Bachelor of Technology (Mechanical Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VII

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	ME-401	Measurement and Control	4:0:0	4	4.0	75	25	0	100	3
2	ME-403	Mechatronics	4:0:0	4	4.0	75	25	0	100	3
3	ME-405	Industrial Engineering	4:0:0	4	4.0	75	25	0	100	3
4	CE-I	Elective - I*	4:0:0	4	4.0	75	25	0	100	3
5	CE-II	Elective - II*	3:0:0	3	3.0	75	25	0	100	3
6	ME-407	Measurement & Control Lab	0:0:2	2	1.0	0	40	60	100	3
7	ME-409	Mechatronics Lab	0:0:2	2	1.0	0	40	60	100	3
8	ME-411	Project-1**	0:0:8	8	4.0	0	100	100	200	
9	ME-413	Industrial Training (Viva-voce)					40	60	100	
10	ME-415	Seminar-I	0:0:2	2	1.0		50	50	100	
		Total		**33**	**26.0**	**375**	**395**	**330**	**1100**	

*The students will chose any two departmental electives courses out of the given elective list in VII Sem.
**Project-1 is to be submitted in the 7th semester itself. Project-I should not be related to Project-II unless it involves large amount of work, time and effort.

Course No.	Elective - I (CE-I)	Course No.	Elective - II (CE-II)
ME-417	Non-Conventional Machining	ME-429	Finite Element Methods in Engineering
ME-419	Soft Computing Techniques	ME-431	Advanced Manufacturing Technology
ME-421	Non-Destructive Evaluation & Testing	ME-433	Robotics: Mechanics and Control
ME-423	Design and Optimization	ME-435	Simulation of Mechanical Systems
ME-425	Computational Fluid Dynamics	ME-437	Control Engineering
ME-427	Fundamentals of Gas Dynamics	ME-439	Environmental Pollution and Abatement

Bachelor of Technology (Mechanical Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VIII

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam. (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	ME-402	Automobile Engineering	4:0:0	4	4.0	75	25	0	100	3
2	CE-III	Elective* – III	4:0:0	4	4.0	75	25	0	100	3
3	CE-IV	Elective* - IV	4:0:0	4	4.0	75	25	0	100	3
4	ME-404	Power Plant Engineering	4:0:0	4	4.0	75	25	0	100	3
5	ME-406	Quality Assurance & Reliability	4:0:0	4	4.0	75	25	0	100	3
6	ME-408	Automobile Engineering Lab	0:0:2	2	1.0	0	40	60	100	3
7	ME-410	Project-II	0:0:10	10	5.0		100	100	200	
8	ME-412	Seminar-II	0:0:2	2	1.0	0	100	0	100	
		Total		**34**	**27.0**	**375**	**365**	**160**	**900**	

*The students will chose any two Departmental Elective courses out of the given elective list in VIII Sem.
Project-I should not be related to Project-II unless it involves large amount of work, time and effort.

Course No.	Elective - III (CE-III)	Course No.	Elective - IV (CE-IV)
ME-414	Smart Materials, Structures& Devices	ME-426	Manufacturing Management
ME-416	Lubrication Technology	ME-428	Design of Pressure Vessels and Piping
ME-418	'Energy Management	ME-430	Concurrent Engineering
ME-420	Waste Heat Recovery System	ME-432	Industrial Combustion
ME-422	Foundry Engineering	ME-434	Metal Forming and Finishing
ME-424	Ergonomics in Design	ME-436	Air Craft and Rocket Propulsion

	B. Tech. (7th Semester) Mechanical Engineering						
ME-401	**MEASUREMENT AND CONTROL**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Theory**	**Sessional**	**Total**	**Time (hrs.)**
4	**-**	**-**	**4**	**75**	**25**	**100**	**3**
Purpose	To understand the fundamentals of mechanical instruments and enable the students for solving the problems related transfer function of control systems						
Course Outcomes							
CO1	To study the fundamentals of measurement systems and understand the static performance characteristics of measurement systems.						
CO2	To enable the students to understand the motion, force and torque measurement and study the measurements of strain and vibration.						
CO3	To study the instruments related to pressure, flow and temperature measurements.						
CO4	Learn about various concepts related to control systems.						

UNIT I

Fundamentals of Measurements: Definition, application of measurement instrumentation, functional elements of a generalized measuring system, measuring standards, types of measurement, types of input to measuring instruments and instrument system, classification of measuring instruments, merits and demerits of mechanical measuring systems, comparison of mechanical measuring system with electrical measuring systems, calibration.

Generalized Measurement System: Introduction, types of error, types of uncertainties, propagation of uncertainties in compound quantity, Static performance parameters: accuracy, precision, resolution, static sensitivity, linearity, hysteresis, dead band, backlash, and drift, sources of error, selection of measuring instruments, mechanical and electrical loading.

UNIT 2

Motion, Force and Torque Measurement: Introduction, relative motion, measuring devices, electromechanical, optical, photo electric, Moore-Fringe, pneumatic, absolute motion devices, seismic devices, spring mass & force balance type, calibration, hydraulic load cell, pneumatic load cell, elastic force devices, separation of force components, electro mechanical methods, torque transducer, torque meter**.**

Measurement of Strain and Vibrations: Type of strain gauges and their working, strain gauge circuits, Mcleod gauge, Pirani gauge, temperature compensation. strain rosettes, analysis of strains.

Vibration and noise measurement: Seismic instruments, vibration pick-ups and decibel meters.

UNIT 3

Pressure and Flow Measurement: Moderate pressure measurement, monometers, elastic transducer, dynamic effects of connecting tubing, high pressure transducer, low pressure measurement, calibration and testing, quantity meters, positive displacement meters, flow rate meters, variable head Meters, variable area meters, rotameters, pitot-static tube meter, drag force flow meter, turbine flow meter, electronic flow meter, electro-magnetic flow meter, hot-wire anemometer.

Temperature Measurement: Introduction, measurement of temperature, non-electrical methods – solid rod thermometer, bimetallic thermometer, liquid in- glass thermometer, pressure thermometer, electrical methods – electrical resistance thermometers, semiconductor resistance

sensors (thermistors), thermo-electric sensors, thermocouple materials, radiation methods (pyrometry), total radiation pyrometer, selective radiation pyrometer

UNIT 4

Control Analysis: Introduction, classification of control systems, control system terminology, servomechanism, process control and regulators, manual and automatic control systems, physical systems and mathematical models, linear control systems, Laplace transform, transfer function, block diagram, signal flow graphs.

Reference and Text Books:

1. Mechanical measurements & control- By D.S. Kumar, Metropolitan book
2. Instrumentation and Mechanical measurements- By A.K. Tayal, Galgotia Publ.
3. Measurements systems application and design-By Ernest Doebelin, McGraw-Hill
4. Automatic Control Systems- By S. Hasan Saeed

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (7th Semester) Mechanical Engineering						
ME 403	**MECHATRONICS**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**0**	**-**	**4**	**75**	**25**	**100**	**3**
Purpose	The Objective of this course is to make the students aware about Mechanical and Electronic instruments together for different applications. This course will help students to build the fundamental concepts of inter disciplinary problems.						
CO 1	To understand Mechatronics system and study of number system and Boolean algebra and able to convert number systems from one system to another.						
CO 2	Students will be able to understand different sensors and transducers as well as recognize various Pneumatic and Hydraulic system components along with their symbols.						
CO 3	Able to explain mechanical actuation systems and architecture of microprocessors.						
CO 4	Able to understand basic structure of PLC and its applications and concepts of Robotics.						

UNIT- I.

Introduction to Mechatronics and its Systems: Evolution, Scope, Measurement Systems, Control Systems, open and close loop systems, sequential controllers and microprocessor based controllers, mechatronics approach.

Basics of Digital Technology: Number System, Boolean algebra, Logic Functions, Karnaugh Maps, Timing Diagrams, Flip-Flops, Applications.

UNIT - II

Sensors and transducers: Introduction, performance terminology-Displacement, Position and Proximity, Velocity and motion, force, Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing.

Pneumatic and Hydraulic actuation systems: actuation systems, Pneumatic and hydraulic systems, directional control valves, pressure control valves, cylinders, process control valves, rotary actuators.

UNIT - III

Mechanical actuation systems: Mechanical systems, types of motion, kinematics chains, cams, gear trains, ratchet and pawl, belt and chain drives, bearings, mechanical aspects of motor selection.

Microprocessor: Introduction, Architecture, Pin Configuration, Instruction set, Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A converters and A/D converters, Applications, Temperature control, Stepper motor control, Traffic light controller.

UNIT - IV

Programmable Logic Controller: Introduction, Basic structure, Input/output Processing, Programming, Mnemonics, Timers, Internal relays and counters, Data handling, Analog Input/Output, Selection of a PLC.

Robotics: Introduction, types of robots, Robotic control, Robot drive systems Robot end effectors, selection parameters of a robot, applications.

Text Books:

1. R. K Rajput, "A Textbook of Mechatronics", Edition 2010.

Reference Books:

1. Bolton W., "Mechatronics", Longman, Second Edition, 2004.
2. Histand Michael B. and Alciatore David G., "Introduction to Mechatronics and Measurement Systems", McGraw Hill International Editions, 2003.
3. HMT Ltd., "Mechatronics", Tata McGraw Hill Publishing Co. Ltd., 1998.
4. Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", Tata McGraw-Hill publishing company Ltd, 2003.

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (7th Semester) Mechanical Engineering						
ME-405	**INDUSTRIAL ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**-**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	Students will be able to comprehend the major aspects of Industrial Engineering like work, method & time study, theoretical & analytical studies regarding organization, forecasting, product life cycle, wages, SCM & Time Management.						
Course Outcomes							
CO1	Students will be able to attain the theoretical knowledge of different work, method & time study, recording charts and technique.						
CO 2	Students will be able to attain the theoretical knowledge of the concept of industrial organization, PPC & Product development.						
CO 3	Students will be able to attain the theoretical knowledge of Objectives and importance of sales forecasting & inventory control.						
CO 4	Students will be able to attain the theoretical knowledge Wages, JIT, SCM, VE, TIME MANAGEMENT.						

Unit-I

Introduction to Work Study; Method Study; Basic procedure, Recording techniques **(**Charts and diagrams**)**; Elemental breakdown; Micro-motion studies; Therbligs; SIMO- chart principles of motion- economy**.** Introduction; Objectives; techniques **(**time**)** information recording; methods of things, Time study allowances; work sampling technique, Performances rating and its determinant ion technique, Performance rating and its determination PMTS; M**.**T**.**M**.**, Work factor**.**

Unit-II

Principle of organization; Importance and characteristics of organization; Organization theories; Classical Organization theory; Neo-Classical organization theory, modern organization theory; Types of organization**.** Military or line organization, Functional organization, line and staff organization, Committee objectives of PPC; Functions of PPC Preplanning and planning; Routing; Estimating; scheduling; master schedule; Daily schedule; Gantt chart; Dispatching; centralized vs. decentralized; Control; Follow up and progress reporting.
Introduction; Product development; Product characteristics; Role of product development;
3Ss – Standardization; Simplification and Specialization.
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Unit-III

Introduction, objectives and importance of sales forecasting, Types of forecasting, Methods of sales forecasting, Collective opinion method, Delphi technique, economic indicator method; Regression analysis, introduction, Functions of inventory; Types of inventory; Control importance functions, Inventory costs, factors affecting inventory control, Various inventory controls models; A**.**B**.**C**.** analysis, lead-time calculations**.**

Unit-IV

Introduction, Objective and Concept of V.E.; Steps in V.E., life cycle of a product, Methodology and techniques, Fast diagram, Matrix method. Various concepts in industrial engineering.
Wages and Incentives Concept; Types, plans, Desirable characteristics;
Supply Chain Management; Its Definition, Concept, Objectives, Applications, Benefits, some successful cases in Indian Industries; JIT; Its definition, concept, importance, misconception, relevance, Applications, Elements of JIT (brief description);
Time Management; Introduction, steps of time management, Ways for saving time KEY for time saving.

