DEPARTMENT OF TECHNOLOGY
SHIVAJI UNIVERSITY, KOLHAPUR

STRUCTURE AND SYLLABUS
OF
FINAL YEAR B. TECH.
(MECHANICAL ENGINEERING)

TO BE EFFECTIVE FROM
ACADEMIC YEAR 2019 - 2020

B. Tech. Programme in Mechanical Engineering

1. Vision

To be a premier centre of engineering education and industrial research that provides excellent academic ambience and nurtures innate talents of students to become technically sound, application oriented, innovative and successful mechanical engineers

2. Mission

To empower students with the fundamentals of Mechanical Engineering through innovative curriculum and effective teaching thereby enabling them for successful career by imparting knowledge, skills and right attitude and a spirit to serve the society with professional ethics.

3. Program Educational Objectives (PEO)

Graduate should:

1. Demonstrate successful professional careers with strong fundamental knowledge in Science, Mathematics, English and Engineering Sciences so as to enable them to analyze the Mechanical Engineering related problems leading to leadership, entrepreneurship or pursuing higher education
2. Acquire technical knowledge in specialized areas of Mechanical Engineering such as Materials, Design, Manufacturing and Thermal Engineering with a focus on research, innovation and gaining the technical skills in advanced software packages.
3. Work with multidisciplinary field of engineering and technology to enlarge the ability among the students to understand the different industrial environments.
4. Continuously learn, research and develop with strong professional, moral and ethical values and with a zeal for life-long learning.

4. Program Outcomes (PO)

An engineering graduate of Mechanical Engineering Programme at Department of Technology by the time of graduation will achieve and demonstrate:

a) An ability to apply basic knowledge of science, mathematics and engineering fundamentals in the field of Mechanical Engineering.

b) An ability to identify, formulates, review research literature and analyze mechanical engineering problems using basics principles of science, mathematics and engineering.

c) An ability to design for complex mechanical engineering problems using basic design concepts, analyze and process to meet the desired needs with in realistic constraints such as manufacturability , durability, sustainability and economy with appropriate consideration for the public health, safety, cultural, societal, and environmental considerations.

d) An ability to design and conduct experiments using research-based knowledge and methods including design of experiments, analyze, interpret the data and results with valid conclusion.

e) An ability to apply the modern tools and apply appropriate techniques to synthesize, model, design, analyze, verify and optimize to solve complex mechanical engineering problems within defined specification by using suitable modern tools to satisfy the needs of the society within realistic constraints such as social, economical, political, ethical, health, safety and manufacturing.

f) An ability to understand the impact of mechanical engineering solutions globally, in terms economic, societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) An ability to understand the principles, commitment and practice to improve product sustainable development globally in mechanical engineering with minimal environmental effect.

h) An ability to understand and apply ethical principles and commitment to address professional ethical responsibilities of an engineer.

i) An ability to function efficiently as an individual and as a group member in a team in multidisciplinary activities

j) An ability to communicate, comprehend and present effectively with engineering community and the society at large on complex engineering activities by receiving clear instructions for preparing effective reports and design documentation.

k) An ability to acquire and demonstrate the knowledge of contemporary issues related to finance and managerial skills to bring up entrepreneurs and entrepreneurship.

l) An ability to recognize and adapt to emerging field of application in engineering and technology by developing self-confidence for continuing education and lifelong learning process.

5. Programme Specific Outcomes (PSO)

m) The Mechanical Engineering Graduates will be able to function in various domains of manufacturing industry in the areas of foundry, jigs fixtures, forming processes, quality control, production management and industrial engineering.

n) The Mechanical Engineering Graduates will be able apply the skills of advanced software tools.

o) The Mechanical Engineering Graduates will be able to work in automobile industry, power plants, energy technology in the sphere of operation and maintenance.

DEPARTMENT OF TECHNOLOGY
FINAL YEAR B.TECH
Scheme of Teaching and Examination
Semester – VII (Mechanical Engineering)

To be implemented from Academic Year 2019- 20

Sr. No	Subject	Teaching Scheme (Hours / Week)				Examination Scheme (Marks)					
						Theory			Practical		
		L	T	P	Credits	Scheme	Max. marks	Min. Passing	Scheme	Max. marks	Min. Passing
1.	Refrigeration and Air Conditioning	04	-	-	04	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
2.	Machine Design III	04	-	-	04	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
3.	Hydraulics and Pneumatics	04	-	-	04	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
4.	Manufacturing Engineering. – III	03	-	-	03	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
5.	Elective I	03	-	-	03	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	---------
6.	Laboratory Refrigeration and Air Conditioning	-	-	02	01	------	-------	--------	IPE	50	20
									EOE	50	20
7.	Laboratory Hydraulics and Pneumatics	-	-	02	01	------	-------	--------	EPE	50	20
8.	Laboratory Manufacturing Engineering. – III	-	-	02	01	------	-------	--------	EOE	50	20
9.	Major Project Phase I*	-	-	02	03	-----	-------	--------	IOE	50	20
10.	Report of Industrial Training	-	-	-	-	------	-------	--------	IOE	50	20
	Total	18	-	08	24	------	**500**	--------	--------	**300**	--------
Audit Course											
11.	Constitution of India (Audit Course)	02	-	-	--	------	-------	--------	-----	----	---

Total Credits: 24 Total Contact Hours/Week: 28 hrs

Note:

#: Minimum 40% marks must be secured in SEE to pass that head.

* Students are expected to do self study for two hours as per the guide hence contact hours to be taken as two for the calculation of contact hours.

• Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.

CIE – Continuous Internal Evaluation, SEE – Semester End Examination,
IPE – Internal Practical Evaluation, EPE–External Practical Examination,
IOE– Internal Oral Evaluation, EOE–External Oral Examination

Elective – I:

1. Finite Element Analysis
2. Cryogenics
3. Operations Research
4. Tribology
5. Production Management
6. Open Elective

Note on Electives:

A particular elective will be offered when at least 20 students opt for it.

Note on Open Elective:

In order to promote interdisciplinary study department can offer open electives to students. This elective will be offered from the electives of other branches, particularly available in Sem. VII only. Students shall attend the theory lectures as per schedule of respective branch.

DEPARTMENT OF TECHNOLOGY
FINAL YEAR B.TECH
Scheme of Teaching and Examination
Semester – VIII (Mechanical Engineering)

To be implemented from Academic Year 2019-20

Sr. No	Subject	Teaching Scheme (Hours / Week)				Examination Scheme (Marks)					
						Theory			Practical		
		L	T	P	Credits	Scheme	Max. marks	Min. Passing	Scheme	Max. marks	Min. Passing
1.	Automobile Engineering	04	-	-	04	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
2.	Power Plant Engineering	04	-	-	04	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
3.	Mechatronics and Robotics	04	-	-	04	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
4.	Total Quality Management	03	-	-	03	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	--------
5.	Elective – II	03	-	-	03	CIE	50	20	--------	-------	--------
						SEE	50	20	--------	-------	---------
6.	**Laboratory** Automobile Engineering	-	-	02	01	--------	-------	--------	EOE	50	20
7.	**Laboratory** Power Plant Engineering	-	-	02	01	--------	-------	--------	EOE	50	20
8.	**Laboratory** Mechatronics and Robotics	-	-	02	01	--------	-------	--------	EOE	50	20
9.	Major Project(Phase II)*	-	-	02	03*	--------	-------	--------	IPE	50	20
						--------	-------	--------	EPE	100	40
	Total	**18**	**-**	**8**	**24**	--------	**500**	--------	--------	**300**	--------
Audit Course											
10.	Human Values and Professional Ethics (Audit Course)	02	-	-	--	--------	-------	--------	-----	----	---

Total Credits: 24 Total Contact Hours/Week: 28hrs

Note:

#: Minimum 40% marks must be secured in SEE to pass that head.

* Students are expected to do self study for two hours as per the guidance given by the project guide hence contact hours to be taken as two for the calculation of contact hours.

Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.

CIE – Continuous Internal Evaluation, SEE – Semester End Examination,

IPE – Internal Practical Evaluation, EPE–External Practical Examination,

IOE– Internal Oral Evaluation, EOE–External Oral Examination

***Elective – II:**

1. Computational Fluid Dynamics
2. Vibration and Noise
3. Nanotechnology
4. Machine Tool Design
5. Industrial Automation and Robotics
6. Open Elective

Note on Electives:

A particular elective will be offered when at least 20 students opt for it.

Note on Open Elective:

In order to promote interdisciplinary study department can offer open electives to students. This elective will be offered from the electives of other branches, particularly available in Sem. VIII only. Students shall attend the theory lectures as per schedule of respective branch.

Class and Semester	**Final Year B. Tech. (Mechanical Engineering), Part IV, Semester VII**				
Course Title	:	**REFRIGERATION AND AIR CONDITIONING**			
Teaching Scheme (Hours)	:	**Lectures = 4 hours/weeks = 4 x 12 weeks = 48 hours minimum**	***Total Credits***	:	**04**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50 SEE = 50** **Grand Total = 100**	***Duration of SEE***	:	**3 hours**
Revision:	:	**First**	***Month***	:	**June 2019**

Pre-requisites **:** Knowledge of Engineering Thermodynamics, Laws of Thermodynamics, Thermodynamic cycles, Fluid properties and Fluid dynamics, Modes of heat transfer, Extended Surfaces, Condensation and Boiling, Heat Exchangers.

Type of Course **:** Theory

Course Domain **:** Core

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Study the fundamental principles, applications of refrigeration cycles and psychrometry.
2. Analyze the vapour compression cycle and interpret the usage of refrigerants.
3. Performance evaluation of Refrigeration and Air Conditioning Systems.
4. Demonstrate the use of psychrometry and calculate cooling load for air conditioning systems used for various applications.
5. Enable the students to analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain fundamentals, need and importance of HVAC systems.

2. Apply knowledge for various applications of refrigeration, air conditioning and cryogenics.
3. Analyze psychrometric terms its application in HVAC, comfort conditions and Design of refrigeration and air conditioning system.
4. Solve problems of heat transfer in buildings and its application to heating and cooling load estimation.
5. Explain duct design system , air-distribution system and commercial
6. Applications of refrigeration and air conditioning system.

Curriculum Content	Hours

UNIT 1 **07**

BASIC REFRIGERATION CYCLES:

Carnot cycle, Reversed Carnot cycle, Simple Vapour compression cycle, sub superheating, Liquid to suction vapour heat exchanger, Calculations and performance of above cycles, Actual vapour compression cycle, Bell Coleman cycle, Air cycles for air craft's (Only theory)

UNIT 2 **09**

REFRIGERATION EQUIPMENTS AND REFRIGERANTS:

A. Refrigeration Equipments: Compressor, Condenser, Evaporator, Expansion devices, Types, selection, use of insulation, methods of charging and testing, Non-conventional methods of refrigeration like vortex tube, Pulse Tube, safety controls.

B. Refrigerants: Classification, Desirable Properties like Thermodynamic, physical, Comparison among commonly used refrigerants, Selection of Refrigerants, Effect on Ozone depletion and global warming, Alternative Refrigerant.

UNIT 3 **08**

MULTI PRESSURE AND VAPOUR ABSORPTION SYSTEM:

A. Removal of flash gas, Flash inter-cooling, water cooling, Multistage , multi evaporator and Cascade System, Introduction to cryogenic engineering system, Claude Cycle, Linde Cycle.

B. Vapour Absorption System, Practical Vapour Absorption system, Aqua Ammonia system, Lithium Bromide water vapour system, Coefficient of Performance, Comparison with vapour compression system (Descriptive treatment only)

UNIT 4 **08**

PSYCHROMETRY:

Moist air as a working substance, Psychometric properties of air, Use of Psychometric

tables and charts, Basic Processes in conditioning of air, Combinations and Calculations, Apparatus Dew Point, Sensible heat factor, Bypass factor, Air washer and it's applications.

COMFORT:

Thermal exchange between human body and environment, factors affecting comfort, effective temperature comfort chart, ventilation requirements

UNIT 5 **08**

HEATING AND COOLING LOAD CALCULATION:

Air Conditioning system, Different heat sources, Load analysis RSHF, GSHF, ESHF, Factors forming the load on air conditioning systems, Different Air Conditioning System: Central Station Air Conditioning System, Unitary Air Conditioning System, District Air Conditioning System and Self Contained Air Conditioner, Components related to Air Conditioning System, Transport Air Conditioning: Air Conditioning System for Automobiles, Railway, Marine.

UNIT 6 **08**

DUCT DESIGN,AIR-DISTRIBUTION AND APPLICATIONS:

Losses in duct system, , Types of supply air outlets, methods used for duct design, duct arrangement systems, Air-Distribution system, Ventilation System

Energy Conservations and Green Buildings, freeze drying, Air – conditioning system for house and offices, hotels and restaurants, stores, Theatres and auditoriums, hospitals , textile industry

Text Books

1. "Refrigeration and Air Conditioning" Arora C P, Tata McGraw Hill
2. "Refrigeration and Air Conditioning" Arora Domkundwar , Dhanpat Rai and Sons

Reference Books

1. "Principal of Refrigeration" Dossat Ray J., S.I. Version, Wiley Eastern Limited, 2000
2. "Refrigeration and Air-conditioning" Manohar Prasad, Wiley Eastern Limited, 1983
3. "Refrigeration and Air-conditioning" Stocker W.F. and Jones J.W., McGraw Hill International editions 1982
4. "Thermal Environmental Engineering", Threlkeld J.L., Prentice Hall Inc. New Delhi
5. "Basic of Refrigeration and Air Conditioning", Anantnarayan, Tata McGraw Hill Publications
6. "Handbook of Refrigeration and Air Conditioning", Shan Wang, McGraw Hill Publications

7. "Industrial Refrigeration", Wilbert Stocker, McGraw Hill Publications
8. "Cryogenics systems" Randall Barron, Mc Graw Hill Book Co
9. "Absorption chillers and Heat Pumps", Keith Harold, McGraw Hill Publications
10. ASHRAE and ISHRAE Handbook
11. ASHRAE, Air Conditioning System Design Manual, 2nd edition ASHRAE

Class and Semester		**Final Year B. Tech. (Mechanical Engineering) , Part IV, Semester VIII**			
Course Title	:	**MACHINE DESIGN III**			
Teaching Scheme (Hours)	:	**Lectures = 4 hours/weeks** **= 4 x 12 weeks** **= 48 hours minimum**	*Total Credits*	:	**04**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50** **Grand Total = 100**	*Duration of SEE*	:	**3 hours**
Revision:	:	**First**	*Month*	:	**June 2019**

Pre-requisites **:** Engineering Physics, strength of materials, Material science etc.

Type of Course **:** Theory

Course Domain **:** Core

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to:

1. Study the concept of aesthetics, ergonomics, innovation and creativity considerations in product design
2. Study design of various mechanical systems such as pressure vessel, brakes, clutches, machine tool gear box, I.C. Engine.
3. Study the concepts of optimization of mechanical systems /elements.
4. Study and apply various IS Codes, Design data books, Handbooks required for system design.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Incorporate aesthetic, ergonomic, innovation and creativity considerations in industrial product design.
2. Design different systems such as Pressure vessel, Brakes, Clutches, Machine tool Gear box and I. C. Engine.
3. Optimize design of various components/systems in mechanical engineering

4. Use IS Codes, Design data books, Handbooks required for system design.

Curriculum Content	Hours

UNIT 1 **06**

AESTHETIC AND ERGONOMIC CONSIDERATION IN DESIGN:

Basic types of product forms, Designing for appearance, shape, Design features, Materials, Finishes, proportions, Symmetry, Contrast etc. Morgon's colour code. Ergonomic considerations Relation between man, machine and environmental factors. Design of displays and controls. Practical examples of products or equipments using ergonomics and aesthetic design principles. Creativity concept in designing.

