analyze mathematical tools applied to thermal engineering study cases.

SYLLABUS
UNIT-I Error definition, round off errors and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering Roots of Equations by numerical methods: Secant Method, Newton- Raphson method, Horner's Method.
UNIT-II Solving ODE"s using: Picard's method, Runge Kutta f ourth order and Stiffness of ODE using shooting method. Solving PDE's by numerical method: one dimensional wave equation and heat equation.
UNIT-III Probability distributions: Binomial, Poisson. Normal. Sampling Theory: Testing of hypothesis using t and test, Goodness of fit
UNIT-IV F-test, Analysis of Variance: One – way with/without inter actions, problems related to ANOVA, Design of experiments, RBD. Engineering Applications on : i) The swinging Pendulum ii) ii) Vibrating string

REFERENCES
1. C. Ray Wylie and Louis C Barrett, "Advanced Enginee ring Mathematics". 6 th edition, McGraw-Hill, 1995. 2. K Shankar Rao, "Introduction to Partial Differentia l Equations" Prentice - Hall of India Pvt. Lt. , 1995 Edition. 3. Steven C Chapra and Raymond P Canale, "Numerical Me thods for Engineers," 7 th Ed.,McGraw-Hill Edition, 2015.

4. William W.H., Douglas C.M., David M.G.and Connie M.B., “Probability and Statistics in Engineering, 4th Edition, Willey Student edition, 2008.
5. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
6. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.

[MTME 033] COMPOSITE MATERIALS

Objectives: The course is framed to cover basic and important knowledge of composites. Students will be able to acquire essential details about the types of composite materials and common manufacturing techniques. Students will be taught how to select composite materials for particular applications. The syllabus is developed to cover important domains to impart necessary and relevant information including the state of-the-materials..

Course Outcome:

The students will be able to	
CO1	Explain and differentiate composite materials based on specific applications.
CO2	Describe the important fabrication methods based on matrix materials.
CO3	Narrate the various methods available to test the Composites through NDT methods.
CO4	Explain the purpose and significance of Multi-Functional Composites.

SYLLABUS

UNIT-I

INTRODUCTION: Introduction to Composites, function of the matrix and reinforcement in composites. Classification: polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon composites, fiber reinforced composites, particulate reinforced composites and nature-made composites.

Reinforcement types: Fiber Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide

UNIT-II

MANUFACTURING METHODS: Polymer Matrix Composites-Thermoset Composite manufacturing- Layup processes, Spray up process, Fiber placement process, Resin transfer moulding, Vacuum assisted resin transfer moulding, Compression moulding process, Filament winding. Thermoplastic Composite manufacturing- Sheet moulding, Injection moulding, sheet moulding, Calendaring, Extrusion, Blow moulding, rotational moulding, Thermoforming.

Metal Matrix Composites- Solid state methods- hot iso static pressing (HIP), Foil diffusion bonding. Liquid state methods- Stir casting, Squeeze casting, Pressure infiltration; Ceramic matrix composites- sintering,

CVD.

UNIT-III

COMPOSITES DESIGN AND TEST: Laminate theory, Rule of mixtures, symmetry and balance. Nondestructive testing of Composites- Visual inspection, Tap testing, Ultrasonic inspection, X-ray inspection, Thermography. Manufacturing process selection: Cost, performance, size shape, rate of production. Steps for process selection.

MULTI-FUNCTIONALCOMPOSITES: Properties of multi-functional composites, Fabrication techniques of multi-scale Composites. Methods of CNT Incorporation within Multi-scale Composites-Dispersion, Ultra sonication. Growth of CNTs on Fibre Surface-Spraying Method, Transfer Printing, Chemical Grafting Process. Properties of Multi-scale Composites- Mechanical properties, Electrical and Thermal Conductivity, Electromagnetic Shielding, Self-sensing Properties.

UNIT-IV

POLYMER COMPOSITE MATERIALS: Synthesis of Graphene- Bottom-up approaches,

Top-down approaches. Surface modification of grapheme -Non-covalent modification, Covalent modification. Fabrication of grapheme polymer composites- Solution mixing, In-situ polymerization, Melt blending, Other methods. Applications- Structural reinforcement materials, Functional materials, Biomedical applications.

REFERENCES

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.
5. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
6. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

SEMESTER-III
OPEN ELECTIVE-III
[MTOE 031] BUSINESS ANALYTICS

Objectives:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.

Course Objectives:

The students will be able to	
CO1	Students will demonstrate knowledge of data analytics.
CO2	Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
CO3	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
CO4	Students will demonstrate the ability to translate data into clear, actionable insights.

SYLLABUS
UNIT-I **Business analytics:** Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.
UNIT-II **Trendiness and Regression Analysis:** Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
UNIT-III Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
UNIT-IV Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using , Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

REFERENCE

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

[MTOE 032] INDUSTRIAL SAFETY

Objective: The objective of this syllabus is to provide a comprehensive understanding Industrial safety, Fundamentals of maintenance engineering, Wear and corrosion and their prevention etc.