REFERENCES AND TEXT BOOKS:

1. Industrial Engg. by M. Mahajan / lndustrial Engg. by Savita Sharma.
2. Production planning and control by S. Elion.
3. Modern Production Management by S.S. Buffa.
4. Industrial Engg. and Management manufacturing system by Surender Kumar, SatyaParkashan.
5. Essence of Supply Chain Management by R.P. Monaty and S.G. Deshmukh.
6. Industrial Engg., and management by S. Sharma and Savita Sharma.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (7th sem.) Mechanical Engineering						
ME 407	**MEASUREMENT AND CONTROL LAB**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
-	**-**	**2**	**1**	**40**	**60**	**100**	**3**

Purpose: To enable the students to understand about the applications of measurement systems.

Course Outcomes:

1. To understand about the basics and working principle of pressure, temperature and flow measurement.
2. Identify the different variation of measurement parameter with various input conditions
3. To analyze the primary, secondary and tertiary measurements.
4. To learn about the various control devices and parts of measurement systems

1. Study of a strain gage based cantilever beam and measurement of strain on the beam
2. Study of a LVDT and measurement of linear displacement
3. Study of an inductive pick up and measurement of linear displacement
4. Study of a LDR and measurement of linear displacement
5. Study of capacitive pick up and measurement of angular displacement
6. Study of temperature transducers and measurement of temperature of fluid
7. Study of a LVDT (strain gage based) and measurement of linear displacement.
8. Study of a torque pick up and measurement of torque .
9. Study of a pressure pick up and measurement of pressure of fluid.
10. Study of load cell and measurement of load with load cell
11. Study of non-contact type speed pick up and measurement of rotational speed
12. Comparison of sensitivity of thermocouple, thermister and RTD

Note: **At least eight experiments should be performed from the above list.**

	B. Tech (7th Semester) Mechanical Engineering						
ME 409	**MECHATRONICS LAB**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
-	**-**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.						
CO 1	Able to perform operations on Assembly language programming of 8085						
CO 2	Able to understand distinguish hydraulic and pneumatic control system						
CO 3	Able To demonstrate experiments on DC motor, traffic light and stepper motor interface						
CO 4	Able to demonstrate working of sensors and transducer.						

LIST OF EXPERIMENTS:

1. To perform various operation on Assembly language programming of 8085 – Addition – Subtraction Multiplication – Division – Sorting – Code Conversion.
2. To Study Stepper motor interface.
3. To study the Traffic light interface using a PLC kit.
4. To Perform Speed control of DC motor kit.
5. To Study various types of Sensors and transducers.
6. To Study hydraulic System.
7. To study Pneumatic and electro-pneumatic circuits.
8. To study PLC and its applications.
9. To Study image processing technique.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

	B.Tech. (7th sem.) Mechanical Engineering						
ME 411	**PROJECT-1**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
-	**-**	**8**	**4**	**100**	**100**	**200**	

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group not more than four students in a group. Viva- voce must be based on the preliminary report submitted by students related to the project.

	B.Tech. (7th sem.) Mechanical Engineering						
ME 413	**INDUSTRIAL TRAINING (VIVA-VOCE)**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
-	**-**			**40**	**60**	**100**	

The training report will be submitted by the students along with the certificate indicating the duration of training and the nature of Project-done.

The students will have to appear for viva-voce examination based on training performed at the end of previous semester in industries.

	B.Tech. (7th sem.) Mechanical Engineering						
ME 415	**SEMINAR- I**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
-	**-**	**2**	**1.0**	**100**	**0**	**100**	

The students are required to deliver a seminar on some emerging areas of Mechanical Engineering, given as follows:

- CAD/CAM/CAE/FEA
- Robotics
- Machine Vision
- Automation
- Tribology
- CFD
- Energy Conservation
- Alternate Energy Sources
- Hybrid Fuels
- Advances in IC Engines
- Vehicle Dynamics
- Aerodynamics
- Advanced Manufacturing Techniques
- Advanced Engineering Materials
- Supply Chain Management
- Business Process Re-engineering
- Six-Sigma Technique
- Lean Manufacturing Technique
- Just-in-Time Technique
- Agile Manufacturing
- Value Engineering
- Reliability Engineering

- Any other topic related to Design/Thermal/Industrial/Production Engineering

The student will deliver a power point presentation for about 30 minutes in the seminar on any of the above topics. This will be followed by question answering session for about 10 minutes. The questions on the seminar topic will be asked by the teacher concerned and class students. The students will also prepare a detailed report in MS word and after spiral binding will submit it to the teacher concerned. The report is to be submitted at least one week prior to the presentation. The grades/awards will be given according to the student's presentation, report submitted, and answering of questions asked after the presentation.

ELECTIVE -I

	B. Tech. (7th sem.) Mechanical Engineering							
ME 417	**NON-CONVENTIONAL MACHINING**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4	0		4	4	75	25	100	3
Purpose	This course provides the knowledge about the advanced technologies and different processes of Non-conventional machining.							
COURSE OUTCOMES								
CO1	To impart the basic knowledge of various Non-conventional machining processes, rapid prototyping processes and process parameters and metal removal mechanism of Ultra-Sonic machining process.							
CO2	To acquaint the student with deep knowhow about the Electrochemical and Electro Discharge machining processes.							
CO3	To acquaint the students to classify the various kind of Jet machining processes, process parameters and metal removal mechanism, limitations and applications associated with these processes.							
CO4	To make the students to understand the process mechanism of Rapid Prototyping processes and rapid tools used in industries.							

UNIT I

Introduction: Introduction, need of Non-conventional machining processes, Rapid prototyping processes, their classification, consideration in process selection.

Ultrasonic Machining: Element of process, design of cutting tool, metal removal mechanism, effect of parameters, economic consideration, limitation and applications, surface finish.

UNIT II

Electrochemical Machining: Element of process, process chemistry, metal removal mechanism, tool design, accuracy, surface finish and work material characteristics, economic consideration, advantage, limitation and application, Electrochemical grinding, debarring and honing, chemical machining.

EDM: Principal and metal removal mechanism, generators, electrode feed control, electrode material, tool electrode tool design, EDM wire cutting, surface finish, accuracy and application.

UNIT III

Jet Machining: Principal and metal removal mechanism of abrasive and water jet machining, process variables, design of nozzle, advantage, limitation and application.

Plasma arc machining, Electron beam machining, Laser beam machining, their principal of metal removal mechanism, process parameter, advantage and limitations.

UNIT IV

Rapid Prototyping: Fundamentals, process chain, physics of processes, principal and process mechanism of SLA, SGA, LOM, FDM, and SLS processes, their advantage and limitations, application of RP process, RP data format, STL file format, STL file problems, STL file repair, others translators and formats.

Rapid Tooling Process: Introduction, fundamentals, classifications, indirect RT processes, principal of Silicon Rubber Molding, Epoxy Tooling, Spray Metal Tooling, Pattern for investment casting, Vacuum casting and vacuum forming processes, direct RT processes, Shape Deposition manufacturing, their advantage, limitations and applications.

Reference and Text Books:

1. Modern machining processes – By P.C. Pandey and M.S. Shan, 1 M1 I.
2. Machining Science – By Gosh and Malik, Affiliated East west
3. Nontraditional Manufacturing Processes – By G.F. Benedict, Maicel Dekker.
4. Advanced Method Of Machining – By J.A. Mcgeongh, Chapman And Hall.
5. Electrochemical Machining Of Metals – By Ruryantsev & Davydov, Mir Pub.
6. Rapid Prototyping: Principal And Application ix.,n Manufacturing

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (7th Semester) Mechanical Engineering						
ME-419	**SOFT COMPUTING TECHNIQUES**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**0**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	This course is designed to give an insight into the latest developments regarding smart materials and their use in structures.						
Course Outcomes							
CO 1	To expose the concepts of feed forward neural networks.						
CO 2	To provide adequate knowledge about feedback neural networks.						
CO 3	To teach about the concept of fuzziness involved in various systems.						
CO 4	To expose the ideas about genetic algorithm and to provide adequate knowledge about of FLC and NN toolbox.						

UNIT I

Introduction and Artificial Neural Networks

Introduction of soft computing – soft computing vs. hard computing various types of soft computing techniques applications of soft computing Neuron Nerve structure and synapse Artificial

Neuron and its model activation Functions Neural network architecture single layer and multilayer feed forward networks McCulloch Pitts neuron model, perceptron model Adaline and Madaline multilayer perception model back propagation learning methods effect of learning rule coefficient back propagation algorithm factors affecting back propagation training applications.

UNIT II

Artificial Neural Networks

Counter propagation network architecture functioning & characteristics of counter Propagation Network Hopfield/ Recurrent network configuration stability Constraints Associative Memory and Characteristics limitations and applications Hopfield v/s Boltzman machine Adaptive Resonance Theory Architecture Classifications Implementation and training Associative Memory.

UNIT III

Fuzzy Logic System

Introduction to crisp sets and fuzzy sets basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control Fuzzification inferencing and defuzzification Fuzzy knowledge and rule bases Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control Fuzzy logic control for nonlinear time delay system.

UNIT IV

Genetic Algorithm

Basic concept of Genetic algorithm and detail algorithmic steps adjustment of free Parameters Solution of typical control problems using genetic algorithm Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

Applications

GA application to power system optimization problem Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab Neural Network toolbox. Stability analysis of Neural Network Interconnection systems Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox Stability analysis of fuzzy control systems.

REFERENCES:

1. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Pearson Education,
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
3. Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2011.
4. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
5. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996.
6. http://www.myreaders.info/html/soft_computing.html

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (7th sem.) Mechanical Engineering						
ME 421	**NON-DESTRUCTIVE EVALUATION AND TESTING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Theory**	**Sessional**	**Total**	**Time**
4	**0**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	To give the basic idea of NON-DESTRUCTIVE EVALUATION AND TESTING						
Course Outcomes							
CO1	To make student able to acquire knowledge of different types of NDT techniques.						
CO2	To make student able to understand the basic principles underlying each NDT techniques.						
CO3	To make student able to acquire knowledge of established NDE techniques and basic familiarity of emerging NDET Techniques						
CO4	To make student able to become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them.						

UNIT I

Introduction to NDET and Surface NDT Techniques Introduction to non-destructive testing and evaluation, visual examination, liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.

UNIT II

Radiographic Testing Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrometer, radiographic imaging, inspection standards and techniques, neutron radiography. Radiography applications, limitations and safety.

UNIT III

Eddy Current Testing and Ultrasonic Testing Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing. Special/Emerging Techniques Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography

UNIT IV

Defects in materials / products and Selection of NDET Methods Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Standards and codes.

Reference and Text books:

1. Baldevraj, Jayakumar T., Thavasimuthu M., (2008) “Practical Non-Destructive Testing”, 3rd edition, Narosa Publishers.
Reference Books
1. American Society for Metals, “Non-Destructive Evaluation and Quality Control”: Metals Hand Book: 1992, Vol. 17, 9th Ed, Metals Park, OH.
2. Paul E Mix, “Introduction to nondestructive testing: a training guide”, Wiley, 2nd edition New Jersey, 2005.
3. Ravi Prakash, “Nondestructive Testing Techniques”, New Age International Publishers, 1st rev. edition, 2010.
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Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (7th sem.) Mechanical Engineering							
ME -423	**Design and optimization**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	0	0	4	4.0	75	25	100	3
Purpose	To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable and Introduction to system design.							
COURSE OUTCOMES								
CO1	Students will be able to formulate optimization problems.							
CO2	The student will be able to understand and apply the concept of optimality criteria for various type of optimization problems.							
CO3	The students will be able to solve various constrained and unconstrained problems in single variable as well as multivariable.							
CO4	The students will be to understand advanced optimization techniques.							