UNIT 2 **10**

PRESSURE VESSEL DESIGN:

Thin and thick cylinders; Failure criteria of vessels; Lame's equation; Clavarino's and Birnie's equation; Autofrettage and compound cylinders; Types of pressure vessels- Horizontal and vertical; Classification of pressure vessel as per IS2825, 1969, Introduction to design of pressure vessels as per IS Codes. Shell and end closures. Effect of opening and nozzles in shell and covers. Types of pressure vessel support.

UNIT 3 **08**

DESIGN OF BRAKING AND CLUTCH SYSTEM:

A. Brakes: Design consideration in brakes, Band, Internal expanding shoe, External contracting shoe. Thermal consideration and rating of brakes.

B. Clutches: Design requirement of friction clutches, Selection criteria. Torque transmitting capacity of single plate, Multidisc clutch, Cone clutch and Centrifugal clutch.

UNIT 4 **10**

DESIGN OF GEAR BOXES FOR MACHINE TOOL APPLICATIONS:

Determination of variable speed range- Graphical representation of speeds- Structure diagram Deviation diagram- Ray diagram- Selection of optimum ray diagram- Difference between number of teeth of successive gears in a change gear box- Analysis of twelve speed gear box Compound ray diagram

UNIT 5 **08**

DESIGN OF I. C. ENGINE COMPONENTS:

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, Design of cylinder liners, Design of piston and piston-pins, Piston rings, Design of connecting rod, Design of crank-shaft and crank-pin.

UNIT 6 **06**

OPTIMUM DESIGN:

Objectives of optimum design- Johnsons Method of Optimum Design (MOD), Adequate and optimum design. Primary, Subsidiary and Limit equations- Optimum design with normal specifications of simple machine elements like tension bar, transmission shaft, helical spring. Introduction to optimum design with Langrange Multiplier.

Text Books

1. "Design of machine element", V.B.Bhandari, Tata Mc- Graw Hill Publication, 3rd Edition.
2. "Mechanical Engineering Design", Shigley and C.R.Miscke, Tata Mc- Graw Hill Publication.
3. "Mechanical Design Analysis", M.F.Spotts, Prentice Hall Publication.
4. "Design of Machine Tools", S.k. Basu and D.K. Pal Oxford and IBH Publication, 6th Edition.
5. "Machine Tools Design", N.K. Mehta, Tata Mc- Graw Hill Publication, 5th Edition.
6. "Design Data Book", P.S.Gill (PSG) 3rd Edition.
7. I.S.:2825 Code for Unfired Pressure Vessels.

Reference Books

1. "Handbook of Gear Design",Jitin Maitra,Tata Mc-Graw Hill Publication.
2. "Machine Design", Black P.H.and O.Eugene Adams, Tata Mc- Graw Hill Publication.
3. "Mechanical Design Synthesis with Optimisation Applications",Johnson R.C.,Von Nostrand-Reynold Publicaion.
4. "Engineering Design",Dieter G.E., Tata Mc- Graw Hill Publication, 4th Edition.
5. "Machine Design III",S.P.Patil, Jaico Publication House,New Delhi,2nd Edition.
6. "Product Design and Process Engineering",Benjamin W. Niebel , Alan B. Draper, Tata Mc-Graw Hill Publication.
7. "Design of Pressure Vessel", Harve, CBS Publishers and Distributors Van Nostrand Reinhold
8. "Engineering Optimization Theories and Practice", S.S.Rao, New Age Publication, 3rd Edition.
9. "Process Equipment Design", M.V.Joshi , Macmillal Publication, 3rd Edition.
10. "Machine Design", Robert L. Norton, Tata Mc- Graw Hill Publication.

Class and Semester	**Final Year B. Tech. (Mechanical Engineering) , Semester VII**				
Course Title	:	**HYDRAULICS AND PNEUMATICS**			
Teaching Scheme (Hours)	:	**Lectures = 4 hours/weeks** **= 4 x 12 weeks** **= 48 hours minimum**	***Total Credits***	:	**04**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50** **Grand Total =100**	***Duration of SEE***	*:*	**3 hours**
Revision:	:	**First**	***Month***	:	**June 2019**
Pre-requisites	**:**	Engineering Physics, Fluid Mechanics and Turbomachinary.			
Type of Course	**:**	Theory			
Course Domain	**:**	Core			

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Introduce industrial hydraulics and pneumatics their elements, function and their structure.
2. Apply physical laws and principles that governs the behavior of fluid power systems
3. Study different ISO/JIC symbol used in hydraulic and pneumatic system.
4. Explain various hydraulic and pneumatic circuit.
5. Explain troubleshooting caused in hydraulic and pneumatic system and general safety rule in fluid power system.
6. Identify application of hydraulic and pneumatic in various industries.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Identify, understand and select various components used in hydraulics system.
2. Develop efficient hydraulic circuits with their application.
3. Identify troubleshooting of fluid power system and suggest suitable remedial actions to correct it.

4. Explain fluidics and their application.

Curriculum Content	Hours

UNIT 1 **08**

INTRODUCTION TO FLUID POWER :

a) Classification, general features, applications in various fields of engineering, various hydraulic and pneumatic ISO/JIC Symbols, transmission of power at static and dynamic states, advantages and disadvantages.
b) Principle of hydraulic system, Types of hydraulic fluids and their properties, selection of fluid, effect of temperature on fluids.
c) Introduction and Application of pneumatics, Physical properties, Principles, basic requirement of pneumatic system, comparison with hydraulic System.

UNIT 2 **08**

HYDRAULIC SYSTEM ELEMENTS :

a) Classification, types of seals, sealing material, pipes, hoses, compatibility of seal with fluid, sources of contamination and its control, strainer, filter, heat-exchanger, reservoir.
b) Pumps-types, selection of pumps from Gear, vane, piston, screw, bal pump etc. for various applications.
c) Actuators-linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings.
d) Accumulators, intensifier and their applications.

UNIT 3 **08**

CONTROL OF FLUID POWER ELEMENTS :

a) Requirements of Pressure control, direction control and flow control valves.
b) Principle of pressure control valves directly operated and pilot operated pressure relief valve, pressure reducing valve, sequence valves, counter balance valve.
c) Principles and Types of direction Control valves-2/2, 3/2, 4/2, 4/3, 5/2. Open center, close center, tandem center, manual operated, mechanical operated solenoid, pilot

operated direction control valves, check valves.

d) Principles of flow control valves, temperature compensated, pressure compensated temperature and pressure compensated flow control valve.

UNIT 4 **08**

ELEMENTS OF PNEUMATIC SYSTEM :

a) Air compressor- Types, selection criteria, capacity control, piping layout, fitting and connectors, Pneumatic controls, Direction control valves (two way, three way, four way), check valves, flow control valves, pressure control valves, speed regulators, quick exhaust valves, time delay valve, shuttle valve and twin pressure valve. Solenoid operated, pilot operated valves, , Pneumatic actuators, Rotary and reciprocating cylinders–types and their mountings, Air motor – types, Comparison with hydraulic and electric motor.

b) Serving of compressed air – types of filters, regulators, lubricators (FRL **UNIT**), mufflers, dryers.

UNIT 5 **08**

A) HYDRAULIC CIRCUITS AND ITS APPLICATION

i. Speed control circuits – Meter-in, Meter-out, Bleed off, Regenerative, Fast approach

and slow traverse. ii. Sequence circuits – Travel dependent and Pressure dependent iii.

Synchronizing circuit. iv. Regenerative circuit.

B) PNEUMATIC CIRCUITS AND ITS APPLICATION

i. Speed control circuits
ii. Impulse operation circuit.
iii. Sequence circuits.
iv. Time delay circuit.

UNIT 6 **08**

a) Hydraulic and Pneumatic servo system for linear and rotary motion.
b) Maintenance, troubleshooting and safety of hydraulic and pneumatic systems.
c) Introduction to fluidics – study of simple logic gates, turbulence, amplifiers.

Pneumatic sensors, applications.

Text Books

1. "Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication.
2. "Pneumatic Systems", S. R. Mujumdar- Tata McGraw Hill Publication.
3. "Industrial Fluid Power",D. S. Pawaskar, Nishant Prakashan.
4. "Hydraulics and Pneumatics", Shaikh and Khan, R.K. Publication.
5. "Fluid Power with Application", Esposito, Pearson Education , 7th Edition.
6. Eaton-Vickers, Industrial Hydraulics Manual. Eton Corporation.

Reference Books

1. "Industrial Fluid Power", S.S. Kuber, Nirali Prakashan, 3rd Edition.
2. "Hydraulic and Pneumatic",H.L.Stewart,Industrial Press.
3. "Industrial Hydraulic", J. J. Pipenger ,Tata McGraw Hill.
4. "Power Hydraulics", Goodwin 1st Edition.
5. "Introduction to Hydraulic and Pneumatic", S. Ilango and V Soundararajan, Prentice Hall of India, 2nd Edition.
6. "Pneumatic Control",Joji P., Wiley, 1st Edition.
7. "Fluid Power", Jagadeesha T., Wiley Publications.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) , Semester VII**			
Course Title	:	**MANUFACTURING ENGINEERING III**			
Teaching Scheme (Hours)	:	**Lectures = 3 hours/weeks** **= 3 x 12 weeks** **= 36 hours minimum**	*Total Credits*	:	**03**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50** **Grand Total = 100**	*Duration of SEE*	:	**3 hours**
Revision:	:	**First**	*Month*	:	**June 2019**

Pre-requisites **:** Manufacturing processes, Engineering mathematics, Theory of probability and Statistics**.**

Type of Course **:** Theory

Course Domain **:** Core

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Study and develop integrated approach to improve the material handling system.
2. Identify and solve economical problems of machine tools by using analytical techniques involving comparison, selection and alternatives.
3. Study the cost accounting principles and techniques.
4. Understand the role and functions of ERP in carrying out business processes in an industry.
5. Study and utilize project management concepts, tools and techniques.
6. Study the modern approaches in the field of maintenance and reliability.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Apply the material handling techniques in existing production system.
2. Analyze and solve economical problems of machine tools using analytical techniques.
3. Apply the cost accounting principles and techniques for managerial decision making.
4. Understand the role and functions of ERP in an industry
5. Study and utilize the concept and techniques of project management, maintenance , reliability.

Curriculum Content	Hours

UNIT 1 **06**

MANUFACTURING SYSTEMS DESIGNS:

Definition, Systems, Subsystems, Systems Approach Fundamentals, system approach for designing, Manufacturing Systems, Systematic Layout Planning (SLP), Computerized Plant Layout- CRAFT, ALDEP, and CORELAP.

UNIT 2 **10**

MANUFACTURING SYSTEMS ECONOMICS:

Concept of time value of money, Preparation of time profile of project, Single payment, Equal Series payment, Depreciation and its methods, Machine tool replacement and basic methods of economy studies: Payback period, Present worth, Annual worth, Cost- benefit ratio.

UNIT 3 **08**

COSTING AND COST CONTROL

Introduction: (a) Concept of cost, cost unit, cost center, classification of cost, (b) Definition of costing, cost-price-profit equation, **Cost Estimating:** Definition, purpose and functions of estimation, role of estimator, constituents of estimates, estimating procedures. **Cost Accounting Methods:** Job costing, Batch costing, Unit costing, Process costing, Contract costing, Activity based costing. **Cost Control:** control techniques such as budgetary control, standard cost, variance analysis, marginal cost and break even analysis.

UNIT 4 **08**

MRP, ERP and SUPPLY CHAIN MANAGEMENT

Material Requirements Planning (MRP): Definition of MRP systems, MRP modes, Types of MRP– MRP I and II.

ENTERPRISE RESOURCE PLANNING (ERP):

introduction, Evolution, features, purpose of modeling an enterprise, information mapping, generic model of ERP, Modules in ERP, Methodology of implementation, ERP package

selection, supply chain management (SCM).

UNIT 5 **08**

PROJECT MANAGEMENT

Introduction, concept project and its definition, classification of project, project life cycle, project identification, project formulation /evaluating project feasibility, cost of project and means of finance, cost of production and working results, project planning, project organization, tool and techniques of PM, monitoring and control of projects, project information system.

UNIT 6 **08**

MAINTENANCE and RELIABILITY:

Concept of preventive and breakdown maintenance, maintenance cost, optimal preventive maintenance, simple replacement models-individual and group replacement, MAPI method, Reliability definitions, failure analysis and curve, MTBF, MTTF.

SYSTEMS RELIABILITY:

Series parallel, Redundancy, Methods of Improving reliability, Maintainability, availability.

Text Books

6. "Operations management" Schroeder, Mc Graw Hill International
7. "Production operations management" Chary, TMH, New Delhi.
8. "Engineering Management: Industrial Engineering and Management", SC Sharma, Khanna Publishing House, Delhi
9. "Industrial Engineering and Operations Management", SK Sharma
10. "Principles & Practice of Cost Accounting" N. K. Prasad,. Book Syndicate Pvt. Ltd.

Reference Books

1. "Production Operations Management" Adam and Ebert, PHI, New Delhi
2. "Operational Management" Monks, Mcgraw Hill, Int.
3. "Production and Operations Management" Hill, Prentice Hall Int.

4. "Production Planning and Inventory Control" Narasimham etal, PHI, New Delhi
5. "Production and Operation Management" Panneerselvam, PHI, New Delhi
6. "Managing for Total Quality" Logothetis, PHI, New Delhi
7. "Concept of Reliability Engineering" L.S. Srinath, Affiliated East West.
8. "Revolutionizing Product Development" Wheelwright and Clark, Free press.
9. "Management In Engineering" Freeman Ball and Balkwill, PHI, New Delhi.
10. "Production and operations management" Martinich, John Wiely , New Delhi
11. "Toyota Production System" Taichi Ohno, Productivity Press India Ltd, Bangalore.

Class and Semester	**Final Year B. Tech. (Mechanical Engineering) , Semester VII**				
Course Title	: **FINITE ELEMENT ANALYSIS**		**Elective I – 1**		
Teaching Scheme (Hours)	: **Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**		*Total Credits*	:	**03**
Evaluation Scheme (Marks)	: **CIE (20+20) + Course work (10) = SEE = 50**	**Grand Total =100**	*Duration of SEE*	:	**3 hours**
Revision:	: **First**		*Month*	:	**June 2019**

Pre-requisites **:** Engineering Physics, strength of materials, Material science etc.

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: **UNIT** Test I and **UNIT** Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics and thermal analysis problems.
2. Develop the Finite element model for 1D, 2D and 3D problem.
3. Formulate and solve basic problem in Heat transfer, solid mechanics and fluid mechanics.
4. Provides some experience with a commercial FEM software packages.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain the fundamental concepts, equations of equilibrium, Stress-strain relations and the principle of potential energy and approximations of differentials equations.
2. Analyze mathematical model for solution of common engineering problems by formulating into finite element.