Course Outcomes

The students will be able to	
CO1	Identify different types of industrial accidents, their causes, and the resulting consequences
CO2	Understand the primary and secondary functions and responsibilities of the maintenance department
CO3	Learn the different methods of lubrication and their working principles and applications
CO4	Use the decision tree concept to find faults in different types of equipment like machine
CO5	Identify the steps/procedures for periodic and preventive maintenance of different types of equipment like machine tools, pumps, air compressors, diesel generating (DG) sets, etc.

SYLLABUS
UNIT-I Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.
UNIT-II Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.
UNIT-III Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.
UNIT-IV Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal

combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes

UNIT-V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

REFERENCE

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

[MTOE-033] OPERATIONS RESEARCH

Objective: Students are to introduce them to the concepts and techniques used in decision-making and optimization problems, to develop analytical and problem-solving skills, and to equip them with knowledge and tools to apply operations research methods in engineering and management.

Course Outcome:

The students will be able to	
CO1	Students should able to apply the dynamic programming to solve problems of discreet and continuous variables
CO2	Students should able to apply the concept of non-linear programming
CO3	Students should able to carry out sensitivity analysis
CO4	Student should able to model the real world problem and simulate it.

SYLLABUS
UNIT-I Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models
UNIT-II Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming
UNIT-III Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT
UNIT-IV Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.
UNIT-V Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

REFERENCES

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982. 3.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

[MTOE-034]COST MANAGEMENT OF ENGINEERING PROJECTS

Objective: Students are to provide an understanding of the cost management process, cost estimation techniques, cost control measures, and project budgeting.

Course Outcome:

The students will be able to	
CO1	Understand the concepts of relevant cost, differential cost, incremental cost, and opportunity cost for decision-making.
CO2	Gain knowledge of project execution stages, project cost control, and project commissioning.
CO3	Learn about cost behavior, marginal costing, absorption costing, break-even analysis, and standard costing.
CO4	Understand pricing strategies, cost management techniques, budgetary control, and measurement of divisional profitability.
CO5	Acquire knowledge of quantitative techniques for cost management, including linear programming, PERT/CPM, transportation problems, assignment problems, simulation, and learning curve theory.

SYLLABUS
UNIT-I Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
UNIT-II Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process
UNIT-III Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis
UNIT-IV Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing
UNIT-V Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

REFERENCES

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

[MTOE-035] COMPOSITE MATERIALS

Objective: The course aims to provide students with an understanding of the concepts and techniques used in cost management of engineering projects. By the end of the course, students should be able to identify cost drivers, apply cost management techniques, and evaluate the performance of engineering projects.

Course Outcome:

The students will be able to	
CO1	Understand the definition, classification, and characteristics of composite materials and the effect of reinforcement on their overall performance.
CO2	Gain knowledge on the preparation, properties, and applications of different types of reinforcements in composites, as well as their mechanical behavior.
CO3	Learn about the manufacturing methods and properties of metal matrix composites, ceramic matrix composites, and carbon-carbon composites.
CO4	Understand the manufacturing techniques, properties, and applications of polymer matrix composites.
CO5	Gain knowledge on different failure criteria and strength design methods for laminated composites, as well as the effects of stress concentrations.

SYLLABUS
UNIT-I INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
UNIT-II REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.
UNIT-III Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.
UNIT-IV Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.
UNIT-V Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations

REFERENCES

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi

[MTOE-035] WASTE TO ENERGY

Objective: Students are to introduce them to the classification of waste as fuel and various conversion devices, to teach them the methods of biomass pyrolysis, gasification, combustion and biogas production, and to make them familiar with the design, construction, and operation of different biomass conversion processes and biogas plants.

Course Outcome:

The students will be able to	
CO1	Understanding of waste classification and conversion devices such as incinerators, gasifiers, and digestors.
CO2	Knowledge of different types of pyrolysis, manufacture of charcoal, and applications of pyrolytic oils and gases.
CO3	Understanding of gasifiers, their design, construction, operation, burner arrangement for thermal heating, and kinetic considerations in gasifier operation.
CO4	Knowledge of different types of biomass combustors, their design, construction, and operation.
CO5	Understanding of biogas properties, biogas plant technology, types of biogas plants, and different biomass conversion processes such as thermochemical conversion.

SYLLABUS
UNIT-I Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors
UNIT-II Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
UNIT-III Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.
UNIT-IV Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.
UNIT-V Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

REFERENCES

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

[MTME-030] PHASE-I DISSERTATION

Course Outcome:

The students will be able to	
CO1	Students will be exposed to self-learning various topics.
CO2	Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
CO3	Students will learn to write technical reports.
CO4	Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Syllabus Contents:

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

SEMESTER –IV

[MTME-041]Dissertation Phase – II

Course Outcome:

The students will be able to	
CO1	Students will be able to use different experimental techniques.
CO2	Students will be able to use different software/ computational/analytical tools.
CO3	Students will be able to design and develop an experimental set up/ equipment/test rig.
CO4	Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
CO5	Students will be able to either work in a research environment or in an industrial environment.

Syllabus Contents:

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.