Unit I

Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers. Linear Programming Problem, Simplex method, Concept of Duality. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method. Application to Root finding.

UNIT II

Multivariable Optimization Algorithms Optimality Criteria, Unidirectional Search. Direct Search Methods: Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method. Gradient Based Methods: Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method

UNIT III

Nonlinear programming with constraints: Lagrange multipliers, Kuhn-Tucker conditions, quadratic programming. Wolfe’s and Beale’s method, sequential linear programming approach, penalty methods. Interior and exterior penalty function method.

UNIT IV

Advanced optimization techniques: Concepts of multi-objective optimization, genetic algorithms and simulated annealing.

Text Books:

1. S.S.Rao, Optimization-Theory and Applications, , Wiley Eastern, New Delhi, 1978
2. J.C.Pant, Introduction to Optimization, Jain Brothers, New Delhi, 1983
3. Kanthi Swaroop, et.at., Operations Research, S. Chand & Co., New Delhi
4. Kalyanmoy Deb, Optimization for Engineering Design Algorithms and Examples, Prentice Hall of India, New Delhi, 1995

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (7th sem.) Mechanical Engineering						
ME 425	**COMPUTATIONAL FLUID DYNAMICS**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**-**	**4**	**75**	**25**	**100**	**3**
Purpose	To familiarize the students with the basic concepts of Computational Fluid Dynamics.						
Course Outcomes							
CO1	Understand the basic equations which govern the fluid flow and heat transfer phenomena.						
CO2	Classify the different types of differential equations and analyze their mathematical behavior.						
CO3	Understand the basic concepts of discretization and error analysis.						
CO4	Analyze the steady and unsteady heat conduction & combined conduction diffusion problems.						
CO5	Develop knowledge about the calculation of the flow field and numerical understanding of pressure correction technique.						

UNIT I

Methods of prediction: comparison of experimental investigation vs theoretical calculation; Mathematical description of physical phenomena; governing differential equations; the general form of governing differential equation; nature of co-ordinates; one way and two-way co-ordinates; proper choice of co-ordinates.

Mathematical behavior of partial differential equations: Classification of partial differential equations, general behavior of different classes of equations: Elliptic, parabolic and hyperbolic partial differential equations.

UNIT II

Discretization: The concept of discretization; Finite differences; Taylor series formulation; Finite difference discretization of ordinary and partial derivatives; Truncation error, round-off error, discretization error; Consistency and stability of numerical schemes; Variationally formulation; Method of weighted Residuals, control volume formulation.

UNIT III

Heat Conduction: Steady one-dimensional conduction, Inter-face conductivity, Non-linearity, Source-term linearization, Boundary conditions. Unsteady one-dimensional conduction: Explicit, Crank-Nicolson and Fully Implicit Schemes Discretization of two and three dimensional problems, over relaxation and under relaxation.

UNIT IV

Convection and Diffusion: Steady one dimensional convection and diffusion, Upwind scheme, Exponential scheme, Hybrid scheme, Power law scheme, Generalized formulation, Discretization equation for two and three dimensional problems, Outflow boundary condition, false diffusion.

Calculation of the flow field: Need for a special procedure, Vorticity based methods, Representation of pressure-gradient term, Representation of the continuity equation, Staggered grid, Momentum equations, Pressure velocity corrections, Pressure correction equation, SIMPLE algorithm.

Reference and Text books:

1. Numerical Heat Transfer and Fluid Flow – Suhas V. Patankar, Ane Books.
2. Computational Fluid Dynamics: The Basics with Applications – John D. Anderson Jr., McGraw Hill.
3. An Introduction to CFD: Development, Applications and Analysis – Atul Sharma, Ane Books.
4. An Introduction to Computational Fluid Dynamics: The Finite Volume Method – H. Versteeg and W. Malalasekra, Pearson Education.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (7th sem.) Mechanical Engineering						
ME 427	**FUNDAMENTALS OF GAS DYNAMICS**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Theory**	**Sessional**	**Total**	**Time (hrs.)**
4		**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	**To aware the students for basic concepts of gas dynamics and study flow through nozzles and diffusers. Also, to understand the concepts of flame and combustion along with propulsion.**						
Course Outcomes							
CO1	To study the fundamentals of gas dynamics and its properties. Also, to understand the fundamental equations of steady flow.						
CO2	To enable the students to understand isentropic flow, adiabatic flow, frictional flow and variable area flow.						
CO3	To study the flow through nozzles and diffusers.						
CO4	Learn about various concepts related to flame, combustion and propulsion.						

UNIT 1

Basic concepts of Gas Dynamics and Gas Properties*:* Units and dimensions, The concepts of a continuum, properties of the continuum. Methods of describing fluid motion, Lagrangian method. Eulerian Method. The integral form of the equations of Conservations of Mass, momentum and energy as applied to control volumes, applications to the steady flow of inviscid compressible fluids

Fundamental equations of Steady Flow: Continuity and momentum equations, The thrust function, The dynamic equation and Euler's Equation, Bernoulli's Equation. Steady flow energy equations

UNIT 2

Isentropic Flow: Introduction, Acoustic velocity, Mach number, Mach line and mach angle. Classification of flows, Kerman's rules of supersonic flow, flow parameter, critical condition stagnation values.

Adiabatic Flow: Stagnation temperature change, Rayleigh line, Pressure ratio and temperature ratio, Entropy considerations, maximum heat transfer.

Frictional Flow: The fanning equation, Friction factor and friction parameter, Fanno line, Fanno equations.

Variable Area Flow: Velocity variation with Isentropic flow, Criteria for acceleration and deceleration, Effect of pressure ratio on Nozzle operation, Convergent nozzle and convergent

divergent nozzle, Effect of back pressure on nozzle flow, Isothermal flow functions, Comparison of flow in nozzle, Generalized one dimensional flow.

UNIT 3

Flow Through Nozzle: Under and over expansion in nozzle flow, frictional effects on nozzle flow, operation of nozzles, analysis of shock phenomena, shocks in nozzles- normal shock waves, oblique shock waves; thermodynamic directions of a normal shock, Rankins-Hugoniat relation, strength of shock, operation of nozzles, Governing relation of the Normal shock, Pressure, Temperature, Density, Mack number across the shock, Reyleigh and Fanno lines, problems.

Flow through Diffusers: Classification of diffusers, internal compression subsonic diffusers, velocity gradient, effect of friction and area change, the conical internal-compression Subsonic diffusers, external compression subsonic diffusers, supersonic diffusers, Normal shock supersonic diffusers, the converging diverging supersonic diffusers.

UNIT 4

Introduction to Flames and Combustion: Flame propagation, diffusion flames, premixed flames, flame velocity, theories of flame propagation, ignition for combustible mixture, flame stabilization.

Propulsion: Introduction, Brayton cycle, propulsion engines. thrust power and efficiency, thrust consideration power consideration, power conskloiftlion and efficiency consideration, open Brayton cycle for propulsion systems, turbojet, turbo propulsion, ram jet, pulse jet, numericals.

Text Books:

1. Fundamentals of Gas Dynamics- YAHA, S.M. TMI-I, India.
2. Fluid Mechanics-A.K. Mohanty, Prentice Hall of India.

Reference Books:

1. Fundamentals of Fluid Mechanics- YUAN, S.W. Prentice Hall of India.
2. Fundamentals of Gas Dynamics - Robert D. Zucker, Met tire Publication.
3. Gas Dynamics -E-., Radha Krishnan, prentice Hall of India.
4. Gas Dynamics Vol. -I Zucrotuf, Wiley.
5. Gas Dynamics - Shapiro Wiley.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

ELECTIVE-II

	B.Tech. (7th sem.) Mechanical Engineering						
ME 429	**FINITE ELEMENT METHODS IN ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Theory**	**Sessional**	**Total**	**Time (hrs.)**
3	**-**	**-**	**3.0**	**75**	**25**	**100**	**3**
Purpose	Students can able to solve the various problems related to structures, machines etc. through finite element methods. Also, enable the students for predicting the solutions of compressible and incompressible fluid friction film problems						
Course Outcomes							
CO1	To study the fundamentals of finite element methods and understand the various methods for solving engineering problems.						
CO2	To enable the students to understand higher order parametric elements and also to study element shapes, sizes and node locations.						
CO3	Enable the students for solving plane stress and strain problems, axis-symmetric and three-dimensional stress-strain problems.						
CO4	Learn about velocity-pressure and stream function-vorticity formulation. Also, to understand in viscid incompressible flow, potential function and stream function formulation.						

UNIT I

Basic Concept, Historical background, Engineering applications, general description, Comparison with other methods.

Need for weighted-integral forms, relevant" mathematical concepts and formulae, weak formulation of boundary value problems, variationally methods, Rayleigh-Ritz method, and weighted residual approach.

UNIT II

Model boundary value problem, finite element discretization, element shapes, sizes and node locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solution, post-processing, compatibility and completeness requirements, convergence criteria, higher order and isoperimetric elements, natural coordinates, Lagrange and Hermite polynomials.

UNIT III

External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, axis-symmetric and three-dimensional stress-strain problems, strain displacement relations, boundary conditions, compatibility equations, computer programs.

UNIT IV

Variational approach, Galerkin approach, one-dimensional and two-dimensional steady-state problems for conduction, convection and radiation, transient problems. In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity-pressure and stream function-vorticity formulation, Solution of incompressible and compressible fluid film lubrication problems.

Reference and Text Books:

1. The Finite Element Method - By Zienkiewicz, Tata McGraw
2. The Finite Element Method for Engineers -By Huebner, John Wiley
3. An Introduction to the Finite Element Method -By J.N.Reddy, McGraw Hill

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (7th sem.) Mechanical Engineering							
ME - 431	**Advanced Manufacturing Technology**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
3	0	0	3	3.0	75	25	100	3
Purpose	The course covers the details of the advanced machining theory and practices, advanced machining processes, advanced metal forming processes, advanced welding processes and advanced foundry processes							
COURSE OUTCOMES								
CO1	Students will be able to comprehending the surface cleaning, treatments process and vacuum mould processes.							
CO2	Students will be able analyze the advanced casting processes							
CO3	Students will be able to Synthesize the effect of variables on metal forming processes.							
CO4	Students will be able to design vacuum die and evaluate the chief factors in cost estimating.							

UNIT I

Hot machining, Machining of Plastics, Unit heads, Plastics cooling, electro forming, Surface Cleaning and Surface Treatments, Surface Coatings, Paint Coating and Slushing, Adhesive Bonds, Adhesive Bond Joints, Adhesives, Surface Coating for Tooling, Graphite Mould Coating, **Vacuum Mould Process.** Introduction, Types of Composites materials, Agglomerated Materials, Reinforced materials, Laminates, Surface Coated Materials, Production of Composite Structures, Fabrication of particulate composite Structures, Fabrication of reinforced Composite, Fabrication of Laminates, Machining, Cutting and Joining of Composites.

UNIT II

Introduction, Polymers, Polymerization, Addition of Polymers, Plastics, Types of plastics, Properties of Plastics, Processing of Thermoplastic Plastics, Injection Moulding, Casting of Plastics, Machining of plastics, other processing methods of plastics Introduction, casting, thread chasing, Thread Rolling, Die Threading and Tapping, Thread Milling, Thread Measurement and Inspection.

UNIT III

Theoretical basis of metal forming, classification of metal forming processes, cold forming, hot working, Warm working, Effect of variables on metal forming processes, Methods of analysis of manufacturing processes, Open Die forging, Rolling Power Rolling, Drawing, Extrusion.