3. Determine the element matrix equation by different methods by applying basic laws in mechanics and integration by parts.
4. Make use of commercial finite element analysis software to solve complex problems in solid mechanics and heat transfer

Curriculum Content	Hours

UNIT 1 **08**

INTRODUCTION:

Brief history, Introduction to Matrix Notation, General steps of FEM using a simple 1-d element for stress analysis of a stepped bar, Thermal rod, Heat conduction through wall. Applications of FEM Functional, Extremization of a functional, obtaining the variation form from a Differential equation, Principle of virtual work, Principle of Minimum potential energy.

UNIT 2 **08**

A. DISCRITIZATION OF THE PROBLEM:

Introduction, Geometrical approximations, Simplification through symmetry, Basic element shapes and behavior, Choice of element type, Size and number of elements, Element shape and distortion, Location of nodes, Node and element numbering

B. APPROXIMATION METHODS FOR SOLVING DIFFERENTIAL EQUATIONS:

Introduction, Rayleigh-Ritz method, Galerkin method, Least square method, Interpolation Functions and Simplex Elements: Introduction, simplex, complex and multiplex elements, Linear interpolation polynomials for simplex elements, Natural co-ordinates, vector quantities, an axisymmetric element.

UNIT 3 **08**

FORMULATION OF THE ELEMENTS CHARACTERISTIC MATRICES

AND VECTORS FOR ELASTICITY, FIELD , THERMAL PROBLEMS:

A. Formulation of the Elements Characteristic Matrices and Vectors for Elasticity Problems: Introduction, one dimensional elasticity, two dimensional elasticity, axi-symmetric elasticity

B. Formulation of the Elements Characteristic Matrices and Vectors for Field Problems.

C. Introduction, Thermal problems, One dimensional heat transfer, two dimensional heat transfer, axi-symmetric heat transfer. Torsional problems, Fluid flow problems.

UNIT 4 **08**

ASSEMBLY AND SOLUTION OF THE FINITE ELEMENT EQUATIONS:

Introduction, co- ordinate transformations, assembly of element equations, Incorporation of the boundary conditions, solution of the equations, elimination method

UNIT 5 **08**

HIGHER ORDER ELEMENT FORMULATIONS:

Introduction, Natural co – ordinates systems and numerical integration, higher order one dimensional elements – quadratic and cubic elements, evaluation of the element equations, an alternative formulation Higher order two and three dimensional elements – iso-parametric triangular elements, iso-parametric quadrilateral elements, isoparametric solid elements, stress and heat flow calculations. Convergence requirements of interpolation functions.

UNIT 6 **08**

MODELING PROCEDURES RESULTS PROCESSING AND FEM:

Introduction, model validity and accuracy, mesh design and refinement, element distortions, result processing, model checking Solving FEM Problems on a computer, Introduction, Developing on FEM code, Finite element packages.

Text Books

1. "Finite element analysis" Bhavikatti S. S., New Age International Publishers
2. "Introduction to Finite Elements in Engineering" Chandrupatla T. R. and Belegunda A. D., Prentice Hall India.
3. "The Finite Element Method A Practical Course" Liu G. R. and Quek S. S., Butterworth-Heinemann, 2003.
4. "Finite Element Analysis (Procedures in Engineering)" Lakshiminarayana H. V., University Press, 2004.

5. "Finite Element Analysis for Engineering and Technology" Chandrupatla T. R., University Press, 2009.
6. "Text book of Finite Element Analysis" Seshu P., PHI Learning Private Ltd. New Delhi, 2010.
7. "Finite Element Method applications in Engineering" Y. M. Desai, T. L. Eldho and A. H. Shah, Pearson Education.

Reference Books

1. "Finite Element Procedures" Bathe K. J., Prentice-Hall of India (P) Ltd., New Delhi.
2. "Finite Element Analysis, Theory and Practice" Fagan M. J., Pearson Education Limited
3. "Finite Element Modeling for Stress Analysis" Cook R. D., John Wiley and Sons Inc, 1995
4. "Finite Element Method using MATLAB" Kwon Y. W., Bang H.,, CRC Press, 1997
5. "Fundamental Finite Element Analysis and Applications" Asghar Bhatti, John Wiley and Sons Inc, 2005
6. "Fundamental of Finite Element Analysis" David V. Hutton, Tata McGraw-Hill Education Pvt. Ltd.
7. "First Course in the Finite Element Method" Daryl Logan, Cengage Learning India Pvt. Ltd.
8. "The Finite Element Method" Zienkiewicz O. C., Taylor R. I., Butterworth- Heinemann
9. "Introduction to Finite Element Methods" Carlos A., Felippa
10. "Finite Element Application" G. Lakshmi Narasaiah, BS Publications

Class and Semester	**Final Year B. Tech. (Mechanical Engineering) , Semester VII**				
Course Title	: **CRYOGENICS**			**Elective I- 2**	
Teaching Scheme (Hours)	: **Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**			*Total Credits*	: **03**
Evaluation Scheme (Marks)	: **CIE (20+20) + Course work (10) = SEE = 50**	**Grand Total=100**		*Duration of SEE*	*:* **3 hours**
Revision:	: **First**			*Month*	: **June 2019**

Pre-requisites **:** Engineering Mathematics, Heat Transfer, Thermodynamics, Refrigeration.

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Provide the information of fundamental concepts of cryogenics, and its importance and applications.
2. Articulate the gas liquefaction and Cryo cooler system.
3. Explore the gas separation, purification system and measurements it's of low temperature application.
4. Develop the Cryogenic fluid storage and components of transfer system.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Illustrate the applications and importance of Cryogenics.
2. Describe the gas liquefaction systems, and classify the Cryo-coolers.
3. Articulate Gas Separation, Purification and Low Temperature applications measurement systems.
4. Summarize Cryogenic Fluid Storage and Transfer Systems.

Curriculum Content	Hours

UNIT 1 **08**

INTRODUCTION TO CRYOGENIC:

History and development its importance, cryogenic temperature scale. Behavior of materials at low temperature: Low temperature properties of materials, Mechanical Properties Thermal properties, electric and magnetic properties, Properties of cryogenics and fluids.

UNIT 2 **08**

GAS LIQUIFICATION SYSTEMS:

Introduction- production of low temperature , Liquefaction systems for N2, Neon, Hydrogen, He etc.(Numerical Treatment)

UNIT 3 **08**

CRYO COOLERS:

Sterling, G-M and pulse tube cry coolers.

UNIT 4 **08**

GAS SEPARATION AND PURIFICATION SYSTEMS:

Thermodynamically ideal separation systems- properties of mixtures , principles of gas separation Rectification column-Linde single and double column system of air separation. Measurement Systems For Low Temperatures Measurement of different parameters at low temperature like temperature, pressure level mass flow rate etc.

UNIT 5 **08**

CRYOGENIC FLUID STORAGE AND TRANSFER SYSTEMS:

Dewar vessel, insulation types and importance. Components of transfer system with importance. Importance of vacuum and its measurement.

UNIT 6 **08**

APPLICATION OF CRYOGENIC SYSTEMS:

Applications in mechanical, electrical, food preservation, biological and medical, space technology etc.

Text Books

1. “Cryogenic Systems”, Barron F. Randall, Oxford University Press, New York.
2. "Cryogenic Engineering”, Thomas M. Flynn, Marcel Dekkcr. Inc, New York.
3. "Cryogenic Process Engineering”,Klaus D. Timmerhaus, Thomas M. Flynn, Plenum Publishing Corporation (1989).
4. "Applied Cryogenic Engineering”,Vance, R. W, and Duke, Isted, W. M., John Wiley (1962).
5. “Introduction to Cryogenics” B. S. Gawali, Mahalaxumi Publication.

Reference Books

1. “Experimental Techniques in low Temperature Physics”, Guy, K White, Claredon Press, Oxford, (1987).
2. “Cryogenic Research and Applications”, Marshall Sitting and Stephen Kidd, D. Van Nostrand, Inc USA, (1963).
3. “Cryo-Cooler: Fundamentals Part-I”, G. Walker, Plenum Press, New York.
4. “Cryo-Cooler: Fundamentals Part-II”, G. Walker, Plenum Press New York.
5. “International Journal of Cryogenics”, Elsevier Publication.
6. “Advanced Cryogenic Engineering”, Proceedings of Cryogenic Engineering Conference, Vol. 1-145, Plenum Press, New York (1968).

Class and Semester	**Final Year B. Tech. (Mechanical Engineering) , Semester VII**				
Course Title	: **OPERATIONS RESEARCH**		**Elective I**		
Teaching Scheme (Hours)	: **Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**		*Total Credits*	:	**03**
Evaluation Scheme (Marks)	: **CIE (20+20) + Course work (10) = SEE = 50**	**Grand Total =100**	*Duration of SEE*	*:*	**3 hours**
Revision:	: **First**		*Month*	:	**June 2019**

Pre-requisites **:** Engineering Mathematics, Numerical Methods

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. To understand operation research principals.
2. To study the transportation and assignment model for industrial applications.
3. To understand Fundamentals of PERT/CPM Model.
4. Study of sequencing, replacement model, inventory model, decision theory and network analysis of industrial applications.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Formulate the problem by using operation research principals.
2. Evaluate problems of transportation and assignment model.
3. Analyze PERT/CPM models
4. Formulate and Analyze problems regarding sequencing, replacement model, inventory model, decision theory and network analysis of industrial applications

Curriculum Content	Hours

UNIT 1 **08**

INTRODUCTION TO OPERATION RESEARCH

Development of operations Research, characteristics and scope of operations Research, Models in operations Research, Model Formulation, Types of mathematical models, Limitations of operations Research. L.P. models, simplex method, the algebra of simplex method. (Minimization and Minimization problem) method, post optimality analysis, essence of duality theory, Application of sensitivity analysis.

UNIT 2 **08**

TRANSPORTATION AND ASSIGNMENT MODELS

Structure, industrial and business applications.

a. Transportation problems Use of various methods for solving transportation problems, degeneracy and its solution.

b. Assignment problems: Solution of various types of problems, Traveling Salesman problem.

UNIT 3 **08**

FUNDAMENTALS OF CPM / PERT NETWORKS

CPM – construction of networks, critical path, forward and backward pass, floats and their significance, crashing for minimum cost and optimum and minimum duration, resource allocation and leveling.

PERT – Time Estimates, Construction of Networks, Probability of completing projects by given date.

UNIT 4 **08**

a. **Sequencing:** Sequencing of n jobs and 2 and 3 machines, 2 jobs and m machines.

b. **Replacement Analysis:** With and without time value of money, single item and group replacement.

UNIT 5 **08**

Inventory Models: Various costs involved, classification of models, EOQ model with and without shortage, EOQ with uniform demand and production lot size model, EOQ model with single price break.

UNIT 6 **08**

a. **Decision Theory:** Pay off and regret tables, decision rules, decisions under uncertainty and risk, decision tree.

b. **Network Techniques**: Shortest Path Model- Systematic Method, Dijkstra's Algorithm, Floyd's Algorithm

Text Books

5. "Operation Research an Introduction", Hamdy A. Taha, Pearson, 9th Edition.
6. "Operations Research", J. K. Sharma, McMillan India Publication New Delhi, 5th Edition.
7. "Operations Research", Hira and Gupta, S.Chand and Co. New Delhi.
8. "Operations Research", Manohar Mahajan Dhanapat Rai and Sons.
9. "Engineering Optimisation Methods and Application", A Ravindran ,K.M. Ragdell ,G.V. Rklaitis, Willey India Ltd.

Reference Books

1. "Production and Operation Management", Tripathy, Scitech Publication, 2nd Edition.
2. "Introduction to Operation Research", Paneer-Selvam, Prentice Hall of India publication, 2nd Edition.
3. "Operation Research", Pradeep J. Jha, Tata McGraw Hill Publication.
4. "Operation Research", S.R. Yadav, A.S. Mallik, Oxford University Press,(2014).
5. "Operation Research – Principle and Applications", Shriniwasan, Prentice Hall of India Publication, 2nd Edition.
6. "Operation Research", Natrajan, Pearson Publication. 2nd Edition. 14. "Operation Research", Mariappan, Pearson Education

Class and Semester	**Final Year B. Tech. (Mechanical Engineering) , Semester VII**				
Course Title	: **TRIBOLOGY**		**Elective I - 4**		
Teaching Scheme (Hours)	: **Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**		*Total Credits*	:	**03**
Evaluation Scheme (Marks)	: **CIE (20+20) + Course work (10) = 50 SEE = 50**	**Grand Total =100**	*Duration of SEE*	:	**3 hours**
Revision:	: **First**		*Month*	:	**June 2019**

Pre-requisites **:** Engineering Physics, Strength of materials, Material Science.

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
2. Identify the friction and wear characteristic of machine component and its lubrication.
3. Understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
4. Utilize the surface engineering techniques to improve the functionality of machine components.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Illustrate the importance of Tribology in Industry.
2. Analyze the basic concepts of Friction, Wear, Lubrications and their measurements
3. Apply the principles of lubrication and theories of hydrodynamic in machine components.
4. Make use of surface engineering techniques in machine components.

Curriculum Content	Hours

UNIT 1 **06**

INTRODUCTION TO TRIBOLOGY

Introduction to Tribology, Tribology in design, Tribology in industry, economic aspects of Tribology, lubrication, basic modes of lubrication, lubricants, properties of lubricants - physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion. Types of sliding contact bearings, comparison of sliding and rolling contact bearings.

UNIT 2 **06**

FRICTION AND WEAR

Friction: Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theories of friction, effect of surface preparation.

Wear: Types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear.

UNIT 3 **06**

HYDRODYNAMIC LUBRICATION:

Hydrodynamic lubrication: Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, two-dimensional Reynolds equation, infinitely long journal bearing, infinitely short journal bearing, finite bearing.

Hydrodynamic thrust bearing: Introduction, flat plate thrust bearing, pressure equation, load, center of pressure, friction in tilting pad thrust bearing.

UNIT 4 **06**

HYDROSTATIC LUBRICATION

Hydrostatic lubrication: Basic concept, advantages and limitations, viscous flow through rectangular slot, load carrying capacity and flow requirement of hydrostatic step bearing, energy losses, optimum design of step bearing. Compensators and their actions.

Squeeze film lubrication: Introduction, circular and rectangular plates approaching a plane

UNIT 5 **06**

ELASTO-HYDRODYNAMIC LUBRICATION AND GAS LUBRICATION

Elasto-hydrodynamic Lubrication: Principle and application, pressure – viscosity term in Reynolds equation, Hertz theory. Ertel-Grubin Equation.

Gas lubrication: Introduction, merits and demerits, applications.

Lubrication in metal working: Rolling, forging, drawing and extrusion. Bearing materials, bearing constructions, oil seals, shields and gaskets.

UNIT 6 **06**

SURFACE ENGINEERING

Introduction to surface engineering, concept and scope of surface engineering, manufacturing of surface layers, solid surface-geometrical, mechanical and physic chemical concepts, superficial-layer, development of concept, structure of superficial layer, general characteristics of superficial layer, obtained by machining, strengthening and weakening of superficial layer.

Surface Engineering for Wear and Corrosion resistance: Diffusion, coating, electro and electro-less plating, hot deep coating, metal spraying, cladded coating, crystallizing coating, selection of coating for wear and corrosion resistance, potential properties and parameters of coating.

Text Books

1. "Introduction to Tribology Bearings", Mujumdar B. C., S. Chand Company Pvt. Ltd (2008).
2. "Engineering Tribology" Prasanta Sahoo, PHI,Estern Economy Edition.
3. "Fundamentals of Tribology", Basu S K., Sengupta A N., Ahuja B.B., PHI (2006).
4. "Tribology in Industries", Srivastava S., S Chand and Company.
5. "Lubrication of Bearings – Theoretical Principles and Design", Redzimovskay E I., Oxford Press Company (2000)

Reference Books

1. "Theory and Practice of Lubrication for Engineers", Fuller, D. New York company (1998).
2. "Theory and Practice of Lubrication for Engineers", Dudley D.F., John Willey and Sons.
3. "Engineering Tribology", Stachowiak G W and Batchelor A W, Elsevier Inc. 3rd Edition,(2005).
4. "Friction and Wear of Materials", Rabinowicz.E, John Willey and Sons ,UK,(1995).
5. "Theory of Hydrodynamic Lubrication", Pinkus '0', Stemitch.
6. "Basic Lubrication theory ", A.Cameron, Longman, U.K.., (1981).
7. "Lubrication", Fuller D.D.
8. "Principles and Applications of Tribology", Moore, Pergamaon Press (1998).
9. "Tribology Handbook ", M.J.Neale, Newnes. Butter Worth -Heinemann, U.K.,(1995).
10. "Principles of Tribology", Halling J., McMillan Press Limited.
11. "Modern Tribology Handbook", Bhushan, Vol 1 and 2.

Class and Semester		**Final Year B. Tech. (Mechanical Engineering) , Semester VII**			
Course Title	:	**PRODUCTION MANAGEMENT**		**Elective I**	
Teaching Scheme (Hours)	:	**Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**		*Total Credits*	: **03**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50 SEE = 50**	**Grand Total =100**	*Duration of SEE*	*:* **3 hours**
Revision:	:	**First**		*Month*	: **June 2019**
Type of Course	**:**	Theory			
Course Domain	**:**	Elective			

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Understand basic aspects of Production Management.
2. Study various important planning, organizing and controlling aspects of Operations management.
3. Study efficient product design and development.
4. Study loading, scheduling and sequencing of machines for building capacity and aggregate planning.
5. Study management concepts like JIT, Lean manufacturing, Total productive maintenance, inventory management etc. for properly managing the production.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. The students will have fair understanding of the role of Production / Operations Management played in business processes.
2. Streamline the production removing all the hindrances in its way by applying management

techniques like JIT, TPM and inventory management etc.

3. Properly use capital, machine, inventory, tools and equipments to increase profit margin.

Curriculum Content	Hours

UNIT 1 **07**

PRODUCTION FUNCTION

Production types, objectives and scope of Production Management, Production Planning and Control (PPC) - Definition, elements, Activities of production planning and production control Interrelationship of Production with other functional areas.

UNIT 2 **06**

PRODUCTION/ OPERATION STRATEGY

Relevance, strategy formulation process, order qualifiers and order winners, attributes, strategic options for Operations- Product portfolio, process technology, capacity, Supply chain issues, Measures to ensure Optional Excellence, WCM practices.

UNIT 3 **07**

PRODUCT DESIGN AND DEVELOPMENT

Role of Product Development in competitiveness, Product Life Cycle (PLC), Product Development Process. Tools for efficient product development- FMECA, concurrent engineering, Design for Manufacturing Mass Customization Process Design Determinants of process characteristics- volume, variety, flow. Types of processes, choice of Process, equipment selection, use of BEP in selection process - product matrix. Estimation of Demand- Time series Analysis and causal forecasting techniques, Least square method, moving average and exponential smoothing forecasting method.

UNIT 4 **08**

CAPACITY AND AGGREGATE PLANNING

Capacity- Definition, Measure of Capacity, capacity strategies Estimation of number of machines, Overcapacity and under capacity factors, Aggregate Planning, Aggregate

Planning Strategies, Pure an d mixed strategies, Use of transportation model approach to aggregate planning , Scheduling of Operations Loading, scheduling and sequencing, Priority sequencing rules. Sequencing problems, n job 2 machines, n Job '3' machines. Forward and backward scheduling, critical ratio scheduling, Production Control Activities

UNIT 5 **06**

A. SUPPLY CHAIN MANAGEMENT :

Concept of supply chain and supply chain management, Manufacturing supply chain, SCM activities Supply chain strategies, Managing supply chain, Measuring supply chain performance

B. JUST IN TIME AND LEAN MANUFACTURING:

JIT Philosophy, origin and core logic of JIT, Elements of JIT, Kanban System-Design of Kanban containers, JIT. Implementation issues and performance, Lean Manufacturing-Pillars, features and process comparison with Traditional Manufacturing. .

C. TOTAL PRODUCTIVE MAINTENANCE AND REPLACEMENT:

Introduction, Definition, six big losses, stages of maintenance, pillars stages of TPM Development, Calculations of OEE.

UNIT 6 **06**

A. INVENTORY MANAGEMENT:

Aims, buffer stocks, lead time, ROL, fixed order quantity system, periodic review system, Selective Inventory Control Techniques - ABC and VED analysis, JIT manufacturing / purchasing, Stores management: objectives, functions, procedure, documentation, stock taking and reconciliation

B. HUMAN CONSIDERATION IN PRODUCTION MANAGEMENT: Industrial Psychology – Introduction, motivational factors, behavioral aspects, grievances, working conditions, safety; shop supervisor's role in above functions.

Text Books

1. "Production Planning & Control", Samuel.Eilon
2. "Production Management" R. Mayer, McGraw Hill

3. "Modern Production Management" E.S. Buffa, John Wiley
4. "Production Management" Burbridge, ELBS
5. "Stores Management" K.S. Menon, Mac Millan
6. "Total Quality Management" R S Naagarazan, A A Arivalagar, Publisher-New Age International.
7. "Re-engineering the manufacturing system: applying the theory of constraints (TOC)". Stein, R. E., Marcel Dekker 1996.

Reference Books

1. "Production and Operations Management", Buffa. Elwood modern Wiley India,8th Edition.
2. "Operation Management, Process and Value Chain", Krajewski and Ritzman, Malhotra Pearson Education.
3. "Production and Operations Management", Ashwathappa, Bhat , Himalaya Publishing
4. "Techniques of Value Analysis and Engineering", Miles Lawrence.
5. "Operation Management Theory and Practice", Mahadevan B Pearson Education,(2007)
6. "Operations Management" Kaither and Frazer, Cengage Publication
7. "Production and Operation Management", Everett E. Adam and Ebert, PHI Publication, ISBN no. 9788120308381.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**						
Course Title	:	**LABORATORY : Refrigeration and Air conditioning**						
Teaching Scheme (Hours)	:	**Practical = 2 hours/week = 2 x 13 = 26 hours**				*Credits*	:	**1**
Evaluation Scheme (Marks)	:	**IPE** : **50**	**EPE** : **Nil**			*Duration of Exam (in case of External Evaluation)*	:	**02 hours**
		IOE : **Nil**	**EOE** : **50**					
Revision:	:	**First**				*Month*	:	**June 2019**

Pre-requisites **:** None

Type of Course **:** Practical

Course Domain **:** Core

Course Assessment Methods:

Practical Journal Assessment, Internal Practical Examination and External Oral Exam

Course Objectives:

The course aims to

1. To understand construction of vapour compression system and its various components.
2. Analyze the vapour compression cycle.
3. To study Psychrometric properties and calculate the cop of air conditioning system.
4. Student must do market survey to understand the current available technology.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand different types of refrigerant compressors, expansion devices and Controls used in vapour compression refrigeration system
2. Perform trial on VCR System, ice plant, two stage cascade system, air Conditioning system to evaluate cycle performance and actual coefficient of Performance.

3. Participate in a group atmosphere for the understanding of an industrial Refrigeration system.
4. Communicate verbally and in written form through the preparation of journal report and practical presentation.

Practical List : **Any Eight**

The students should perform the following experiments.

(Three trials and market survey report is compulsory/ Total 08 are compulsory)

1. Study of basic components of simple vapour compression refrigeration system.
2. Study and demonstration of vapour Absorption system.
3. Trial on vapour compression refrigeration system.
4. Trial on Ice plant.
5. Study and trial on two stage cascade system.
6. Study and Trial on heat pump.
7. Trial on Air conditioning system
8. Study of controls in refrigeration system.
9. Industrial Visit related to refrigeration and air conditioning system.
10. Market survey of various refrigeration and air conditioning systems which include the Equipment's with related specifications, manufacturers, cost and comparison with respect to tonnage, coat and presentation of report in the laboratory.

Lab Manual: Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.

Text Books:

1. "Refrigeration and Air Conditioning" Arora C P, Tata McGraw Hill
2. "Refrigeration and Air Conditioning" Arora Domkundwar , Dhanpat Rai and Sons

Reference Books:

1. "Principal of Refrigeration" Dossat Ray J., S.I. Version, Wiley Eastern Limited, 2000
2. "Refrigeration and Air-conditioning" Manohar Prasad, Wiley Eastern Limited, 1983
3. "Refrigeration and Air-conditioning" Stocker W.F. and Jones J.W., McGraw Hill International editions 1982
4. "Thermal Environmental Engineering", Threlkeld J.L., Prentice Hall Inc. New Delhi
5. "Basic of Refrigeration and Air Conditioning", Anantnarayan, Tata McGraw Hill Publications

6. "Handbook of Refrigeration and Air Conditioning", Shan Wang, McGraw Hill Publications
7. "Industrial Refrigeration", Wilbert Stocker, McGraw Hill Publications
8. "Cryogenics systems" Randall Barron, Mc Graw Hill Book Co
9. "Absorption chillers and Heat Pumps", Keith Harold, McGraw Hill Publications
10. ASHRAE and ISHRAE Handbook
11. ASHRAE, Air Conditioning System Design Manual, 2nd edition ASHRAE

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**						
Course Title	:	**LABORATORY : Hydraulics and Pneumatics**						
Teaching Scheme (Hours)	:	**Practical = 2 hours/week = 2 x13 = 26 hours**				*Credits*	:	**1**
Evaluation Scheme (Marks)	:	**IPE** : **Nil** **EPE** : **Nil** **IOE** : **Nil** **EOE** : **50**				*Duration of Exam (in case of External Evaluation)*	:	**02 hours**
Revision:	:	**First**				*Month*	:	**June 2019**
Pre-requisites	**:**	None						
Type of Course	**:**	Practical						
Course Domain	**:**	Core						

Course Assessment Methods:

Practical Journal Assessment, External Oral Examination

Course Objectives:

The course aims to

1. To apply knowledge of basic components, ISO/JIC symbols and applications of hydraulics and pneumatics in various fields of industries
2. Study various elements used in modern hydraulic and pneumatic system
3. Develop various hydraulic and pneumatic circuits.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Interpret any hydraulic and pneumatic application circuits with practice of symbols and ISO/JIC standard
2. Choose the suitable hydraulic or pneumatic components for a specific fluid power application
3. Develop simple circuits for hydraulic and pneumatic applications.

Practical List : **Any Eight**

The students should perform the following experiments.

1. Study and Demonstration of basic hydraulic and pneumatic system.
2. Study and Demonstration of ISO/JIC Symbols for hydraulic and pneumatic systems.
3. Study and Demonstration of different types of valves used in hydraulic and pneumatic system.
4. Study and Demonstration of accumulators/actuators/intensifiers/hydraulic and pneumatic power brakes.
5. At least five circuit preparations on hydraulic trainer
6. At least five circuit preparations on pneumatic trainer kit.
7. At least two Circuit preparations using Fluid Simulation Software.
8. Design of hydraulic / pneumatic system and related components for any one of the following:
   i. Shaping machine
   ii. Broaching machine
   iii. Slotting machine
   iv. Hydraulic clamps
   v. Pneumatic clamp
   vi. Any one industrial application.
9. Industrial visits are recommended for applications of pneumatic and hydraulic system and their reports.

Lab Manual: Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.

Text Books:

1. Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication.
2. "Pneumatic Systems", S. R. Mujumdar- Tata McGraw Hill Publication.
3. "Industrial Fluid Power",D. S. Pawaskar, Nishant Prakashan.
4. "Hydraulics and Pneumatics", Shaikh and Khan, R.K. Publication.
5. "Fluid Power with Application", Esposito, Pearson Education , 7th Edition.
6. Eaton-Vickers, Industrial Hydraulics Manual. Eton Corporation.

Reference Books:

1. "Industrial Fluid Power", S.S. Kuber, Nirali Prakashan, 3rd Edition.
2. "Hydraulic and Pneumatic",H.L.Stewart,Industrial Press.
3. "Industrial Hydraulic", J. J. Pipenger ,Tata McGraw Hill.

4. "Power Hydraulics", Goodwin 1st Edition.
5. "Introduction to Hydraulic and Pneumatic", S. Ilango and V Soundararajan, Prentice Hall of India, 2nd Edition.
6. "Pneumatic Control",Joji P., Wiley, 1st Edition.
7. "Fluid Power", Jagadeesha T., Wiley Publications.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**							
Course Title	:	**LABORATORY : Manufacturing Engineering III**							
Teaching Scheme (Hours)	:	**Practical = 2 hours/week = 2 x13 = 26 hours**					*Credits*	:	**1**
Evaluation Scheme (Marks)	:	**IPE** : **Nil**		**EPE** : **Nil**			*Duration of Exam (in case of External Evaluation)*	:	**02 hours**
		IOE : **Nil**		**EOE** : **50**					
Revision:	:	**First**					*Month*	:	**June 2019**

Pre-requisites **:** None

Type of Course **:** Practical

Course Domain **:** Core

Course Assessment Methods:

Practical Journal Assessment, External Oral Examination

Course Objectives:

The course aims to

1. Develop integrated approach to improve the material handling system considering the existing production system.
2. Identify and solve economical problems involving comparison and selection of alternatives.
3. Study various approaches and techniques for new product development.
4. Examine the significance of Production Planning and Control (PPC) in Industries
5. Identify and use of appropriate forecasting, maintenance and reliability methods industry.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Apply the material handling techniques in existing production system.
2. Analyze and solve economical problems involving comparison and selection of alternatives.

3. Illustrate various approaches and techniques for developing new products.
4. Apply the manufacturing planning and control strategies.
5. Develop and utilize the methods of forecasting, maintenance and reliability.

Term Work

Term work comprises of assignments on each unit.

Text Books:

1. "Operations management", Schoroeder, Mc Graw Hill International
2. "Production operations management" chary, TMH, New Delhi.

Reference Books:

1. Production Operations Management – Adam and Ebert, PHI, New Delhi
2. Operational Management –Monks, Mcgraw Hill, Int.
3. Production and Operations Management – I. Hill, Prentice Hall Int.11
4. Production Planning and Inventory Control – Narasimham etal, PHI, New Delhi
5. Production and Operation Management- Panneerselvam, PHI, New Delhi
6. Managing for Total Quality-Logothetis, PHI, New Delhi
7. Concept of Reliability Engineering –L.S. Srinath, Affiliated East West.
8. Revolutionizing Product Development – Wheelwright and Clark, Free press.
9. Management In Engineering – Freeman-Ball and Balkwill, PHI, New Delhi.
10. Production and operations management – Martinich, John Wiely , New Delhi.
11. The goal by Eliyahu M. Goldratt and Jeff Cox, Productivity Press India Ltd, Bangalore.
12. Toyota Production System by Taichi Ohno, Productivity Press India Ltd, Bangalore.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**							
Course Title	:	**Major Project (Phase I)**							
Teaching Scheme (Hours)	:	**Practical = 2 hours/week = 2 x13 = 26 hours**						*Credits*	**: 3**
Evaluation Scheme (Marks)	:	**IPE**	:	**Nil**	**EPE**	:	**Nil**	*Duration of Exam (in case of External Evaluation)*	: **02 hours**
		IOE	:	**50**	**EOE**	:	**Nil**		
Revision:	:	**First**						*Month*	: **June 2019**
Pre-requisites	**:**	None							
Type of Course	**:**	Practical							
Course Domain	**:**	Core							

Course Assessment Methods:

Internal Oral Examination

Course Objectives:

The course aims to

1. Embed the skill in group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
2. Encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Improve the professional competency and research aptitude in relevant area.
2. Develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Project Phase I Load:

A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed.