UNIT IV

Introduction, Product Application, Limitation of Die Casting, Die Casting Machines, Molten metal Injection systems, lot chamber machines, Cold chamber machines, Die casting Design, Design of Die casting Dies, Types of Die casting Dies, Die design, Die material, Die Manufacture, Die Lubrication and Coating, Preheating of Dies, Vacuum Die Casting, Recent trends In Die Casting Process. Definition, Cost accounting or costing, Elements of costing, cost structures, Estimation of cost elements, Methods of estimating, Data requirements of cost

estimating, Steps in making cost estimate, Chief factors in cost estimating, Numerical examples, calculation of machining times, Estimation of total unit time

Reference and Text Books:

1. Principles of Manufacturing- By J.S.Campbell, Tata McGraw-Hill
2. Production Engineering Sciences- By Pandey and Sinh Standard Pub.
3. A text book of Production Technology- By P.C. Sharma S.Chand & Company.
4. Manufacturing Materials and Processes- By Lindberg Prentice Hall
5. A text book of Production Engineering- By P.C. Sharma S.Chand & Company.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (7th sem.) Mechanical Engineering							
ME 433	**ROBOTICS: MECHANICS AND CONTROLS**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
3	0	0	3	3	75	25	100	3
Purpose	To acquaint the students about the mechanics and controls of robotic systems and its application in industries.							
COURSE OUTCOMES								
CO1	To make students to aware about the basic of robot and the various drive mechanism used in robot.							
CO2	To acquaint the students about the end effectors and robot controls.							
CO3	To impart the students to understand about the robot transformations and sensors used in robot.							
CO4	To make students understand about the robot cell design and area of application of robot.							

UNIT I

Robot anatomy: Definition, law of robotics, History and Terminology of Robotics, Accuracy and repeatability of Robotics, Simple problems.

Robot drive mechanism: Objectives, motivation, Types of drive systems, Functions of drive system, Lead Screws, Ball Screws, Chain & linkage drives, Belt drives, Gear drives, Harmonic drives.

UNIT II

Mechanical grippers: Slider crank mechanism, Screw type, Rotary actuators, cam type, Magnetic grippers, Vacuum grippers, Air operated grippers, Gripper force analysis, Gripper design-Simple problems

Robot controls: Point to point control, Continuous path control, intelligent robot control system for robot joint, Control actions, Feedback devices: Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

UNIT III

Robot kinematics: Types- 2D, 3D Transformation-Scaling, Rotation, Translation-Homogeneous coordinates, multiple transformation-Simple problems.

Sensors in robot: Touch Sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force Sensor-Light sensors, Pressure sensors.

UNIT IV

Robot cell design: Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software

Robot applications: Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

REFERENCE BOOKS:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, RogerN Nagel, AshishDutta, Industrial Robotics, Technologyprogramming and Applications, McGraw Hill, 2012
3. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin,Robotics Engineering an Integrated Approach, Phi Learning.,2009.
4. Francis N. Nagy, AndrasSiegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
5. P.A. Janaki Raman, Robotics and Image Processing: An Introduction, Tata McGraw Hill Publishing company Ltd.,1995.
6. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "*Robotics control,sensing, vision and intelligence"*, McGraw Hill Book co, 1987
7. Craig. J. J. "*Introduction to Robotics mechanics and control"*,Addison- Wesley, 1999.
8. Ray Asfahl. C., "*Robots and Manufacturing Automation"*, JohnWiley & Sons Inc.,1985.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (7th sem.) Mechanical Engineering							
ME-435	**SIMULATION OF MECHANICAL SYSTEM**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
3			3	3.0	75	25	100	3
Purpose	To make students aware of System and environment concepts of Simulation, statistics in simulation, Modelling elements in manufacturing systems, Simulation of manufacturing systems, Modelling of manufacturing supply chains, Design of simulation experiments.							
COURSE OUTCOMES								
CO1	Students will attain the knowledge of System and environment concepts of Simulation & statistics in simulation.							
CO2	Students will attain the knowledge of Modelling elements in manufacturing systems & Simulation of manufacturing systems.							
CO3	Students will attain the knowledge of modelling of manufacturing supply chains.							
CO4	Students will attain the knowledge of Design of simulation experiments.							

UNIT I

INTRODUCTION: Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, Stochastic processes, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, Steps in a simulation study, Verification, validation and credibility of simulation models, Advantages, disadvantages and pitfalls of simulation,

STATISTICS IN SIMULATION: Review of basic probability and statistics, random variables and their properties, Statistical analysis for terminating simulation and steady state parameters

UNIT II

MODELLING ELEMENTS IN MANUFACTURING SYSTEMS: Definition, Classifications and characteristics of production systems; measures of manufacturing systems performance, modelling elements in manufacturing systems: processes, resources, single and multi-server queues, arrival processes, service times, downtime, manufacturing costs, resources selection rules, different manufacturing flexibilities.

SIMULATION OF MANUFACTURING SYSTEMS: Simulation of Job shop, batch and Flexible manufacturing systems, Case studies for above systems.

UNIT III

MODELLING OF MANUFACTURING SUPPLY CHAINS (SC): Introduction of SC, Modelling elements in SC, Measures of SC performance, brief review of bear game, SC initiatives and effect on SC performance Modelling of Supply Chain Processes at different

Supply chain nodes like: Retailer, assembler, distributor, and manufacturer; Modelling of different SC processes, inventory control policies like (s, S), (s, Q) systems, production control issues like Manufacturing-to-order, Manufacturing-to-stock, Assemble-to-order, Assemble-to-stock; Modelling of material transport system in SC, Development of Simple SC models

UNIT IV

DESIGN OF SIMULATION EXPERIMENTS: Consideration for selecting length of simulation run, no of replication and warm-up period, elimination of initial bias, Finance Considerations of a simulation study, Variance reduction techniques, 2^k factorial design, fractional factorial design, factor screening, response surface, Meta-models and sensitivity, optimization procedures.

Suggested Reading:

1. Simulation Modeling and Analysis, 3e, Law A.M. and Kelton W.D., TMH, New Delhi.
2. Simulation with Arena - Kelton and Sadowski, 2003, (McGraw-Hill).
3. Analysis and Control of Production Systems, Printice Hall Publn, E.A. Elsayed and T.O. Boucher, 1994.
4. Modelling and Analysis of Dynamic Systems, C.M. Close and Dean K.F., Houghton Mifflin.
5. Simulation of Manufacturing, Allan Carrie, John Wiley & Sons.
6. System Simulation, Geoffrey Gordon, Prentice Hall, 1998.
7. Modern Production /Operations Management, 8e, Buffa E.S. and Sarin R.K., John Wiley.
8. Designing and Managing the Supply Chain, 3/e, Simchi-Levi D., Kaminsky P., Simchi-Levi E., Shankar R., TMH,
   New Delhi.

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (7th sem.) Mechanical Engineering							
ME - 437	**Control Engineering**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
3	0	0	3	3.0	75	25	100	3
Purpose	Modeling, performance analysis and control with potential application to engineering systems.							
COURSE OUTCOMES								
CO1	Students will be able to understand basis of different types of control systems.							
CO2	Students will be able to Apply systems theory to complex real world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.							
CO3	The student will be able to Predict system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain.							
CO4	The students will be able to Analyze the behavior of closed loop systems using tools such as root locus, Routh Hurwitz, Bode.							

Unit I

Introduction to Control Systems: Introduction, Brief History of Automatic Control, Examples of Control Systems, Engineering Design, Mechatronic Systems, the Future Evolution of Control Systems

UNIT II

Mathematical Models of Systems: Differential Equations of Physical Systems, Linear Approximations of Physical Systems, the Laplace Transform, the Transfer Function of Linear Systems, Block Diagram Models and Signal-Flow Graph Models

UNIT III

Feedback Control System Characteristics: Error Signal Analysis, Sensitivity of Control Systems to Parameter Variations, Disturbance Signals in a Feedback Control System, Control of the Transient Response, Steady-State Error, The Cost of Feedback.

UNIT IV

The Design of Feedback Control Systems: Approaches to System Design, Cascade Compensation Networks, Phase-Lead Design Using the Bode Diagram, Phase-Lead Design Using the Root Locus, System Design Using Integration Networks, Phase-Lag Design Using the Root Locus, Phase-Lag Design Using the Bode Diagram, Design on the Bode Diagram Using Analytical Methods.

Text Books:

1. Modern Control System by Richarc C. Drof and Robert H. Bishop,11th Edition Person Int.
2. Modern Control Engineering by Katsuhiko Ogata, 4th Edition, Prentice Hall of India.

3. Automatic Control Systems by Benjamin C.Kuo, 8th Edition, Farid Golnaraghi, John Wiley & Sons.
4. Control Systems Engineering by Nagrath and Gopal New Age Publication
5. Feedback and Control Systems by Joseph J Distefano 2nd Edition TMH

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME-439	**Environment Pollution and Abatement**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
3	0	0	3	3.0	75	25	100	3
Purpose	This course is very important for Mechanical Engineers considering the expectation of the Industries for pollution control in their premises so as to comply with newer and tougher laws and acts that are being enforced in India and globally. This course introduces the principles and methods to control air, water and soil pollution to the undergraduate students of chemical engineering.							
COURSE OUTCOMES								
CO1	To make students aware with the Recycle and reuse of waste, energy recovery and waste utilization.							
CO2	To make students aware with the Air pollution and its measurement, design of pollution abatement systems for particulate matter and gaseous constituents.							
CO3	To make students aware with the Design of waste-water and industrial effluent treatment; Hazardous waste treatment and disposal; Solid-waste disposal and recovery of useful products.							
CO4	To make students aware with the water, air and land pollution; legislation and standards; Recycle and reuse of waste, energy recovery and waste utilization.							

UNIT I

Introduction: Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards for ambient air, noise emission and effluents.

Unit II

Pollution Prevention: Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization, Fugitive emission/effluents and leakages and their control-housekeeping and maintenance.

Air Pollution Control: Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers.

UNIT III

Water Pollution Control: Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation. Waste water, waste water management.

UNIT IV

Solids Disposal: Solids waste disposal - composting, landfill, briquetting / gasification and incineration. **Biological Treatment:** Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying.

Reference books:

1. "Pollution Control Acts, Rules, Notifications issued there under" CPCB, Ministry of Env. and Forest, G.O.I., 3rd Ed. 2006.
2. Vallero D; "Fundamentals of Air Pollution", 4 th Ed; Academic Press.
3. Eckenfelder W. W; "Industrial Water Pollution Control", 2 Ed; McGraw Hill.
4. Kreith F. and Tchobanoglous G., "Handbook of Solid Waste Management", 2 Ed; Mc Graw Hill.
5. Pichtel J; "Waste Management Practices: Municipal, Hazardous and Industrial", CRC.
6. Tchobanoglous G.,Burton F. L. and Stensel H.D., "Waste Water Engineering: Treatment and Reuse", 4th Ed; Tata McGraw Hill.

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (8th sem.) Mechanical Engineering							
ME-402	**Automobile Engineering**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4	0		4	4.0	75	25	100	3
Purpose	To make aware the students with the study of engineering which teaches manufacturing, and mechanical-mechanisms as well operations of automobiles. It is an introduction to vehicle engineering which deals with motorcycles, cars, buses trucks etc. It includes branch study of mechanical, electronic, and safety elements. Some of the engineering attributes and disciplines that are of importance to the automotive engineer.							
COURSE OUTCOMES								
CO1	Students will be able to Develop a strong base for understanding future developments in the automobile industry							
CO2	Students will be able to Explain the working of various parts like engine, transmission, gear box etc.							
CO3	Students will be able to Describe how the brakes and the suspension systems operate							
CO4	Students will be able to Understand the steering geometry and emission control system.							