Project Phase I Definition:

- The project phase I work can be a design project / experimental project and or computer simulation project on Mechanical engineering or any of the topics related with Mechanical engineering stream.
- The project phase I work is allotted in groups on different topics.
- The students groups are required to undertake the project phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with timeframe.
- The project phase I work is to be extended for project phase II at B. Tech. (Mech.) Sem. VIII with same group working under guidance of same Faculty member assigned for project phase I.

Project Phase I Term Work:

The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for
   a. Searching suitable project work
   b. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.
   c. Day to day activities carried out related to project work for entire semester.
   d. Synopsis.

The group should submit the synopsis in following format

i. Title of Project
ii. Names of Students
iii. Name of Guide
iv. Relevance
v. Present Theory and Practices
vi. Proposed work
vii. Expenditure
viii. References

2. The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department
3. Presentation: The group has to make a presentation in front of the Faculty members of department at the end of semester.

Project Phase I Report Format:

Project Phase I report should be of 25 to 30 pages (typed on A4 size sheets). For standardization of the project phase I reports the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Point . Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
9. Headings: Times New Roman, 14 Point , Bold Face
10. References: References should have the following format

For Books: "Title of Book", Authors, Publisher, Edition

For Papers: "Title of Paper, Authors, Journal/Conference Details, Year

Important Notes:

- Project group should continue maintaining a diary for project and should write (a) Book referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creative thinking.
- The Diary along with Project Phase I Report shall be assessed at the time of oral examination
- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

Project Load:

Maximum 4 students in one group. Maximum 3 groups shall work under one Faculty Member. Group of one student is not allowed under any circumstances.

Project Term Work:

The internal oral evaluation of students' work carried out under project first phase submitted by students shall include and assessment of work done by the students:

1. Searching suitable project work

2. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring out the project.
3. Brief report of feasibility studies carried to implement the conclusion.
4. Rough Sketches/ Design Calculations, etc.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**						
Course Title	:	**Industrial Training Report**						
Teaching Scheme (Hours)	:	**Practical = 2 hours/week** **= 2 x13 = 26 hours**				*Credits*	:	**Nil**
Evaluation Scheme (Marks)	:	**IPE** : **Nil**	**EPE** : **Nil**			*Duration of Exam (in case of External Evaluation)*	:	**02 hours**
		IOE : **50**	**EOE** : **Nil**					
Revision:	:	**First**				*Month*	:	**June 2019**
Pre-requisites	**:**	None						
Type of Course	**:**	Practical						
Course Domain	**:**	Core						

Course Assessment Methods:

Internal Oral Examination

Course Objectives:

The course aims to

1. To Familiar the students to realize an industrial work.
2. To acquire knowledge of the manufacturing processes used in the industries

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Comprehend the knowledge gained in the course work
2. Create, select, learn and apply appropriate techniques, resources, and modern engineering tools.

Industrial Training

The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with Mechanical engineering during the semester break after Sixth semester and complete within 30 calendar days before the start of seventh semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and

authenticity of contents of the report and award the marks at the end of the semester. It is expected that students should undertake small assignment or work related to any of the course related aspect. Report is based on compilation of work carried out related to facility and layout planning, Industrial engineering- time study and motion study, Line efficiency evaluation and improvement, Process capability evaluation, Industrial automation, Process or machinery modification as identified.

Training Report:

Maximum fifteen students in one batch, involving three groups of maximum students, shall work under one teacher. The same group shall work for the same guide. However, each student should have different and its presentation. The report should be of 20 to 30 pages. For standardization of the report the following format should be followed

1. Page size : Trimmed A4
2. Top Margin : 1.00 Inches
3. Bottom Margin : 1.32 Inches
4. Left Margin : 1.5 Inches
5. Right Margin : 1.0 Inches
6. Para Text : Font - Times New Roman; 12 point
7. Line Spacing : 1.5 Lines
8. Page Numbers : Right aligned and in footer.
9. Headings : Font Times New Roman; 12 point New Times Roman, 14 point, Boldface
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director.

    The entire report should be documented as one chapter with details like

    "Name of Industry with address along with completed training certificate"

    Area in which Industrial training is completed
11. **All Students have to present their reports individually.**

Marking Scheme:

Training Report: 10 marks

Presentation: 15 marks

All students have to present their reports individually before the faculty members.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**							
Course Title	:	**Constitution of India (Audit Course)**							
Teaching Scheme (Hours)	:	**Practical = 2 hours/week** **= 2 x13 = 26 hours**						*Credits*	**: Nil**
Evaluation Scheme (Marks)	:	**IPE**	:	**Nil**	**EPE**	:	**Nil**	*Duration of Exam (in case of External Evaluation)*	: **Not Applicable**
		IOE	:	**Nil**	**EOE**	:	**Nil**		
Revision:	:	**First**						*Month*	: **June 2019**

Pre-requisites **:** It has no any pre-requisites. Every citizen of the country ought to study the course content.

Type of Course **:** Audit Course at institute level

Course Domain **:** Humanities and Social Science

Course Assessment Methods:

The students will be given five assignments each for 10 marks. At the end of the course, there will be a written test of 25 marks and a viva voce of 25 marks. There will be assessment for a total of 100 marks. Based on the marks obtained, they will be awarded with a grade similar to other credit courses. Though it is an audit course, obtaining passing grade is essential.

Course Objectives:

The course aims to

1. To get familiarity with preamble
2. To understand the fundamental rights and duties of citizens
3. To know about the union and state executives
4. To interpret and recognize the constitutional provisions
5. To understand and follow the electoral process

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Associate with constitution of India

2. State fundamental duties.
3. Describe union and state executives.
4. Discuss constitutional provisions
5. Illustrate electoral process
6. Report the role of democracy in welfare of society

Curriculum Content	Hours
UNIT 1	**4**
INTRODUCTION TO PREAMBLE: Preamble to the constitution of India. Fundamental rights under Part – III – details of Exercise of rights, Limitations and Important cases.	
UNIT 2	**5**
RELEVANCE OF DIRECTIVE: Principles of State Policy under Part – IV. Fundamental duties and their significance.	
UNIT 3	**4**
UNION EXECUTIVE: President, Prime Minister, Parliament and the Supreme Court of India.	
UNIT 4	**5**
STATE EXECUTIVE: Governors, Chief Minister, State Legislator and High Courts.	
UNIT 5	**5**
CONSTITUTIONAL PROVISIONS: Provisions for Scheduled Castes and Tribes, Women and Children and Backward classes. Emergency Provisions.	
UNIT 6	**5**
ELECTORAL PROCESS: Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments.	

Text Books:

1. Durga Das Basu: "Introduction to the Constitution of India"(Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
2. R.C.Agarwal, "Indian Political System", (1997) S.Chand and Company, New Delhi.

Maciver and Page, "Society: An Introduction Analysis", Mac Milan India Ltd., New Delhi.

3. K.L.Sharma, "Social Stratification in India: Issues and Themes",(1997), Jawaharlal Nehru University, New Delhi.

Reference Books:

1. An Introduction to Constitution of India" by M.V.Pylee, Vikas Publishing, 2002.
2. Sharma, Brij Kishore, "Introduction to the Constitution of India: Prentice Hall of India, New Delhi.
3. U.R.Gahai, "(1998) Indian Political System ", New Academic Publishing House, Jalaendhar.
4. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.
5. Yogendra Singh, "(1997) Social Stratification and Charge in India ", Manohar, New Delhi.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) , Semester VIII**			
Course Title	:	**AUTOMOBILE ENGINEERING**			
Teaching Scheme (Hours)	:	**Lectures = 4 hours/weeks** **= 4 x 12 weeks** **= 48 hours minimum**		*Total Credits*	: **04 + 00 + 00 = 04**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50**	**Grand Total = 100**	*Duration of SEE*	: **3 hours**
Revision:	:	**First**		*Month*	: **December 2019**
Pre-requisites	**:**	None			
Type of Course	**:**	Theory			
Course Domain	**:**	Core			

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Study and understand various components, sub assemblies and assembly of an automobile.
2. Study the design of various automobile systems.
3. Study and diagnose the effects of various factors on subassemblies of an automobile.
4. Evaluate the performance of an automobile.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Implement the knowledge obtained in theory towards design procedure of various automobile systems
2. Understand components and layout of automobile
3. Analyze the effect of various factors on subsystems of automobile and remedies can be proposed
4. Evaluate the performance of automobile

Curriculum Content

Hours

UNIT 1 **08**

INTRODUCTION:

Vehicle specifications, classifications, chassis layout, frame main components of automobile and articulated vehicles. Engine cylinder arrangements, Design considerations, materials and their properties. Power requirements, motion resistance and power loss; tractive efforts and vehicle performance curves.

UNIT 2 **08**

STEERING AND SUSPENSION SYSTEMS:

Steering system, principle of steering, centre point steering, steering linkages, steering geometry and wheel alignment, power steering. Suspension system, need, types, independent suspension, coil and leaf springs, suspension systems for multi, axle vehicles, trouble shooting and remedies, Design consideration of Steering Mechanism and Suspension System.

UNIT 3 **08**

TRANSMISSION SYSTEM:

Clutches: need, types. Need of gearbox, types of gear transmission, shift mechanisms, over running clutch, fluid coupling, and torque converters. Transmission universal joint, constant velocity joint, propeller shaft, Hotchkiss drive , torque tube drive, front and rear axles types , stub axles , need of differential and types , four wheel drive.

UNIT 4 **08**

BRAKES, WHEELS AND TYRES:

Brakes, need, types, Mechanical, hydraulic and pneumatic brakes, disc and drum types, their relative merits, details of components, brake adjustments and defects, power brakes. Wheels and Tyres: Types, tyre construction, specification, tyre wear and cause, wheel balancing. Design consideration of hydraulic and pneumatic brakes.

UNIT 5 **08**

ELECTRICAL SYSTEMS:

Electrical systems – construction, operation and maintenance of lead acid batteries – battery charging system – principle and operation of cutout and regulators –starter motor– Bendix drive – solenoid drive – magneto coil and solid stage ignition systems – ignition-timing – lighting and electrical accessories – automobile air conditioning – panel board instruments.

UNIT 6 **08**

VEHICLE TESTING AND MAINTENANCE:

Need of vehicle testing, vehicle tests standards, different vehicle tests. Maintenance – trouble shooting and service procedure – over hauling – engine tune up, tools and equipment for repair and overhaul – organization and management of service station – testing equipments. Pollution due to vehicle emissions and exhaust emissions control systems and regulations. Selection of power unit and engine performance characteristics troubleshooting and rectification, engine tuning and servicing, Various vehicle testing agency in India.

Text Books

1. "Automobile Engineering", Dr. Kirpal Singh (Vol. I and II) Standard Publishers, New Delhi.
2. "Automobile Mechanics", N K Giri.
3. "Automobile Engineering", G.B.S. Narang., Khanna Publication ,3rd Edition.
4. "Automotive Technology", H.M. Sethi. Tata McGraw-Hill Education, (2001).
5. "Automobile Engineering", Banga and Singh.
6. "Automotive Mechanics", Joseph Heitner, Affiliated Eastern Law House, 2nd Edition.,(1967).
7. "Motor Vehicle Technology and Practical Work",Dolan. J.A., ELBS, (1978).
8. "Automobile Electrical Equipment", P.L.Kohali ,Technical Education Series, 1st Edition.
9. "Automobile Engineering", R.B.Gupta, Satya Prakasan, 9th Edition.
10. "Automotive Excellence Volume 1 and 2", Gelncoe, Tata McGraw-Hill Publication.

Reference Books

1. "Motor Vehicles",Newton and Steed
2. "Motor Manuals (Vol I to VII)", A.W. Judge., Chapman and Hall Publication.
3. "Automobile Mechanics",W.H. Crouse.,Tata McGraw Hill Publishing Co.

Class and Semester		**Final Year B. Tech. (Mechanical Engineering) , Semester VIII**			
Course Title	:	**POWER PLANT ENGINEERING**			
Teaching Scheme (Hours)	:	**Lectures = 4 hours/weeks** **= 4 x 12 weeks** **= 48 hours minimum**		*Total Credits*	: **04 + 00 + 00 = 04**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50**	**Grand Total = 100**	*Duration of SEE*	: **3 hours**
Revision:	:	**First**		*Month*	: **December 2019**

Pre-requisites **:** Engineering Thermodynamics, Fluid Mechanics, Heat Transfer

Type of Course **:** Theory

Course Domain **:** Core

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Understand the different power generation methods, its economics and global energy situation
2. Familiarize with Equipment, Plant layout, principle of working of various Steam turbine, gas turbine and diesel power plants.
3. Interpret the working principles of various nuclear reactors.
4. Understand the types and capacity calculation of Hydroelectric Power Plant.
5. Understand Non- Convectional Power Plants and its commercialization.
6. Understand Economic analysis and environmental impact of Power Plants.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain the energy resources and energy systems available for the production of electric power in the India and the world.
2. Explain construction and working of steam power plants, Gas turbine power plant, Diesel power plant.

3. Explain the basic principles of nuclear power plants,
4. Explain hydroelectric power plant, major types of Non- conventional power plants and estimate power generation potential.
5. Discuss economic analysis and the environmental impact of electric power production on air quality, climate change, water, and land.

Curriculum Content	Hours

UNIT 1 **08**

INTRODUCTION OF POWER PLANT:

Introduction: Resources and development of power in India, NTPC, NHPC and their role in Power development in India, Present Power position in India and Maharashtra. Power Plants Introduction, Factors affecting Selection and relative merits of steam, Gas, Diesel, Hydro Power Plants

UNIT 2 **08**

STEAM AND GAS TURBINE POWER PLANT:

Steam turbine power plant Introduction, general layout of steam power plant, necessity of feed water treatment, high pressure boilers and importance of water purity, effect of operating variable on thermal efficiency, regeneration, reheating, Cogeneration power Plant

Gas turbine power plant Introduction, general layout of gas turbine power plant, effect of operating variable on thermal efficiency, regeneration, reheating, and performance of closed and semi closed cycle gas turbine plant.

UNIT 3 **08**

NUCLEAR AND DIESEL POWER PLANT:

Nuclear power plant: Elements of nuclear power plant, Nuclear reactors and its types, fuel moderators, coolants, control rod, classification of nuclear power plants, waste disposal.

Diesel Power Plant: Field of Use, Plant Layout, Different systems of Diesel Power Plant, application, advantages and disadvantages of diesel power plant

UNIT 4 **08**

HYDROELECTRIC POWER PLANT:

Hydroelectric Power Plant (HPP): site selection, classification of HPP, and their field of use, capacity calculation for hydro power, dam, head water control, penstock, water turbines, specific speeds, governors, hydroelectric plant auxiliaries, plant layout, automatic and pumped storage, project cost of hydroelectric plant. Advantages and limitations of hydro power plant.

UNIT 5 **08**

NON- CONVENTIONAL POWER PLANTS:

Wind Power plant: Introduction, wind availability measurement, types of wind machines, site selection, and wind power generation. Solar Power Plant: Introduction, components ,Types of Collectors and Solar Ponds, Low and High Temperature Solar Power Plant. Photovoltaic Power System, Heliostat Tidal, OTEC, geothermal, magneto hydrodynamics, fuel cell, hybrid power plants, Challenges in commercialization of Non-Conventional Power Plants.

UNIT 6 **08**

ECONOMIC ANALYSIS AND ENVIRONMENTAL IMPACT:

Cost of energy production, selection of plant and generating equipment, performance and operating characteristics of power plants, tariffs for electrical energy.

Environmental Impact due to Power Plant: Introduction, Different pollutants due to thermal power plant and their effect on human health, Global warming and greenhouse effect, thermal Pollution of water and its control.

Text Books

1. "Power Plant Engineering" Domkundwar and Arora, Dhanpat Rai and Sons, New Delhi
2. "Power Plant Engineering" P. K. Nag,, Tata McGraw Hill, New Delhi
3. " Power Plant Engineering" R.K.Rajput , Laxmi Publications, New Delhi.

Reference Books

1. "Power Plant Engineering" E.I. Wakil, Publications, New Delhi
2. "Steam and Gas turbines" R. Yadav, Central Publishing House, Allahabad
3. "Non-conventional energy sources" G. D. Rai

Class and Semester		**Final Year B. Tech. (Mechanical Engineering) , Part IV, Semester VIII**			
Course Title	:	**MECHATRONICS AND ROBOTICS**			
Teaching Scheme (Hours)	:	**Lectures = 4 hours/weeks** **= 4 x 12 weeks** **= 48 hours minimum**		*Total Credits*	: **04 + 00 + 00 = 04**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50**	**Grand Total =100**	*Duration of SEE*	*:* **3 hours**
Revision:	:	**First**		*Month*	: **December 2019**
Pre-requisites	**:**	Engineering Physics, Basic Electrical Engineering			
Type of Course	**:**	Theory			
Course Domain	**:**	Core			

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to:

1. Understand the various components of Mechatronics and Robotics system and sensors used in industrial application
2. Study the various signal conditioning process and its components
3. Understand the difference between the microprocessor and microcontroller
4. Study the functions of PLC programming and its applications
5. Study the fundamentals of robotics.

Course Outcomes:

Upon successful completion of this course, the student will be able to

1. Design and evaluate a Mechatronics and Robotics system based upon various sensors for industrial application.
2. Analyze the signals using signal conditioning process.
3. Implement the microprocessor or micro controller based upon the application

4. Evaluate the functions of PLC programming and its application
5. Design a robotic system using the fundamental knowledge.

Curriculum Content	Hours

UNIT 1 **08**

INTRODUCTION:

Introduction to Mechatronics and Robotics, Mechatronics and Robotics systems, Measurement systems, Multi discipline scenario Transducers and Sensors:-Position Sensors: Limit switch, Photoelectric switches, Proximity sensors, Pneumatic limit valves and backpressure sensors, Pressure switches, resolvers, Incremental and absolute encoders, Decoders and relays. Displacement:

Potentiometer sensors, LVDT, Capacitive displacement sensors. Velocity sensors: Tachogenerator, Use of encoders, Introduction to VFD.

UNIT 2 **08**

SIGNAL CONDITIONING:

Signal conditioning process, Operational amplifier (inverting amplifier, Non-inverting amplifier, Summing, Integrating amplifier, Differtiating amplifier, Logarithmic amplifier), Protection, Filtering, Data acquisition, Multiplexer, Analog to Digital Converter (ADC), Digital to Analog Converter (DAC). Oscillators to generator sinusoidal, Square, Triangular and impulse waveforms, 555 timer, Sample and hold, Demultiplexing. Interfacing input output ports, Serial and parallel interfacing requirements, Buffers, Handshaking, Polling and interrupts.

UNIT 3 **08**

DIGITAL CIRCUITS, MICROPROCESSOR AND MICROCONTROLLER:

Digital logic, Number systems, Logic gates, Boolean algebra, Application of logic gates, Sequential logic, Flip flop, D flip flop, JK flip flop, Master slave flip flop. Microcontroller: Comparison between microprocessor and micro controller, Organization of a microcontroller system, Architecture of MCS 51 /ATMEL /PIC controller, Pin diagram of 8051, Addressing modes, Instruction types and set, Selection and Applications of Microcontroller

UNIT 4 **08**

PROGRAMMABLE LOGIC CONTROLLERS (PLC):

Introduction, Definition, PLC system and components of PLC Input output module, PLC

advantages and disadvantages. Ladder diagram and PLC programming fundamentals: Basic components and other symbols, Fundamentals of ladder diagram, Machine control terminology, Update – Solve ladder – Update, Physical components Vs. program components, Light control example, Internal relays, Disagreement circuit, Majority circuit, Oscillator, Holding (sealed or latches) contacts, Always ON always OFF contacts, Nesting of ladders.

UNIT 5 **08**

PLC PROGRAMMING:

PLC Input instructions, Outputs, Coils, Indicators, Operational procedures, Contact and coil input output, Programming example, Fail safe circuits, Simple industrial applications. PLC Functions PLC timer functions – Introduction, Timer functions, Industrial applications, Industrial process Timing applications, PLC control functions – PLC counters and its industrial applications, Introduction to SCADA and MEMS.

UNIT 6 **08**

FUNDAMENTAL OF ROBOTICS:

Fundamentals of Industrial Robots: Specifications and Characteristics, Criteria for selection. Robotic Control Systems: Drives, Robot Motions, Actuators, Power transmission systems; Robot controllers, Dynamic properties of robots-stability, control resolution, spatial resolution, accuracy, repeatability, compliance, work cell control, Interlocks

Robotic End Effectors and Sensors: Transducers and sensors- sensors in robotics and their classification, Touch (Tactile) sensors, proximity and range sensors, force and torque sensing, End Effectors- Types, grippers, Various process tools as end effectors; Robot- End effector interface, Active and passive compliance, Gripper selection and design.

Text Books

1. "Mechatronics", W. Bolton, Pearson Education , 4th Edition
2. "Mechatronics", Mahalik, TATA McGraw Hill, (2006) Reprint
3. "Microprocessor 8085", Gaokar Prentice Hall of India, 5th Edition
4. "Introduction to PLC Programming" NIIT.
5. "Programmable Logical Controller", Hackworth, Pearson Education, (2008).
6. "Programmable Logical Controller", Reis Webb, Prentice Hall of India 5th Edition.
7. "MEMS and Microsystems", HSU Tairan, TATA McGraw Hill Publication. 1st Edition.
8. "Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004).

Reference Books

1. "Mechatronics"Appu Kuttam, Oxford Publications, 1 st Edition.
2. "Automated Manufacturing Systems",S. Brain Morris, Tata McGraw Hill.
3. "Mechatronics and Microprocessor",Ramchandran , Willey India, (2009).
4. "Mechatronics: Integrated Mechanical Electronic System", Ramchandran , Willey India,1st Edition.
5. "Programmable Logical Controller",Gary Dunning Cengage Learning, 3rd Edition.
6. "Mechatronics Source Book", N C Braga, Cengage Learning.
7. Robot Technology Fundamentals", Keramas, James G, Thomson Learning –Delmar ISBN: 981-240-6212, (1998).
8. "Handbook of Robotics", Noff, Shimon Y., John Wiley and Sons.
9. "Introduction to Robotics, Analysis, Systems and Applications", Niku, Saeed B. (2002), Prentice Hall of India.
10. "Robotics for Engineers", Koren, Yoram, Tata McGraw Hill.,(2003)

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) , Semester VII**			
Course Title	:	**TOTAL QUALITY MANAGEMENT**			
Teaching Scheme (Hours)	:	**Lectures = 3 hours/weeks** **= 3 x 12 weeks** **= 36 hours minimum**	*Total Credits*	:	**03**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50** **Grand Total =100**	*Duration of SEE*	:	**3 hours**
Revision:	:	**First**	*Month*	:	**December 2019**

Pre-requisites **:** Basic Knowledge Metrology and Quality Control

Type of Course **:** Theory

Course Domain **:** Core

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Know the concept of Total Quality and role of Quality assurance.
2. Understand planning and controlling techniques for quality.
3. Understand the product and system reliability and Taguchi's Quality Philosophy.
4. Study principles and Approaches to TQM implementation.
5. Understand Essentials, tools and techniques of TQM.
6. Study TQM in service sector and ISO Standard series for TQM.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Identify and solve the quality related problems in manufacturing or service sector at various stages by using various TQM tools and techniques.
2. Apply Taguchi's Philosophy to reduce defects in process and product and maintain good Quality.
3. Train and bring awareness to the people working in manufacturing and service sector for implementation of TQM.
4. Successfully implement TQM and can save time, money, reduce scrap and produce quality

product and service to satisfy customers.

Curriculum Content	Hours

UNIT 1 **05**

QUALITY BASIC CONCEPTS:

Various definitions and their implications. ISO definition of quality, Quality cost estimation and reduction. Q.A. system: Concept of total quality, role and objectives of Q.A. Q.A. cycle, process approach to Q.A. (input-process-output), significance of feedback, internal customer Approach

UNIT 2 **07**

PLANNING FOR QUALITY:

Specifications of quality, planning for specification of processes, planning through trial lots, information feedback, field complaints analysis, defect prevention programs, quality planning with vendors, vendor control procedures, vendor rating. Controlling techniques for quality – significance of N-D curve, SPC, problem solving QC tools, process capability analysis, six sigma-concept, need, implementation, DPMO, gradation.

UNIT 3 **06**

PRODUCT AND SYSTEM RELIABILITY :

Basic concepts, prediction and evaluation of parallel, series and combined system reliability, reliability tests (life testing, burn-in test, accelerated life testing) Taguchi's quality engineering: Taguchi's quality philosophy, system design, parameter design, tolerance design, orthogonal arrays, S/N ration, loss functions.

UNIT 4 **06**

PRINCIPLES OF TQM:

Concept and definition of TQM, principles, Models, characteristics, and benefits of TQM. Approaches to TQM: Deming's approach, Juran's triology, Crosby and quality improvement, Ishikawa's CWQC, Feigenbaum's theory of TQC.

UNIT 5 **07**

ESSENTIAL'S OF TQM:

Customer focus: customer perception of quality, customer satisfaction, Kano's model of satisfaction, customer retention,. TQM leadership - role and commitment and accountability of leadership, quality policy and objectives, organizational structure for TQM, role of HR in TQM, training for TQM, developing quality culture. Tools and techniques for TQM: 5-S campaign, TEI, quality circles, QFD, FMEA; and FTA, Poka - Yoke, KAIZE

UNIT 6 **05**

TQM IN SERVICE SECTOR :

Definition and meaning and service, problems in defining service quality, attributes of service quality, SERVQUAL model, Implementing TQM in service industries, measurement system for service quality.

ISO 9001:2008 series of standards : Structure of ISO 9001:2008 series standards, clauses, contents, interpretation and implementation, audit

Text Books

1. "Statistical Quality Control" Grant E.L., McGraw Hill Book Company, New York.
2. " Fundamentals of Quality Control and Improvement" Amitava Mitra, Pearson Education
3. "Introduction to Statistical Quality Control" Montgomery Willey India.
4. "Quality Contro" Kulkarni Bewoor, Willey India
5. "Total Quality Management" Senthil Arasu/Paul ,SCITECH publication
6. "ISO-9000- Preparing for registration" Lamprecht
7. "Implementing Total Quality" Joe Culle
8. "Total Quality Management – Text and cases",Jankiraman and Gopal, Prentice Hall India Publication. (ISBN 978-81-203-2995-9).
9. "Total Quality Management" Dr. Suri and Dr. Sharma, Wiley Publication, (ISBN 978-93- 5004-317-2).
10. "Total Quality Management",Dr. Rajaram, Wiley Publication, (ISBN 978-81-7722-63-2).

Reference Books

1. "Total Quality Management",Dale H. Besterfiled,et.al. ,Pearson Education, Asia (ISBN 978 81-317-3227-4).
2. "Total Quality Management",Dr. Poornima Charantimath Pearson Education, Asia (ISBN 978-81-317-3262-5) ,2nd Edition.
3. "Fundamentals of Quality Control and Improvement", Amitava Mitra Pearson Education ,Asia.
4. "Handbook of Total Quality Management"Dr. R.P.Mohanti ,R.R. Lakhe Jaico Publishing House , (ISBN 81-7224-833-44).
5. "Total Quality Management in Service Sector",Dr. R.P. Mohanti Jaico ,Publishing House.
6. "Quality Planning and Analysis",Juran J.M and Gryna.
7. "Inspection, Quality Control and Reliability",Sharma S.C., Khanna Publishers (ISBN 81-7409-022-3).
8. "Global Management Solutions Demystified", Dinesh Seth, Subhash C. Rastogi, Ceneage Education (Former ThomsonAsia Pvt.Ltd.) (ISBN 981-265-142-X).
9. "Total Quality Control", Feigenban, Tata McGraw Hill Book Company, New York.
10. "Managing Quality", Barrie G Dale,Wiley India Pvt .Ltd. (ISBN 978-81-265-2246-0), 5th Edition.

Class and Semester	**Final Year B. Tech. (Mechanical Engineering) , Part IV, Semester VIII**				
Course Title	: **Computational Fluid Dynamics**		**Elective II - 1**		
Teaching Scheme (Hours)	: **Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**		*Total Credits*	:	**03**
Evaluation Scheme (Marks)	: **CIE (20+20) + Course work (10) = 50 SEE = 50**	**Grand Total = 100**	*Duration of SEE*	:	**3 hours**
Revision:	: **First**		*Month*	:	**December 2019**

Pre-requisites **:** Engineering Physics, Fluid Mechanics, Applied Thermodynamics, Material science.

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Understand basic concept of thermodynamics law, energy equation and continuity equation.
2. To analyze the different numerical techniques used in CFD.
3. To develop skills in the analysis of fluid systems for lifelong learning

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain the basic concept of thermodynamics law, energy equation and continuity equation.
2. Apply basic knowledge of one Dimensional Isentropic Flow: Adiabatic flow and reference speed to solve the problems.
3. Explain the basic concepts of normal shock and its relations.
4. Numerically solve the governing equations for fluid flow.

5. To analyze the different numerical techniques used in CFD.

Curriculum Content	Hours

UNIT 1 **08**

BASIC CONCEPTS:

Thermodynamics laws and relation, Energy equation, Continuity equation, Momentum equation, Mach number, Mach angle, various regions of flow. Forms of the Governing Equations Particularly Suited for CFD, Solution methodology- Pre-processing, Solver, Post processing.

UNIT 2 **08**

1 D ISENTROPIC FLOW:

One Dimensional Isentropic Flow: Adiabatic flow and reference speed, Relation between M and M, Fllegnerl's formula, Impulse function, Gas tables and charts, Performance of convergent divergent nozzle.