UNIT I

INTRODUCTION: Brief history of automobiles, Main components of an automobile, Brief description of each component. Brief description of constructional details and working of a four stroke I.C. Engine (S.I. Engines and C.I. Engines) including lately developed overhead cam shaft, Multi-cylinder engines, Introduction to recent developments in I.C. Engines- Direct injection systems, Multi-point fuel injection systems, Introduction, Brief description of different components of Transmission System.

CLUTCH: Clutch Introduction to Clutch and its different types, Principle of Friction Clutch, Clutch Lining and friction materials used in Friction Clutches, Torque transmitted, Brief description of Cone Clutch, Single Plate and Multiplate Clutches, Dry and wet clutches, Automatic clutch action, Centrifugal clutches, Electromagnetic clutches, Fluid Flywheel.

UNIT II

GEAR BOX: Gear Box Air resistance, gradient resistance and rolling resistance coming across a moving automobile, Tractive effort, Variation of tractive effort with speed, Performance curves (object and need of a gear box), Sliding mesh gear box, Control mechanism, Sliding type selector mechanism, Ball type selector mechanism, Steering column gear shift control, Constant mesh gear box, Synchromesh device, Automatic transmission in general, AP automatic gear box, Torque converter, Torque converter with direct drive, Lubrication of Gear Box.

PROPELLER SHAFT: Functions and requirements of a propeller shaft, Universal joints, Constructional forms of universal joints, Flexible-ring joints, Rubber-bushed flexible joints.

Constant-velocity joints. Differential : Principle of operation, Constructional details of a typical Differential unit, Traction control differentials, Multi-plate clutch type traction control device.

UNIT III

BRAKES: Functions and methods of operation, Brake efficiency. Elementary theory of shoe brake, brake shoe adjustments, A modern rear-wheel brake, Disc brakes, Brake linkages, Leverage and adjustment of the brake linkage, Servo- and power operated brakes, Vacuum brake operation,' Hydraulic Brakes-constructional details and working, Direct action vacuum servos, Power-operated brakes, A dual power air brake system,

Suspension system Suspension principles, Road irregularities and human susceptibility, Suspension system, Damping, Double tube damper, Single tube damper, Lever arm type damper, Springs-Leaf springs, Coil and torsion springs, variable rate springs, Composite leaf springs, Rubber springs, Air springs, Adjustable and self-adjusting suspensions, Interconnected suspension system, Interconnected air and liquid suspensions, Independent suspension system, Different independent suspension layouts, McPherson strut type, Rear suspension-live axle, McPherson strut rear suspension.

UNIT IV

Steering Geometry: Castor, Camber, Kingpin inclination, Combined angle, Toe-in, Steering system-basic aims, Ackerman linkage, Steering linkages for independent suspension, Center point steering, Costarring or trailing action, Cornering power, Self-righting torque, Steering characteristics-over steer and under steer, Axle beam, Stub-axle construction, Steering column, Reversible and irreversible steering, Rack-and-pinion steering mechanism, Effect of toe-in on steering, Power steering, Vickers System. Recent trends in automobile engineering Multi fuel automobiles, Automobiles running on alternate sources of energy, Emission control through catalytic converter, Double catalytic converter, Aspects of pollution control in Automobiles.

Reference and Text Books:

1. The Motor Vehicle - By Newton, Steeds and Garretle Basic

2. Automobile Engineering - By Kirpal Singh

3. Automobile Engineering *' -By K.M. Gupta, Umesh Publications

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (8th sem.) Mechanical Engineering						
ME-404	**POWER PLANT ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**0**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	To make student aware about the modern aspects of power generation, problems of energy demand and supply and power plant economics.						
Course Outcomes							
CO1	To introduce about the different sources of energy, hydrology and hydro power generation.						
CO 2	To analyze the steam power cycles, steam generators, fuels and different handling systems in power plants.						
CO 3	To understand the concept of combined cycles power generation and diesel engine power plants.						
CO 4	To know about the nuclear energy and the economics of power generation.						

UNIT I

Energy Sources: Conventional and non-conventional sources of energy, Importance of electrical energy, Geothermal power plants, Tidal power plants, Windmills, Solar power plants, Direct energy conversion systems, Energy sources in India, Recent developments in power plants.

Hydroelectric power plant: Hydrology, Rainfall, runoff, hydrographs, flow duration curves, Site selection for hydro power plants, Classification of hydro power plants, Storage type hydro power plant and its operation, Estimation of power availability, Selection of water turbines, Combination of hydro power plants with steam plants, advantages and disadvantages of hydro power plants.

UNIT II

Analysis of steam cycle: The ideal Rankine cycle, externally irreversible Rankine cycle, Superheat, Reheat, Regeneration, internally irreversible Rankine cycle, open feed water heaters, closed type feed water heaters with drains cascaded backward and pumped forward, Typical layout of steam power plant, Efficiency and heat rate.

Steam generators: Introduction to steam generators, Steam generator control, Fluidized bed boilers, Supercritical boilers, Ultra supercritical technology, Advanced Ultra supercritical technology, Flue gas de-nitrification and desulphurization, fabric filters and baghouses, feed water treatment, Deaeration, Internal treatment, boiler blowdown, steam purity.

Fuel and combustion: Coal as fuel, classification of coals, analysis of coal, Coal handling, Dead and live storage, Combustion of coal, combustion equipment for coal burning, mechanical stokers, pulverized fuels and burners, Ash handling and disposal, Dust collectors. Heat balance sheet for thermal power plants, environmental aspects of power generations.

UNIT III

Diesel engine power plants: Applications of diesel engines in power field, Advantages and disadvantages of diesel plants over thermal power plants, Schematic arrangement of diesel

engine power plant, Different systems of diesel power plant, Performance Characteristics, Supercharging, Layout of Diesel Engine power plant.

Gas turbine and combined cycles: Gas turbine cycles, the ideal Brayton cycle, the non-ideal Brayton cycle, Modification of the Brayton cycle, Combined Cycles: combined cycles with heat recovery boiler, The STAG combined-cycle power plant, combined cycles with multi-pressure steam, combined cycle for nuclear power plants.

UNIT IV

Nuclear Power Plants: Basic theory and terminology, Nuclear fission and fusion processes, Fission chain reaction, Moderation, Fertile materials, Nuclear fuels, General components of nuclear reactor, Different types of reactors: PWR, BWR, GCR, LMFBR, CANDU-PHW, India's nuclear power program, Disposal of nuclear waste and related issues.

Economics of power generation: Introduction to economics of power generation, Different terms and definitions, Cost analysis, Selection of power plant equipment, factors affecting economics of generation and distribution of power, Performance and operating characteristics of power plants, Economic load sharing, Tariff for electrical energy.

Text Books:

1. Power Plant Engineering by Morse
2. Power Plant Engineering by PK Nag
3. Power Plant Technology -By El-Wakil
4.

Reference Books:

1. Power Plant Engineering -By P.C. Sharma
2. Power Plant Engineering -By Domkundwar
3. Power Plant Technology- By G.D.Rai
4. Power Plant Engineering by R.K. Rajput

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME 406	**Quality Assurance & Reliability**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time)Hrs(.**
4	0	---	4	4.0	75	25	100	3
Purpose	This course provides the understanding of Concepts of quality in engineering domain. Various aspects of quality such as quality management, statistical quality control, system reliability, etc. will be taught to students.							
COURSE OUTCOMES								
CO1	Students will understand the concepts of quality, quality assurance and management.							
CO2	Students will be able to demonstrate the ability to use the methods of statistical process control and able to use and interpret control charts for variables.							
CO3	Students will be able to use and interpret control charts for attributes, also able to understand sampling inspection.							
CO4	Understand the concepts of reliability, carry out reliability data analysis, Get acquainted with computation of system reliability and reliability improvement methods.							

UNIT I

Introduction- Definition of Quality, Quality function, Dimensions of Quality, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs, Introduction to Quality function deployment.

Quality Assurance (QA) - Introduction, Definition, Management principles in QA, Forms of QA, QA in different stages. Quality planning, QA program, QA aspect, Quality in material management, Vendor selection & development.

UNIT II

Statistical Process Control - Introduction to statistical process control, Concept of variation, Assignable & Chance causes, Attributes & variables, Frequency distribution curve & its types. Normal Distribution curve, Problems on FD curve & ND curve, Application of SPC.

Control Charts for Variables- Definition, Formulae & its problems. Control chart patterns, Process capability. Problems on x & R chart and Process capability.

UNIT III

Control Charts for Attributes- Definition, Formulae & its problems. Problems on p, c charts. Choice between variables and attributes control charts. Guidelines for implementing control charts.

Sampling Inspection - Sampling: Definition, types of sampling, importance, benefits and limitations of sampling, Operating Characteristic Curve, Average Outgoing Quality Curve, Errors in Making Inferences from Control Charts (Type I and II errors).

UNIT IV

Reliability Concepts - Introduction of Reliability concepts, Failure data analysis and examples, Failure rate, Failure density, Probability of failure, Mortality rate, Mean time to failure, Reliability in terms of Hazard rate and Failure Density, examples, Useful life and wear out phase of a system,

System Reliability and Improvement: Reliability of series and parallel connected systems and examples, Logic diagrams, Improvement of system reliability, Element Redundancy, Unit redundancy, Standby redundancy.

Suggested Reading:

1. Grant E L, Statistical Quality Control", McGraw-Hill.
2. Mahajan, "Quality Control and Reliability", Dhanpat Rai & Sons
3. Srinath L S, "Reliability Engineering", East west press.
4. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B.Tech. (8th sem.) Mechanical Engineering							
ME-408	**Automobile Engineering Lab**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time(Hrs.)**
0	0	2	2	2.0	40	60	100	3
Purpose	To understand construction details and working of various parts of automotive system							
COURSE OUTCOMES								
CO1	To make students aware with constructional details and working of Cylinder, Ignition System and Injection System of I C Engine.							
CO2	To make students aware with constructional details of Automotive Clutches, Automotive Transmission Systems Automotive Drive Lines & Differentials.							
CO3	To make students aware with the Design and constructional details of Automotive Suspension Systems and Automotive Suspension Systems.							
CO4	To make students aware with t Design and constructional details Automotive Tyres & wheels Automotive Brake Systems Automotive Emission / Pollution control systems.							

List of Experiments:

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems.

(a) Multi-cylinder: Diesel and Petrol Engines.

(b) Engine cooling & lubricating Systems.

(c) Engine starting Systems.

(d) Contact Point & Electronic Ignition Systems.

2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems:

(a) Carburetors (b) Diesel Fuel Injection Systems (c) Gasoline Fuel Injection Systems.

3. To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. (a) Coil-Spring Clutch (b) Diaphragm – Spring Clutch. (c) Double Disk Clutch.

4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems. (a) Synchromesh – Four speed Range. (b) Transaxle with Dual Speed Range. (c) Four Wheel Drive and Transfer Case. (d) Steering Column and Floor – Shift levers.

5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials. (a) Rear Wheel Drive Line. (b) Front Wheel Drive Line. (c) Differentials, Drive Axles and Four Wheel Drive Line.

6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Front Suspension System. (b) Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering. (b) Power steering Systems, e.g. Rack and Pinion Power Steering System. (c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.

8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres& wheels. (a) Various Types of Bias & Radial Tyres. (b) Various Types of wheels.

9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems. (a) Hydraulic & Pneumatic Brake systems. (b) Drum Brake System. (c) Disk Brake System. (d) Antilock Brake System. (e) System Packing & Other Brakes.

10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

NOTE: 1. At least ten experiments are to be performed in the Semester. 2. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of the syllabus

	B.Tech. (8th sem.) Mechanical Engineering						
ME 410	**PROJECT-II**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
-	**-**	**10**	**5.0**	**100**	**100**	**200**	

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group not more than four students in a group. Viva- voce must be based on the preliminary report submitted by students related to the project.

	B.Tech. (8th sem.) Mechanical Engineering						
ME 412	**SEMINAR- II**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
-	**-**	**2**	**1.0**	**100**		**100**	

The students are required to deliver a seminar on some emerging areas of Mechanical Engineering, given as follows:

- CAD/CAM/CAE/FEA
- Robotics
- Machine Vision
- Automation
- Tribology
- CFD
- Energy Conservation
- Alternate Energy Sources
- Hybrid Fuels
- Advances in IC Engines
- Vehicle Dynamics
- Aerodynamics
- Advanced Manufacturing Techniques
- Advanced Engineering Materials
- Supply Chain Management
- Business Process Re-engineering
- Six-Sigma Technique
- Lean Manufacturing Technique
- Just-in-Time Technique
- Agile Manufacturing
- Value Engineering
- Reliability Engineering

- Any other topic related to Design/Thermal/Industrial/Production Engineering

The student will deliver a power point presentation for about 30 minutes in the seminar on any of the above topics. This will be followed by question answering session for about 10 minutes. The questions on the seminar topic will be asked by the teacher concerned and class students. The students will also prepare a detailed report in MS word and after spiral binding will submit it to the teacher concerned. The report is to be submitted at least one week prior to the presentation. The grades/awards will be given according to the student's presentation, report submitted, and answering of questions asked after the presentation.

ELECTIVE-III

	B. Tech. (8th Semester) Mechanical Engineering						
ME-414	**Smart Materials, Structures & Devices**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**0**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	This course is designed to give an insight into the latest developments regarding smart materials and their use in structures.						
Course Outcomes							
CO1	Describe the basic concepts related to Smart materials and Intelligent Materials.						
CO2	Describe the role of various smart materials in structural systems and usage of Electrorheological fluids.						
CO3	Describe the working and Engineering applications of Piezoelectric materials						
CO4	To make student understand the Structural Applications of Smart Materials and different aspects of Biomimetic structural design.						

UNIT-I

Smart materials:

Introduction, Historical Perspective, Overview of Microsystems and Smart Systems, Need for Miniaturization, Role of Microfabrication, Typical applications of Microsystems and Smart Systems.

Intelligent materials:

Structural Materials, Functional Materials, Primitive functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with Humanity, Intelligent Biological Materials.

UNIT-II

Smart Materials and Structural Systems:

The principal ingredients of a premier class of smart materials, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent Systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive actuator based Smart Structures, Active Sensing and Reactive Smart Structures. Smart Skins, Synthesis of Future smart systems.

Electrorheological Fluids:

Suspension and Electro-rheological fluids, The Electro-Rheological Phenomenon, Charge Migration mechanism for the dispersed phase, Electrorheological Fluid Actuators, Experimental investigations.

UNIT-III

Piezoelectric Materials:

Introduction, Basic Principle, History, Classification of Dielectric materials, Important Dielectric Parameters, Electrostrictive effect, Piezoelectric Effect, Pyroelectric Effect, Ferroelectric Materials, Poling. Examples of Piezoelectric Materials: Quartz, Lead Zirconate Titanate(PZT), Fabrication of PZT, Polymer Piezoelectric Materials, Barium Titanate, Zinc Oxide Thin Films, Polymer Composites.

Engineering Applications of Piezoelectric Materials:

Gas Lighter, Pressure Sensor, Accelerometer, Piezoelectric Gyroscope, Piezoelectric Microphone, Piezoelectric Actuators, Piezoelectric Motor, Piezoelectric Transformer

UNIT-IV

Structural Applications of Smart Materials:

Introduction, Materials and Applications; Shape Memory alloys, Substitute for steel, Engineered Cementitious Composites, Carbon Fiber Reinforced Concrete, Smart Concrete, ER/MR Fluids, Induced Strain Actuators. Active Control of Structures, Passive Control of Structures, Hybrid Control, Smart Material Tag, Retrofitting, Restoration of Cultural Heritage using SMA Devices, SMA for Seismic Retrofit of Bridges, Self-Healing Materials, Self-Stressing for Active Control, Structural Health Monitoring, Active Railway Track Support, Active Structural Control against Wind.

Biomimetic Structural Design:

Biomimetic, Characteristics of Natural Structures, Biomimetic Structural Design; Fiber Reinforced Organic Matrix Natural Composites, Fiber Reinforced Natural Ceramers: Bone and Antler, Fiber Reinforced Organic Matrix and Ceramic Matrix Composites: Mollusks, Biomimetic Sensing, Cochlea, Bats, Challenges and Opportunities

References:

1. Smart Materials and Structures by B.V. Gandhi and B.S. Thompson, Chapman and Hall Pub.
2. Smart Materials Edited by Mel Schwartz , CRC Press.
3. Smart Structures Analysis and Design by A.V. Srinivasan and D. Michael McFarlaid, Cambridge University Press.
4. Piezoelectric Materials and Devices: Applications in Engineering and Medical Sciences by M.S. Vijaya, CRC Press.
5. Smart Structures and Materials by Brian Culshaw, Artech House.
6. Smart Structures by Gauenzi, P., Wiley Publication.
7. Piezoelectricity by Cady, W. G., Dover Publication.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME 416	**LUBRICATION TECHNOLOGY**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time)Hrs(.**
4			4	4.0	75	25	100	3
Purpose	Providing a fundamental understanding of lubricants and lubricant technology including emerging lubricants such as synthetic and environmentally friendly lubricants & application & usage of lubricants in Automobiles & Machines.							
COURSE OUTCOMES								
CO1	Students will interpret, exemplify & use the terminology pertaining to Lubricants & Lubrication as in Industries & can differentiate & classify various types of lubricants based upon their properties.							
CO2	Students will attain knowledge regarding the production or distillation of Mineral & Chemically modified lubricating base oils & Need, Application, Uses, Classification & Properties of Synthesized base oils & Metal Working Fluids.							
CO3	Students will attain a theoretical understanding of various types of lubrications & their applications to avoid/reduce friction & wear.							
CO4	Students will be able to classify & theoretically distinguish between various Steam & Gas Turbine Oils, Compressor, Vacuum Pump & Refrigeration Oils.							

UNIT I :BASICS OF LUBRICANTS

Terminology related to Lubricants & Lubrication : Viscosity; Absolute & Kinematic Viscosity; Newtonian & Non -Newtonian Fluids; Viscosity Measurement; Viscosity Index; Additives; Base Stocks; Anti-Foam Agents; Anti-oxidant; Anti-Wear Agents; Aromatic agents; Role of lubricants in Asperity; Boundary Lubrication; Corrosion Inhibitor; Demulsibility; Detergent; Dielectric Strength; Diester; Dispersant; Dropping Point; Dry Running; Emulsifier; Extreme-Pressure Agent; Film Strength)Lubricity(; Hydrolytic Stability; Neutralization Number; Oxidative Stability; Paraffinic etc.

Lubricants: Introduction; Functions of lubricants, types and properties; Mineral Oils, Synthetic Oils, Biodegradable, Environment friendly oils; Automotive Engine Oils; Metal Working Fluids; Aviation Oils; Greases .

UNIT II:

Mineral & Chemically modified lubricating base oils : Introduction; Steps Involved in production of Mineral base oils in refineries; Vacuum Distillates characteristics & Properties; Conventional refinery production of Lubricating base oils;

Synthesized base oils : Introduction, Need, Application & Uses, Classification, Properties.

Metal Working Fluids : Classification of Metal Working Fluids; Emulsions & Lubricants; Surface Active compounds in metal working fluids; rolling oils for steel; performance evaluation of steel rolling oils.

UNIT III :LUBRICATION, FRICTION & WEAR

Introduction; Dry friction; Boundary lubrication; Hydrodynamic, Hydrostatic and Elasto-hydrodynamic lubrication; Lubricant additives; Principles, application to rolling contact bearings, cams, Gears.

UNIT IV :INDUSTRIAL LUBRICANTS

Steam & Gas Turbine Oils : Classification of Turbine Oils, Properties & Functions of Turbine Oils, Viscosity, Rust & Corrosion Protection, Demulsibility, Air Release, Foam Control, Anti-wear Property, Oxidation Stability, Gas Turbine Oils.

Compressor, Vacuum Pump & Refrigeration Oils : Classification & Specifications of Compressor Oils, Functions of Compressor Oils; Lubrication of Reciprocating Compressor : Compressor Oil properties; Synthetic compressor oils; Vacuum Pump oils; Refrigeration compressor oils; requirement & specification of Refrigeration oils.

Suggested Reading :

1. Developments in Lubricant Technology –By S.P .Srivastava, Wiley
2. Mechanics and Chemistry in Lubrication -By Dorinson and Ludema , Elsevier
3. Friction and wear of Materials -By E .Robinowicz, Johan Wiley
4. Principles of Lubrication-By A .Cameron, Longmans
5. Chemistry and Technology of Lubricants – By R .M .Mortier, S .T .Orszulik, Springer-Science +Business Media, B.V.
6. Lubricant Additives :Chemistry and Applications -Second Edition edited by Leslie R . Rudnick, CRC Press, Taylor & Francis Group.

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME 418	**ENERGY MANAGEMENT**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4			4	4.0	75	25	100	3
Purpose	This course will enlighten the students about the knowledge of Site & Building Surveys, HVAC Systems, Illumination Systems, Process Energy, Building Envelope, Economics & Use of Computers in Energy Management.							
COURSE OUTCOMES								
CO1	Students will be able to discuss how Site & Building Surveys are done & the key parameters involved. The technicalities, operating principles & classification of HVAC Systems.							
CO2	Students can describe the fundamental principles, classification & can solve technical problems regarding Illumination Systems & principles, application & advantages of Process Energy.							
CO3	Students will be able to describe the Economics of Energy Management & Conservation Building Envelopes its design & other key considerations.							
CO4	Students can theoretically explain the use of Computers in Energy Management.							

UNIT I

Site & Building Surveys: Phases involved in surveys: Initiation phase, audit and analysis phase, implementation phase; General methodology for Building and Site Energy Audit**; Site survey**: Methodology, Site survey-electrical system, steam and water systems; **Building Survey:** Methodology, Basic energy audit instrumentation, Measurement for building surveys.

Heating, Venting & Air Conditioning System: General principles**;** The requirements for human comfort**;** Description of typical systems-dual duct HVAC system**;** Multi zone HVAC systems: Variable and Volume systems, Terminal repeat system, Evaporative systems, Package system**;** Basic principle governing HVAC system, Package system**;** Energy management opportunities in HVAC systems; Modeling of Heating and cooling loads in buildings; Problems.

UNIT II

Illumination Or Lightning Systems: General principles**;** Illumination and human comfort**;** Basic principles of lighting system**;** Typical illumination system and equipment; Fundamentals of single phase and 3 phase A.C. circuits**;** Energy management opportunities for lighting systems, motors and electrical heat**;** Electrical analysis and their parameters, peak demand control**;** Problems.

Process Energy: General principles; Process heat; Energy saving in: Condensate return, Steam generation and distribution, Automotive fuel control, Hot water and Water pumping; Direct and indirect Fired furnaces *over* process electricity; Other process energy forms-compressed air and manufacturing processes; Problems.

UNIT III

Economics of Energy Management: General consideration, life cycle costing, break-even analysis, cost of money, benefit/cost analysis, payback period analysis, prospective rate of to return, problems.

Building Envelope: Environmental conformation; Passive design; Conservation building envelope design consideration; Integration of building system; Energy storage problems.

UNIT IV

Energy Management Principle Involving Computers: Basics of computer use**;** Analysis: Engineering and Economic calculations, Simulation, Forecast**;** CAD/CAM controls: Microprocessor and Minicomputers**;** Building cycling and control**;** Peak demand limiting and control: Industrial power management; Problems.