UNIT 3 **08**

NORMAL SHOCK:

Fanno process, Rayleigh process, Formation of shock wave, Prandti meyer relation, pressure and temperature ratios across the shock, Stagnation pressure loss and increase in entropy, Supersonic diffusers. Introduction, Governing equations, Prandtl relation, oblique shock relation, Mach angle.

UNIT 4 **08**

FLOW WITH FRICTION:

Governing equation, Fanno equation, Change in entropy, Isothermal flow, Governing equation, Rayliegh equation, Maximum enthalpy point, Maximum entropy point, Valuation of fluid properties, Maximum heat.

UNIT 5 **08**

BASIC OF DISCRETIZATION and GRID GENERATION:

Basic aspects of discretization - Discretization techniques Finite difference - Finite volume and Finite element method Comparison of discretization by the three methods, Transformation of non-uniform grids to uniform grids.

Equation of motion in Cartesian co-ordinates, continuity equation, momentum equation, Vortices components, radial and tangential accelerations, Velocity potential, Stream function and its equation.

UNIT 6 **08**

MEASUREMENT TECHNIQUES:

Wind tunnel, Suction tunnel, Supersonic tunnel, Shock tube, Flow visualization, Smoke techniques, Liquid film method, Measurement of Velocity, Measurement of Velocity, Measurement of Flow

Text Books

1. "Computational Fluid Mechanics the Basics with Applications",Anderson J. D. Jr,Tata McGraw Hill Education Pvt. Ltd.
2. "An Introduction to Computational Fluid Dynamics the Finite Volume Method" H. K.Versteeg and W. Malalasekera, Pearson Publication.
3. "Numerical Heat Transfer Fluid Flow",Suhas V. Patankar ,Taylor and Francis.
4. "Introduction to Computational Fluid Dynamics", Pradip Niyogi, S. K. Chakrabarthy, M. K. Laha , Pearson Publication.

Reference Books

1. "Computational Fluid Dynamics: A Practical Approach",Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu, Butterworth – Heinemann.
2. "Computational Fluid Dynamics", T. J. Chung, Cambridge University Press.
3. "Introduction to Computational Fluid Dynamics",Anil W. Date, Cambridge University Press.
4. "Convective Heat and Mass Transfer",S. Mostafa Ghiaasiaan, Cambridge University Press.

Class and Semester	**Final Year B. Tech. (Mechanical Engineering) , Semester VIII**				
Course Title	: **Vibration and Noise**		**Elective II - 2**		
Teaching Scheme (Hours)	: **Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**		*Total Credits*	:	**03**
Evaluation Scheme (Marks)	: **CIE (20+20) + Course work (10) = 50 SEE = 50**	**Grand Total =100**	*Duration of SEE*	*:*	**3 hours**
Revision:	: **First**		*Month*	:	**December 2019**

Pre-requisites **:** Engineering Mechanics, Strength of Material, Machine Design.

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: **UNIT** Test I and **UNIT** Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Understand the basics of vibrations in the body.
2. Analyze the vibration phenomenon, control of vibration in machine parts and balancing.
3. Understand the basic terminology of noise, its effect and control.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Describe the basic concept of vibration.
2. Explain free and forced vibration in single DOF and multi DOF system.
3. Explain different vibration measuring instrument.
4. Solve the numerical to determine various parameters of vibration such as amplitude, transmissibility, transmission force etc.
5. Determine natural frequency of mechanical vibrating system/element.

6. Explain the basic concept of sound, noise effects, rating and regulation of noise.

Curriculum Content **Hours**

UNIT 1 **06**

INTRODUCTION:

Importance and scope, Concepts and terms used in SHM, Vector and Complex method of representing vibration, Degree of freedom, Newton's law, Fourier series and harmonic analysis

UNIT 2 **09**

SINGLE DOF SYSTEM:

a. Damped free vibrations, Types of damping, Logarithmic decrement, Coulomb damping, and damping materials.
b. Forced Vibrations: Types of excitation, Forced excitation, Support excitation, Excitation due to unbalance in machines, Response due to above types of excitations, transmissibility, Force transmissibility and motion transmissibility, Vibration isolators, commercial isolation materials and shock mounts.
c. Forced vibrations of un-damped systems due to non-harmonic excitations

UNIT 3 **08**

MULTI DOF SYSTEM:

a. Free un-damped vibrations Principal modes and natural frequencies, Co –ordinate coupling and principal co-ordinates.
b. Forced vibrations (Undamped) - Harmonic excitation, Vibration, Dampers and absorbers, Dynamic vibration absorber -Tuned and Untuned type, Vibration of elastic bodies, Vibration of strings, Longitudinal, Lateral and Torsional vibrations.

UNIT 4 **08**

APPROXIMATE METHODS:

Introduction to Numerical Methods in vibration, Holzer method, Raleigh's method and Matrix iteration method to find natural frequency.

UNIT 5 **08**

VIBRATION MEASURING INSTRUMENTS:

Approximate methods of evaluating the Eigen frequencies and the dynamics response of continuous systems, Instruments for measurement of displacement, velocity, acceleration and frequency of vibration, Sensors and Actuators, Introduction of X – Y plotter, Spectral analyzers, FFT analyzer.

UNIT 6 **09**

SOUND, NOISE- EFFECTS, RATING AND REGULATION:

Sound level and subjective response to sound, Frequency dependent human response to sound , Sound pressure dependent human response ,Decibel scale, Relation among sound power, Sound intensity and sound pressure level, Octave band analysis.

Non auditory effects of noise on people, Auditory effects of noise, Noise standards and limits, Ambient emission noise standards in INDIA, Hazardous noise explosion, Day night noise level, Noise sources and control.

Text Books

1. "Mechanical Vibrations", S.S. Rao, Addison Wesley Longman
2. "Mechanical Vibrations", S S Rao, Pearson
3. "Mechanical Vibrations", GK Grover, Nem Chand Bros.
4. "Mechanical Vibration" Dr. V. P. Singh, Published by S. Chand and Sons New Delhi.
5. "Noise and Vibration Control" M. L. Munjal, IISc Press, World Scientific
6. "Mechanical vibration and Noise Engineering" A.G.Ambekar, Prentice Hall of INDIA

Reference Books

1. "Schaumm's Outline series in Mechanical Vibration" S. Graham Kelly
2. "Noise and vibration control" Leo L. Bernack, Tata Mc- Graw Hill Publication

Class and Semester		**Final Year B. Tech. (Mechanical Engineering) , Semester VIII**			
Course Title	:	**Nano Technology**		**Elective II - 3**	
Teaching Scheme (Hours)	:	**Lectures = 3 hours/weeks** **= 3 x 12 weeks** **= 36 hours minimum**		*Total Credits*	: **03**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50**	**Grand Total = 100**	*Duration of SEE*	*:* **3 hours**
Revision:	:	**First**		*Month*	: **December 2019**

Pre-requisites : Engineering Physics, Engineering Chemistry

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: **UNIT** Test I and **UNIT** Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Understand the fundamentals of Nanotechnology.
2. Study various synthesis and characterization techniques involved in Nanotechnology.
3. Understand different classes of nanomaterials.
4. To provide an overview about the wide applications of nanotechnology in various technological fields.
5. To introduce students to inter-disciplinary science and engineering

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand the fundamentals of nanotechnology
2. Understand various synthesis methods of nanomaterial.
3. Comprehend characterization techniques involved in nanotechnology
4. Recognize different classes of Nanomaterial

5. Identify application of nanotechnology in various technological fields

Curriculum Content	Hours
UNIT1	**06**
INTRODUCTION TO NANOTECHNOLOGY:	
Introduction and scientific revolutions, Time and length scale in structures, Definition of a Nanosystem, Dimensionality and size dependent phenomena, Surface to volume ratio, Properties at Nano scale	
UNIT 2	**06**
SYNTHESIS OF NONMATERIAL'S:	
Top down methods, Bottom -up methods, Mechanism of self assembly.	
UNIT 3	**06**
CHARACTERIZATION TECHNIQUES:	
Introduction, Electron microscopes, Scanning probe microscopes, Diffraction techniques, Spectroscopies	
UNIT 4	**06**
LITHOGRAPHY:	
Introduction, Photolithography, E-beam lithography, Scanning probe lithography, Soft lithography, Nano-imprint lithography**.**	
UNIT 5	**06**
DIFFERENT CLASSES OF NANOMATERIALS	
Classification based on dimensionality ,Quantum dots, wells and wires ,Carbon-based nano materials, Carbon Nanotubes and Graphene ,Metal based nano materials ,Metal oxide based nano materials ,Nanocomposites and nanopolymers, Nanoglasses and nano ceramics, Biological nanomaterials	

UNIT 6 **06**

APPLICATIONS

Medicine and health care ,Electronics, energy, Automobiles, Sports, Textiles, Space and Defense, safety issues, Nanotechnology and Environment

Text Books

1. "A Textbook of Nanoscience and Nanotechnology" T. Pradeep,, Tata McGraw Hill Education Pvt. Ltd.,
2. "Nanotechnology: Principles and Practices" Sulabha K. Kulkarni,, Capital Publishing Company, 2007

Reference Books

1. "Transports in nanostructures" David Ferry, Cambridge University Press
2. "Introduction to Nanoscience" Stuart M. Lindsay, Oxford University Press, 2009
3. "Nanoscale Science and Technology" Robert Kelsall, Ian Hamley, Mark Geoghegan, John Wiley and Sons,2005.
4. "Introduction to Nanoscience and Nanotechnology" Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore, CRC Press

Class and Semester		**Final Year B. Tech. (Mechanical Engineering) , Semester VIII**			
Course Title	:	**Machine Tool Design**		**Elective II – 4**	
Teaching Scheme (Hours)	:	**Lectures = 3 hours/weeks** **= 3 x 12 weeks** **= 36 hours minimum**		*Total Credits*	: **03**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50** **SEE = 50**	**Grand Total =100**	*Duration of SEE*	*:* **3 hours**
Revision:	:	**First**		*Month*	: **December 2019**

Pre-requisites **:** Tool Engineering, Manufacturing Engineering and machine design etc

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: Unit Test I and Unit Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Study design for drives based on power requirement.
2. Understand design procedure for machine tool structure, guide ways and slide ways.
3. Understand design of spindles, spindle supports and power screws.
4. Analyze the dynamics of machine tool.
5. Understand special features in machine tool.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Design the drives based on power requirement.
2. Design and analyze machine tool structure, guide ways and slide ways
3. Design spindles, spindle supports and power screws.
4. Study the dynamic characteristics of the machine tool.
5. Perform design and analyze consideration for CNC, SPM and micro-machining.

Curriculum Content	Hours

UNIT 1 **08**

DRIVES :

Design considerations for drives based on continuous and intermittent requirement of power, Types and selection of motor for the drive, Regulation and range of speed based on preferred number series, geometric progression. Design of speed gear box for spindle drive and feed gear box.

UNIT 2 **08**

DESIGN OF MACHINE TOOL STRUCTURE :

Analysis of forces on machine tool structure, static and dynamic stiffness. Design of beds, columns, housings, bases and tables

UNIT 3 **08**

DESIGN OF GUIDE-WAYS :

Functions and types of guide ways, design criteria and calculation for slide-ways, design of hydrodynamic, hydrostatic and aerostatic slide-ways, stick-slip motion in slide ways.

UNIT 4 **08**

DESIGN OF SPINDLES, SPINDLE SUPPORTS AND POWER SCREWS :

Design of spindle and spindle support using deflection and rigidity analysis, analysis of anti-friction bearings, preloading of antifriction bearing.

Design of power screws: Distribution of load and rigidity analysis.

UNIT 5 **08**

DYNAMICS OF MACHINE TOOLS:

Dynamic characteristic of the cutting process, Stability analysis, vibrations of machine tools. Control Systems, Mechanical and Electrical, Adaptive Control System, relays, push button control, and electrical brakes, drum control.

UNIT 6 **08**

SPECIAL FEATURES IN MACHINE TOOL DESIGN:

Design considerations for SPM, NC/CNC, and micro machining, Retrofitting, Recent trends in machine tools, Design Layout of machine tool using matrices.

Step-less drives. Design considerations of Step-less drives, electromechanical system of regulation, friction, and ball variators, PIV drive, Epicyclic drive, principle of self locking.

Text Books

6. "Machine Tool Design" N.K. Mehta,, Tata McGraw Hill, ISBN 0-07-451775-9.
7. "Principles of Machine Tool" Bhattacharya and S. G. Sen., New Central Book Agency Calcutta, ISBN 81-7381-1555.
8. "Design of Machine Tool" D. K Pal, S. K. Basu, 4th Edition. Oxford IBH 2005, ISBN 81-204-0968

Reference Books

1. "Machine Tool" N. S. Acherkan, Vol. I, II, III and IV, MIR publications.
2. "Design Principles of Metal Cutting Machine Tools" F. Koenigsberger, The Macmillan Company New York 1964
3. "Tool Design" Cyril Donaldson, George H. Lecain and V. C. Goold,, Tata McGraw Hill, ISBN 0070153922.

Class and Semester		**Final Year B. Tech. (Mechanical Engineering) , Semester VIII**			
Course Title	:	**FLEXIBLE MANUFACTURING SYSTEM**		**Elective II – 5**	
Teaching Scheme (Hours)	:	**Lectures = 3 hours/weeks = 3 x 12 weeks = 36 hours minimum**		*Total Credits*	: **03**
Evaluation Scheme (Marks)	:	**CIE (20+20) + Course work (10) = 50 SEE = 50**	**Grand Total =100**	*Duration of SEE*	: **3 hours**
Revision:	:	**First**		*Month*	: **December 2019**

Pre-requisites : Manufacturing Engineering, Computer Integrated Manufacturing.

Type of Course **:** Theory

Course Domain **:** Elective

Course Assessment Methods:

1. Continuous Internal Evaluation: **UNIT** Test I and **UNIT** Test II and Course work.
2. Semester End Examination (SEE).

Course Objectives:

The course aims to

1. Understand the basic concepts in flexible manufacturing system.
2. Design control structure, jig and fixtures for components.
3. Implement the database management system, material handling system in plant.
4. Use various simulation softwares in FMS.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain the basic concepts of flexible manufacturing such as types, components, task selection in FMS.
2. Illustrate with example architecture of flexible manufacturing system.
3. Design the appropriate jig and fixture for given components.

4. Apply the knowledge of database management system and material handling system to solve real life problems.
5. Use analysis and simulation software like ARENA, FLEXSIM.

Curriculum Content	Hours
UNIT 1	**08**
INTRODUCTION	
Flexible and rigid manufacturing, Concept of F.M. Cell and F.M. System, Functions of a manufacturing cell, Types and components of FMS, Tests of flexibility, Group Technology and FMS, Optimization of FMS, Tasks in selection of FMS.	
UNIT 2	**08**
CONTROL STRUCTURE OF FMS	
Architecture of typical FMS, Automated work piece flow in FMS, Hierarchical control system architecture of FMS – Factory level, Cell level and Equipment level; Factory networks, Distributed Numerical Control (DNC), unmanned operation, FMS Diagnostics.	
UNIT 3	**08**
TOOLING AND FIXTURING IN FMS	
A. Tooling in FMS: Tool holders for CNC machines, modular tooling, tool monitoring; preset, offset and wear compensation values, robotized tool assembly, tool database, tool management system, tool flow control in FMS **B. Fixturing in FMS:** Palletizing of parts, pallet pool, flexible fixturing – principles and methodologies, standard fixtures, modular fixturing system – T-slot based and dowel pin based and their components; Computer aided fixture design – approaches, use of GT in fixture design – fixture design process, fixturing structure and fixturing information tree, fixture database.	
UNIT 4	**08**
DATABASE MANAGEMENT SYSTEMS IN FMS	
Conceptual DBMS, types of data structures and their applications in FMS, Integrated DBMS in FMS and its implementation	
UNIT 5	**08**
MATERIAL HANDLING IN FMS	

Functions of an integrated material handling system in FMS, Flexibilities in material handling, Layouts in FMS, Industrial robots for load / unload applications, Robotic cell layouts; Automatically Guided Vehicles (AGVs) – types, Control of AGVs- Wire guided, optically guided, dead reckoning, free ranging AGVs, Scheduling of AGV, Storage and retrieval machines in AS/RS.