Text Book:

1. Energy Management Principles by Criag B. Smith, Published by Pergamon Press.

2. Energy systems and developments – Jyoti Parikh, Oxford University Press.

Reference Books:

1. Energy – resources, demand and conservation with reference to India – Chaman Kashkari, Tata Mc Graw Hill Co. Ltd.

2. Integrated renewable energy for rural development – Proceedings of Natural solar energy convention, Calcutta.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME 420	**WASTE HEAT RECOVERY SYSTEM**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4	0		4	4.0	75	25	100	3
Purpose	This course provides the knowledge about upcoming concept of Waste Heat Recovery Systems & Cogeneration and also enables the students to think and analyse the techno economic viability of various energy efficient systems.							
COURSE OUTCOMES								
CO1	Students will develop an understanding to the basics of Waste heat recovery & then can classify the commercially viable waste heat recovery devices along with their applications & associated saving potential.							
CO2	Students will be able to describe the basic thermodynamic principles of cogeneration, the cogeneration technologies based on steam turbine, gas turbine and IC engine.							
CO3	Students will attain a theoretical understanding of applications & issues related to waste heat recovery & cogeneration technologies.							
CO4	Students will theoretically analyze the Economical & environmental aspects of Waste heat recovery systems & Cogeneration.							

UNIT I :Waste Heat Recovery

Introduction; Heat Losses; Heat recovery from heat treatment furnace; Heat Recovery Classification and Application; Benefits of Waste Heat Recovery; Development of a Waste Heat Recovery System; Commercial Waste Heat Recovery Devices: Heat Pipe, Economizer, Shell and Tube Heat Exchanger, Plate heat exchanger, Run Around Coil Exchanger, Waste Heat Boilers, Heat Pumps, Thermo compressor, Direct Contact Heat Exchanger.

UNIT II: Cogeneration

Principles of cogeneration; Performance indices of cogeneration systems; Cogeneration systems based on steam turbine, gas turbine, combined cycle, and IC engines.

Advanced cogeneration systems based on fuel cells, Stirling Engines; Cogeneration plants electrical interconnection issues - Utility and cogeneration plant-interconnection issues.

UNIT III: Waste Heat Recovery & Cogeneration: Applications

Applications of cogeneration: Utility sector, Industrial, Construction and Rural sectors; Impacts of waste heat recovery & cogeneration plants: Fuel, Electricity and Environment.

Waste heat sources; Selection criteria for waste heat recovery technologies; Recuperative and regenerative heat exchangers for waste heat recovery; Waste heat boilers: Classification, Design considerations, Sizing, Location, Performance calculations, Service conditions; Heat pumps - types, design.

UNIT IV: Waste Heat Recovery & Cogeneration: Economics

Application. Economic analysis of cogeneration and waste heat recovery systems. procedure for optimization of system selection and design, load curves, sensitivity analysis. Regulatory and financial framework for cogeneration and waste heat recovery systems. Environmental considerations. Mitigation of harmful emissions from energy production, conversion and utilization technologies. Control of air, water and ground pollution.

Suggested Reading:

1. Khartchenko N.V. Green Power: Eco-Friendly Energy Engineering, Tech Books, New Delhi,2004.
2. Boyce M.P. cogeneration and combined cycle power plants, ASME press, 2nd ed., 2010
3. Pehnt M. et al. Micro Cogeneration Springer, 2005.
4. Meckler, M., Hyman L.B. Sustainable on-Site CHP Systems, McGraw-Hill, 2010.
5. Obara S. Distributed energy systems, Nova Science, 2009.
6. Khartchenko N.V. Advanced Energy Systems, Taylor and Francis, Washington DC, 1998.
7. Harvey D.L. Handbook on Low-Energy Buildings and District-Energy Systems, Earthscan, 2006.

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th Semester) Mechanical Engineering						
ME-422	**FOUNDRY ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**0**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	The present course focus on giving the exposure of various Foundry processes for a product whose scale ranges from miniature to extra-large, Moulding-Coring practice, Melting inoculations practices, Quality Control of the casting.						
Course Outcomes: After learning the course the students should be able to:							
CO 1	Express Knowledge about the fundamentals of the casting, basic terminology related to casting process.						
CO 2	Decide the alternative method for the manufacturing of component for engineering Applications.						
CO 3	Select the methods of the casting and Decide correct melting practice of different cast alloy & different melt-treatments.						
CO 4	Demonstrate the ability to select the proper molding material, type of furnace with relevant refractory material, use appropriate casting design and temperature measurement device to obtain quality cast products.						
CO5	Minimize the defects generated during casting.						

UNIT-I

Introduction: Introduction to metal casting and foundry industry in modern industrial scenario. Advantages and limitations of casting methods. Classification of foundries. Different sections in a foundry and their functions. Important cast metals and alloys-their composition, properties and uses.

Patterns: Types of patterns, brief classification of pattern making materials, consideration in selection of pattern materials, color coding, pattern allowances, core boxes, types of core boxes.

UNIT-II

Moulding and core making: Ingredients of common type of moulding and core making sands, their properties and behavior, testing of sands and clay.

Moulding processes: Classification of molding processes and casting processes, brief description of all processes such as green sand dry sand, loam sand floor, pit and machine molding.

Casting processes: Shell molding, CO_2 silicate process, Investment casting process, permanent moulding process, Gravity and pressure die casting, centrifugal casting process.

UNIT-III

Elements of Gating system: Classification, basic consideration in gating design, gating ratio, gating practice for ferrous and nonferrous alloys, pouring equipment.

Risering Practice: function of riser, directional and progressive solidification, centerline feeding resistance, riser efficiency, riser design consideration, risering curves, Cain's, N.R.L and modulus method, feeding distance feeding aids, blind and atmospheric risers.

UNIT-IV

Melting Practice: Melting of cast iron, Mechanical features of cupola, operational steps and principles of cupola operation, Advanced practices in the cupola operation, melting of aluminum and copper based alloys including mold treatments such as dressing, grain refining, and modification.

Quality control in foundry: Casting defects, their causes and remedies. Shop floor quality control tests such as composition control, Wedge test, fluidity, temperature measurement. Casting Modification by different methods like Friction stir processing.

Reference Books:

1. Manufacturing Technology: Foundry, Forming and Welding by P.N.Rao, Tata McGraw Hill Education Private Limited
2. Principles of Metal Casting, R. W. Heine, C. R. Loper and P. C. Rosenthal, (Tata McGraw Hill)
3. Principles of Foundry Technology, P. L. Jain, (Tata McGraw Hill).
4. Fundamentals of Metal Casting Technology, P. C. Mukherjee, (Oxford & IBH)
5. Foundry Technology, P. R. Beeley
6. Foundry Engineering, H. F. Taylor, M. C. Flemings,(Wiley Eastern)
7. Foundry Technology, D. Kumar & S. K. Jain, (CBS Pub.)

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th Semester) Mechanical Engineering						
ME-424	**ERGONOMICS IN DESIGN**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**0**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	To introduce basic approaches of work system design, ergonomic principles and their application in the design of work, equipment and the workplace.						
Course Outcomes							
CO1	To demonstrate the application of work study and its methods						
CO 2	To familiarize the students with the work measurement and sampling techniques						
CO 3	To introduce the human factor engineering and the factors affecting the human performance.						
CO 4	To exercise for the design of the work space, equipment's and environment.						

Unit I

Introduction to Work Study: Productivity, Scope of methods, motion and time study.

Work Methods Design: Operation Process Chart, Flow Process Chart, Flow Diagram, String Diagram, Man and machine chart, Two handed process chart, Travel Chart, Micro motion and memo motion study.

Unit II

Work Measurement: Tools and Techniques

Work Sampling: Determining time standards from standard data and formulas, Pre-determined motion time standards, Work factor system, Methods time measurement, Analytical Estimation, Measuring work by physiological methods – heart rate measurement – measuring oxygen consumption– establishing time standards by physiology methods.

Unit III

Human Factors Engineering: Introduction to ergonomics, Man/machine/environment systems concept, Human Anthropometry and its use in work place layout.

Human Performance: Information input and processing, factors affecting human performance, physical work load and energy expenditure, heat stress, manual lifting, Static and dynamic muscular load, human motor activity, metabolism, physical work load, repetitive and inspection work, measurement of physical work load, mental work load and its measurement, musculo-skeleton disorder, work duration and work pauses, principles of motion economy.

Unit IV

Design of Work Space & Equipment: Work-space design for standing and seated workers, arrangement of components with in a physical space, Interpersonal aspect of work place design, Ergonomic Factors to be considered, design of displays and controls, design for maintainability

Design of Environment: Illumination and its effect, Climate - Heat Humidity – Body heat balance, effective temperature scales, zones of discomfort, effect of heat on body and work performance, Vibrations - Response of body to low frequency vibrations, vibrations and discomfort, effect on health of worker, high frequency vibrations, effect of high frequency vibrations, methods of reducing vibrations, Noise - Physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent threshold shift, effect of noise on performance, reduction of noise, personal noise protection, Standards and social aspects.

Text Books:

1. Introduction to Work Study, I.L.O., 3rd Revised Edn.
2. Motion and Time Study – Design and Measurement of Work, Barnes, Raeph.m., John Wiley & sons, New York.
3. Human Factors in Engineering and Design, Macormick, E.J., Tata McGraw-Hill
4. A Guide to Ergonomics of Manufacturing, Martin Helander, TMH.
5. Human Factor Engineering, Sanders & McCormick, McGrawhill Publications.
6. Sound, Noise and Vibration Control, Lyle, F. Yerges, Van Nostrand.

Reference Books:

1. Improving Productivity and Effectiveness, Mundel, Marvin, E., Prentice Hall.
2. Human Factors Engineering & Design, Sounders, M.S. and McCornic, E.J., McGraw Hill.
3. Motion and time study, Benjamin .W. Neibel,, Richard .D .Irwin Inc., Seventh Edition.
4. Work design Stephen Konz., Publishing Horizon Inc., Second Edition.
5. Introduction to Ergonomics, Bridger R.S.,McGraw Hill.
6. Applied Ergonomics, Hand Book: Brien Shakel (Edited) Butterworth Scientific, London.
7. Work Study and Ergonomics, Shan, H.S, DhanpatRai& Sons.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

ELECTIVE-IV

	B.Tech. 8th Semester Mechanical Engineering						
ME-426	**MAUFACTURING MANAGEMENT**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
4	**-**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	Students will be able to comprehend the major aspects of Manufacturing management like production & operation management, plant location and layout, material handling and management, Waste Management & Automation.						
Course Outcomes							
CO1	Students will be able to attain the theoretical knowledge of production & operation management.						
CO 2	Students will be able to attain the theoretical knowledge of the concept of plant location and layout.						
CO 3	Students will be able to attain the theoretical knowledge of material handling and management.						
CO 4	Students will be able to attain the theoretical knowledge of Waste Management & Automation.						

UNIT-1

INTRODUCTION TO PRODUCTION AND OPERATION MANAGEMENT: Introduction, Historical Evolution of Production and Operation Management, Concept of Production, Production System, Production Management, Operation System, Operation Management, Managing Global Operations, Scope of Production and Operation Management.

UNIT-2

PLANT LOCATION AND LAYOUT: Introduction and Meaning, Need for Selecting a Suitable Location, Factors influencing Plant location, Location theories, Location models, Location economics, Plant layout, Classification of layout, Design of Product layout, Design of Process layout, Service layout, Organization of physical facilities.

UNIT-3

MATERIAL HANDLING AND MANAGEMENT: Introduction, Objectives of Material Handling, Principles of Material Handling, Selection of Material Handling Equipment, Evaluation of Material Handling System, Material Handling Equipment, Guidelines for Effective Utilization of Material Handling Equipment, Relationship Between Plant Layout and Material Handling, Scope and Function of Material Management, Material Planning and Control,

Inventory Control, Standardization, Simplification, Ergonomics, Just-in-Time(JIT) Manufacturing.

UNIT-4

WASTE MANAGEMENT: Introduction Reasons for Generation and Accumulation of Obsolete, Surplus and Scrap Items, Identification and Control of Waste, Disposal of Waste.

AUTOMATION: Introduction, Types of Automation, Computer Integrated Manufacturing, Reasons for Automation, Advantages and Disadvantages of Automation, Automation Strategies, Automated Flow Lines, Automated Guided Vehicles System, Automated Storage/Retrieval System.

REFERENCES AND TEXT BOOKS:

1**.** Production and operational management by S. ANIL KUMAR/N. SURESH**.**
2**.** Production and operational management by Pratibha Garg**.**
3**.** Modern Production Management Systems by Sushil Gupta Martin Starr**.**
4**.** Manufacturing Operations Management by Sanjay Sharma**.**

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME-428	**DESIGN OF PRESSURE VESSEL AND PIPING**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4			4	4.0	75	25	100	3
Purpose	**The main objective is to present the industrial related problems, procedures and design principles for pressure vessels and enhance the understanding of design procedure of pressure vessel and Design of piping layout.**							
COURSE OUTCOMES								
CO1	Student will attain the knowledge of Introduction to piping system and selection of piping components							
CO2	Student will attain the knowledge of Stresses induced in Pressure vessels and stress analysis							
CO3	Student will attain the knowledge of Detail Designing of vessels and introduction to ASME pressure vessel codes 23							
CO4	Student will attain the knowledge of the Buckling of vessels and its preventions							

UNIT I :INTRODUCTION

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.
Layout of Piping Systems

Selection of Piping Components (Flanges, Valves, Supports, Expansion Joints, etc.), Selection of Material

UNIT II :STRESSES IN PRESSURE VESSELS

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III: DESIGN OF VESSELS

Design of Tall cylindrical self-supporting process columns –Supports for short, vertical and horizontal vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. Introduction to ASME pressure vessel codes 23, Piping Codes & Standards (ASME B31.3)

UNIT IV :BUCKLING OF VESSELS

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

PIPING:-Introduction – Flow diagram – piping layout and piping stress Analysis, Pipe sizing, Flow and Pressure Drop Calculations, Piping Flexibility.

TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.

REFERENCES:

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME-430	**Concurrent Engineering**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4	0		4	4.0	75	25	100	3
Purpose	To make students aware of objectives of Concurrent engineering, Design Product for Customer, Design for Manufacture (DFM), Quality by Design and Design for X-ability.							
COURSE OUTCOMES								
CO1	Students will attain the knowledge of objectives of Concurrent engineering.							
CO2	Students will attain the knowledge of Design Product for Customer							
CO3	Students will attain the knowledge of Design for Manufacture (DFM)							
CO4	Students will attain the knowledge of Quality by Design and Design for X-ability:							

UNIT I

Introduction: Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. Support for CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

UNIT II

Design Product for Customer: Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent Engineering Design: Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns.

UNIT III

Design for Manufacture (DFM): Introduction, role of DFM in CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemble ability.

UNIT IV

Quality by Design: Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality,

experimental approach.

Design for X-ability: Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

Text Books

1. Concurrent Engineering- Kusiak - John Wiley & Sons
2. Concurrent Engineering- Menon - Chapman & Hall

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering						
ME 432	**INDUSTRIAL COMBUSTION**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Theory**	**Sessional**	**Total**	**Time (Hrs.)**
4	**0**	**-**	**4.0**	**75**	**25**	**100**	**3**
Purpose	**This course is designed to offer basic knowledge to the students in the area of applied Combustion. By studying this course, the student shall be able work in industrial power plants and automobile sector.**						
Course Outcomes							
CO1	Apply fundamental principles of the rate of chemical reactions and emission characteristics of fuels used in power plants and transportation sector.						
CO 2	Determine and calculate the values of the flame temperature of commercial fuels burning in the combustion chambers of internal combustion engines						
CO 3	Express the concept of Thermodynamic and transport properties of fuels at elevated pressures and temperatures prevalent in the combustion chambers of actual engines.						
CO 4	Solve the problems on the burning velocity of premixed flames and important combustion characteristics of diffusion flames.						

Unit-I INTRODUCTION

Historical perspective of combustion science, perspective of fuels and combustion technology. Types and general characteristics of fuels, proximate and ultimate analysis of fuels. ROM, DMMF, DAF and bone dry basis. Moisture and heating value determination, gross and net hearting values, calorimetry, Du Long's formula for HV estimation, Flue gas analysis, Orsat apparatus.

Unit-II FUEL TYPES

Solid Fuels: Peat, coal, biomass, wood waste, agro fuels, refuse derived solid fuel, testing of solid fuels. Bulk and apparent density, storage, wash ability, coking and caking coals. Liquid Fuels: Refining, molecular structure, liquid fuel types and their characteristics, fuel quality. Liquefaction of solid fuels. Gaseous Fuels: Classification and characterization.

Unit-III THERMODYNAMICS AND KINETICS OF COMBUSTION

Properties of mixture, combustion stoichiometry, chemical energy, chemical equilibrium and criteria, properties of combustion products. First law combustion calculations, adiabatic flame temperature (analytical and graphical methods), simple

second law analysis. Elementary reactions, chain reactions, pre-ignition kinetics, global reactions, kinetics, reaction at solid surface.

UNIT-IV COMBUSTION OF SOLID, LIQUID AND GASEOUS FUEL

Drying, devolatilization, char combustion. Fixed bed combustion, suspension burning, fluidized bed combustion. Spray formation and droplet behavior, oil fired furnace combustion, gas turbine spray combustion, direct and indirect Injection combustion in IC engines. Energy balance and furnace efficiency, gas burner types, pulse combustion furnace. Premixed charge engine combustion. Detonation of gaseous mixtures.

Text Books:

1. Combustion Engineering by Kenneth W. Ragland, Kenneth M. Bryden, CRC press
2. Fundamental of combustion by D P Mehta, PHI Delhi.

Reference Books:

1. Principles of combustion by Kenneth Kuan Kuo, John Wiley & Sons
2. An introduction to combustion: concept and applications by Stephen R Turns, Mc Graw - Hill companies

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME -434	**Metal forming and Finishing**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4	0	0	4	4.0	75	25	100	3
Purpose	Metal forming and finishing in manufacturing considers a metal-forming process as a system consisting of several interacting variables. These Includes an overall review and classification of all metal-forming processes. T							
COURSE OUTCOMES								
CO1	The Students will be able to apply the fundamentals of plastic deformation process							
CO2	The student will be able to understand the shearing mechanism processes.							
CO3	The students will be able to analyze the metal finishing processes.							
CO4	The students will be able to comprehending the techniques of powder metallurgy.							

Unit I

Introduction Elastic and plastic deformation. Concept of strain hardening. Hot and cold working processes -rolling, forging, extrusion, swaging, wire and tube drawing. Machines and equipment for the processes. Parameters and force calculations. Test methods for formability.

Basics of plastic forming & forging, mechanics of metal working, temperature in metal working, strain rate effects, friction and lubrication, deformation zone geometry. Forging process, classification – equipment, calculation of forging loads, forging defects, residual stresses.

UNIT II

Sheet Metal Working: Applications of sheet formed products. Shearing mechanism. Processes like blanking, piercing, punching, trimming, etc. Forming processes like bending, cup drawing, coining, embossing, etc. Presses for sheet metal working; Part feeding systems; Elements of die; punch and die clearances; Progressive, compound and combination dies. High energy rate forming processes.

UNIT III

Metal finishing: Technological importance of metal finishing. Effect of plating variables on electro deposits. Electroplating techniques - methods of electroplating, surface preparation, Metal finishing processes: Such as diamond machining, honing, lapping's buffing etc.

UNIT IV

Introduction. Production of metal powders. Compaction and sintering processes. Secondary and finishing operations. Economics, advantages, and applications of powder metallurgy.

Reference books:

1. Mechanical Metallurgy by G. E. Dieter, McGraw-Hill.
2. Metal Forming: Fundamentals and Applications by Taylan Altan (ASM Series in Metal Processing)
3. Introduction to Industrial Mechanical Working Process by G. W. Rowe
4. Materials & Processes In Manufacturing By E.Paul De Germo, J T Black & Ronald A Koshav

Note:

The examiner will set question paper in two parts.

Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.

Part B will have two sections.

Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B

Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.

	B. Tech. (8th sem.) Mechanical Engineering							
ME -436	**Air Craft & Rocket Propulsion**							
Lecture	**Tutorial**	**Practical**	**Hrs/Week**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs.)**
4	0	0	4	4.0	75	25	100	3
Purpose	Starting with the basic principles of Mechanics behind the generation of thrust by jet action, the course is developed logically and systematically to look into the various aspects of jet engines and the components that make them.							
COURSE OUTCOMES								
CO1	Students will be able to synthesize compressible flow of thermodynamics properties.							
CO2	Students will be able to evaluate Aircraft maintainability.							
CO3	Students will be able to design performance parameters of rocket propulsion.							
CO4	Students will be able to analyze the basic turbojet engine cycle.							

Unit I

Review of Thermodynamics and Compressible Flow Review Of relevant basic thermodynamics. First Law and energy analysis for closed and open systems. Second law of thermodynamics, limitations on energy conversion, process representation on h-splane (Mollier diagrams). One-dimensional compressible flow with lumped effects of area change, friction. Heat transfer, and mass transfer and the implications there of for the production of thrust. Detailed analysis of one-dimensional steady flow in variable area passages with special reference to nozzles and diffusers.

UNIT II

Various types of structures in airframe construction, tubular, stringers, formers, bulkhead, spars and ribs, honeycomb construction. Aircraft Maintainability: Evolution of maintenance philosophy, periodic maintenance system based on checks at specific intervals and continuous maintenance system. Daily Inspection and trip inspection system. On Condition maintenance techniques, their evolution and effect on design of aircraft systems.

UNIT III

Rocket Propulsion Application of nozzle theory and performance evaluation of rocket engines. Performance parameters of relevance to rocketry such as characteristic velocity, thrust coefficient, specific impulse, etc. Preliminary design and sizing of rocket thrust chambers.

UNIT IV

Gas Turbine based Jet Engines: Ideal Cycle Analysis The basic turbojet engine cycle, analysis of the ideal cycle. Turbojet with afterburner, Ideal cycle, comparison of turbojet performance with and without afterburner. 4 The ideal turbofan, mixed and unmixed exhaust streams, design point optimization and performance. The turboprop engine, analysis of the ideal performance.

Reference books :

1. Oates, G. C., "Aerothermodynamics of Gas Turbine and Rocket Propulsion", AIAA Educational Series, AIAA, Washington, 1988.

2. Hill, P. G. and Peterson, C. R., "Mechanics and Thermodynamics of Propulsion", 2nd ed., Addison-Wesley Publishing Company, Inc., Reading, MA,1992.

3. Treager, I. E., "Aircraft Gas Turbine Engine Technology", 2nd ed., McGraw Hill , Inc., New York, 1979. 4. Jones, J. B. and Dugan, R. E., "Engineering Thermodynamics", Prentice Hall of India, New Delhi,2002

Note:
The examiner will set question paper in two parts.
Part A which is compulsory will have 15 short answer type/ Multiple-choice questions of one mark each.
Part B will have two sections.
Section-I will have **four** questions, two questions from each unit, each carrying **5 marks**. Students will have to attempt all questions from Section-I of Part-B
Section-II will have **eight** questions, two questions from each unit, each carrying **10 marks**. Students will have to attempt **four** questions out of these eight questions, selecting at least one question from each unit.