UNIT 6 **08**

DESIGNING AND SIMULATING FMS

Need, techniques, inputs, procedure, performance analysis, Simulation of FMS shop, using Simulation software package (like ARENA or FLEXSIM) including various modules like Arrive, Server, Depart, Simulate modules, Creating models of FMS shops and simulating the performance to obtain output results

Text Books

1. "Flexible Manufacturing Systems in Practice Applications, Design And Simulation", Joseph Talavage et. al: , Taylor and Francies Publisher: US.
2. "Computer Integrated Design and Manufacturing", Bedworth el.al, Tata McGrawHill,(1991).
3. "Performance Modeling of Automated Manufacturing Systems",N. Viswanadham, Y. Narhari,Prentice Hall Publication, (1992).
4. "Automation, Production Systems and Computer Integrated Manufacturing",Groover, Pearson Education.
5. "CAD/CAM", P.N. Rao, Tewari NK, Kundra TK, Tata McGraw Hill Publications
6. "FMS", H K Shivanand, New Age International Publication.
7. "Handbook of CIMS", Teicholds and Orre, Tata McGraw Hill Publications.

Reference Books

1. "The Design and Operation of FMS", Ranky, Dr. Paul, (1984).
2. "Automation, Production Systems and Computer Integrated Manufacturing", Groover, Mikell P, ,Pearson Education or Prentice Hall India, 2nd Edition, (2002).
3. "Performance Modeling of Automated Manufacturing System",Viswanadhan, N. and Narahari, Y., Prentice Hall of India, (1998).
4. "Operations Scheduling with Applications in Manufacturing and Services",Pinedo, Michael and Chao, Xiuly, Tata McGraw Hill International Editions (with 2 Floppy Disks of LEKIN Scheduling Software),(1999).
5. "Simulation with ARENA", Kelton, Sadowsky and Sadowsky, Tata McGraw Hill International

Editions (with CD of ARENA Simulation Software), 2nd Edition .

6. "CAD / CAM / CIM", Radhakrishnan, Subramanyan, John Wiley.
7. "Computer Aided Fixture Design",Rong, Yeming; Marcel Dekker, ISBN 0-8247-9961-
8. "Production Planning and Scheduling in Flexible Assembly Systems", Sewik, Springer Verlag, ISBN 3-540-64998-0.
9. "Lean Manufacturing Implementation",Hobbs, J. Ross Publishing, ISBN 1-932150-14-2
10. "Agile Manufacturing", Chowdiah, Gargesa and Kumar, Tata McGraw Hill Publication.
11. "Automation, Production System and Computer Integrated Manufacturing",Groover , Englewood Publication.
12. "Design and Operation of SMS", Rankey, IFS.
13. "Flexible Manufacturing System", Wernecks, Spring-Verlag.
14. "FMS in Practice", Bonetto, Northox Ford Publication
15. "Flexible Manufacturing Cells and Systems" W.W. Luggen, Publication, Prentice Hall of India.
16. "Performance Modeling of Automated Manufacturing Systems", Vishwanathan and Narahari, Prentice Hall of India.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**						
Course Title	:	**LABORATORY : AUTOMOBILE ENGINEERING**						
Teaching Scheme (Hours)	:	**Practical = 2 hr /week = 2 x13 = 26 hours**				*Credits*	:	**1**
Evaluation Scheme (Marks)	:	**IPE** : **Nil** **EPE** : **Nil** **IOE** : **Nil** **EOE** : **50**				*Duration of Exam (in case of External Evaluation)*	:	**02 hours**
Revision:	:	**First**				*Month*	:	**December 2019**

Pre-requisites **:** None

Type of Course **:** Practical

Course Domain **:** Core

Course Assessment Methods:

Practical Journal Assessment, External Oral Examination

Course Objectives:

The course aims to

1. Give details components and layout of automobile
2. To implement the knowledge obtained in theory towards working of various automobile systems
3. To study the effect of various factors on subsystems of automobile and remedies can be proposed
4. To work out the performance of automobile

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain components and layout of automobile.
2. Apply the knowledge obtained in theory towards working of various automobile systems.
3. Examine the effect of various factors on subsystems of automobile and remedies can be

proposed.

4. Work out the performance of automobile.

Practical List : **Any Eight**

The students should perform the following experiments.

1. Study and demonstration of four wheeler chassis layout, Two-wheel and four-wheel drive layouts.
2. Study and Demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gearbox.
4. Study and demonstration of final drive and differential.
5. Study and demonstration of working Hydraulic braking system.
6. Study and demonstration of front wheel steering geometry and steering mechanism.
7. Study and demonstration of suspension system of a four-wheeler.
8. Study and demonstration of battery, electrical starting, charging system.
9. Study of Car AC.
10. Visit to servicing station for study of vehicle maintenance, wheel balancing and front wheel alignment, repairs with relevant visit report.

Lab Manual: Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.

Text Books:

1. "Automobile Engineering",Dr. Kirpal Singh (Vol. I and II) Standard Publishers, New Delhi.
2. "Automobile Mechanics",N K Giri.
3. "Automobile Engineering", G.B.S. Narang., Khanna Publication ,3rd Edition.
4. "Automotive Technology", H.M. Sethi. Tata McGraw-Hill Education, (2001).
5. "Automobile Engineering", Banga and Singh.
6. "Automotive Mechanics", Joseph Heitner, Affiliated Eastern Law House, 2ndEdition ,(1967).
7. "Motor Vehicle Technology and Practical Work",Dolan. J.A., ELBS, (1978).
8. "Automobile Electrical Equipment", P.L.Kohali ,Technical Education Series, 1st Edition.
9. "Automobile Engineering", R.B.Gupta, Satya Prakasan, 9th Edition.
10. "Automotive Excellence Volume 1 and 2", Gelncoe, Tata McGraw-Hill Publication.

Reference Books:

1. "Motor Vehicles",Newton and Steed

2. "Motor Manuals (Vol I to VII)", A.W. Judge., Chapman and Hall Publication.
3. "Automobile Mechanics",W.H. Crouse.,Tata McGraw Hill Publishing Co.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**							
Course Title	:	**LABORATORY : POWER PLANT ENGINEERING**							
Teaching Scheme (Hours)	:	**Practical = 2 hr /week = 2 x 13 = 26 hours**						*Credits*	**: 1**
Evaluation Scheme (Marks)	:	**IPE**	:	**Nil**	**EPE**	:	**Nil**	*Duration of Exam (in case of External Evaluation)*	: **02 hours**
		IOE	:	**Nil**	**EOE**	:	**50**		
Revision:	:	**First**						*Month*	: **December 2019**

Pre-requisites **:** None

Type of Course **:** Practical

Course Domain **:** Core

Course Assessment Methods:

Practical Journal Assessment, External Oral Examination

Course Objectives:

The course aims to

1. Understand the different power generation methods, its economics and global energy situation
2. Familiarize with Equipment, Plant layout, principle of working of various Steam turbine, gas turbine and diesel power plants.
3. Interpret the working principles of various nuclear reactors.
4. Understand the types and capacity calculation of Hydroelectric Power Plant.
5. Understand Non- Convectional Power Plants and its commercialization.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain the energy resources and energy systems available for the production of electric power in the India and the world.

2. Explain construction and working of steam power plants, Gas turbine power plant, Diesel power plant.
3. Explain the basic principles of nuclear power plants,
4. Explain hydroelectric power plant, major types of Non- conventional power plants and estimate power generation potential.
5. Analyze economic analysis and the environmental impact of electric power production on air quality, climate change, water, and land.

Term Work :

Assignments on each **UNIT** / Industrial visit to study principles underlying in subject

Text Books:

1. Power Plant Engineering“ Domkundwar and Arora, Dhanpat Rai and Sons, New Delhi
2. “Power Plant Engineering“ P. K. Nag,, Tata McGraw Hill, New Delhi
3. “ Power Plant Engineering“ R.K.Rajput , Laxmi Publications, New Delhi.

Reference Books:

1. “Power Plant Engineering“ E.I. Wakil, Publications, New Delhi
2. “Steam and Gas turbines” R. Yadav, Central Publishing House, Allahabad
3. “Non-conventional energy sources” G. D. Rai

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VIII**						
Course Title	:	**LABORATORY : MECHATRONICS AND ROBOTICS**						
Teaching Scheme (Hours)	:	**Practical = 2 hr /week = 2 x 13 = 26 hours**					*Credits*	**: 1**
Evaluation Scheme (Marks)	:	**IPE** : **Nil**	**EPE** : **Nil**				*Duration of Exam (in case of External Evaluation)*	: **02 hours**
		IOE : **Nil**	**EOE** : **50**					
Revision:	:	**First**					*Month*	: **December 2019**

Pre-requisites **:** None

Type of Course **:** Practical

Course Domain **:** Core

Course Assessment Methods:

Practical Journal Assessment, External Oral Examination

Course Objectives:

The course aims to

1. Understand the working of various sensor and transducers.
2. Understand the use and functions of microcontroller and microprocessor for various applications.
3. Interpret the use of low cost automation in industries.
4. To study the programming languages related to robotics.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain various types of sensors and transducers
2. Analyze the use and function of microcontroller and microprocessor for various applications.
3. To work out the various low cost automation in industries.
4. Examine the various programming languages related to robotics.

Practical List **: Any Eight**

The students should perform the following experiments.

1. Trial on sensors (minimum three)
2. Assignment on Microprocessor and Microcontroller.
3. PLC Programming on Industrial Applications based on Timers, Counters, Internal Relays (Minimum 4 applications)
4. Assignment on PLC Data handling and Fault finding,
5. Assignment on SCADA and MEMS
6. A Case study on low cost automation
7. Study of part delivery system at work stations in automated assembly.
8. Two Programming exercises using various commands of VAL II.
9. Demonstration of various robotic configurations.
10. Industrial visit to study Mechatronic system application/ Industrial automation and robotic application and submission of visit report.

Lab Manual: Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.

Text Books

1. "Mechatronics and Robotics",W. Bolton, Pearson Education , 4th Edition
2. "Mechatronics and Robotics",Mahalik, TATA McGraw Hill, (2006) Reprint
3. "Microprocessor 8085", Gaokar Prentice Hall of India, 5th Edition
4. "Introduction to PLC Programming" NIIT.
5. "Programmable Logical Controller", Hackworth, Pearson Education, (2008).
6. "Programmable Logical Controller", Reis Webb, Prentice Hall of India 5th Edition.
7. "MEMS and Microsystems", HSU Tairan, TATA McGraw Hill Publication. 1st Edition.
8. "Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004).

Reference Books

1. "Mechatronics and Robotics"Appu Kuttam, Oxford Publications, 1 st Edition.
2. "Automated Manufacturing Systems",S. Brain Morris, Tata McGraw Hill.
3. "Mechatronics and Robotics and Microprocessor",Ramchandran , Willey India, (2009).
4. "Mechatronics and Robotics: Integrated Mechanical Electronic System", Ramchandran , Willey India,1st Edition.

5. "Programmable Logical Controller",Gary Dunning Cengage Learning, 3rd Edition.
6. "Mechatronics and Robotics Source Book", N C Braga, Cengage Learning.
7. Robot Technology Fundamentals", Keramas, James G, Thomson Learning –Delmar ISBN: 981-240-6212, (1998).
8. "Handbook of Robotics", Noff, Shimon Y., John Wiley and Sons.
9. "Introduction to Robotics, Analysis, Systems and Applications", Niku, Saeed B. (2002), Prentice Hall of India.
10. "Robotics for Engineers", Koren, Yoram, Tata McGraw Hill.,(2003)

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VIII**							
Course Title	:	**MAJOR PROJECT (PHASE II)**							
Teaching Scheme (Hours)	:	**Practical = 2 hr /week = 2 x 13 = 26 hours**						*Credits*	**: 3***
Evaluation Scheme (Marks)	:	**IPE**	:	**50**	**EPE**	:	**Nil**	*Duration of Exam (in case of External Evaluation)*	: **02 hours**
		IOE	:	**Nil**	**EOE**	:	**100**		
Revision:	:	**First**						*Month*	: **December 2019**

Pre-requisites **:** None

Type of Course **:** Practical

Course Domain **:** Core

Course Assessment Methods:

Internal Practical Examination, External Oral Examination

Course Objectives:

The course aims to

1. Embed the skill in group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
2. Encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Improve the professional competency and research aptitude in relevant area.

2. Develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Project Phase II Load:

A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed. Same groups of Seventh Semester shall work under same faculty member of department.

Project Phase II Definition:

Project phase-II is a continuation of project phase-I started in the seventh semester. Before the end of the eighth semester, there will be two reviews, one at start of the eighth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be external evaluation.

Project Phase II Term Work:

The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for
    a. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.
    b. Brief report of feasibility studies carried to implement the conclusion.
    c. Rough Sketches/ Design Calculations/ Testing reports/ Experimentation results.

Project Report:

Project report should be of 50 to 60 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Point. Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point Times New Roman

9. Headings: Times New Roman, 14 Point Bold face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal /Director
11. Index of Report:
    a. Title Sheet
    b. Certificate
    c. Acknowledgement
    d. Table of Contents.
    e. List of Figures
    f. List of Tables

    i. Introduction
    ii. Literature Survey/ Theory
    iii. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation.
    iv. Observation Results
    v. Discussion on Result and Conclusion
    vi. References: References should have the following format

For Books: "Title of Book", Authors, Publisher, Edition

For Papers: "Title of Paper, Authors, Journal/Conference Details, Year

12. The Project report shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department
13. Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

Important Notes:

- Project group should continue maintaining a diary for project and should write (a) Books referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creative thinking.
- The Diary along with Project Report shall be assessed at the time of oral examination
- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

Class and Semester	:	**Final Year B. Tech. (Mechanical Engineering) Part IV, Semester VII**							
Course Title	:	**HUMAN VALUES AND PROFESSIONAL ETHICS (AUDIT COURSE)**							
Teaching Scheme (Hours)	:	**Practical = 2 hr /week** **= 2 x 13 = 26 hours**						*Credits*	**: Nil**
Evaluation Scheme (Marks)	:	**IPE**	:	**Nil**	**EPE**	:	**Nil**	*Duration of Exam (in case of External Evaluation)*	**: Nil**
		IOE	:	**Nil**	**EOE**	:	**Nil**		
Revision:	:	**First**						*Month*	: **December 2019**

Pre-requisites **:** It doesn't require any pre-requisite as such but eager to know about our profession's connectivity and role and responsibility towards society and environment.

Type of Course **:** Audit Course at institute level

Course Domain **:** Humanities and Social Sciences

Course Assessment Methods:

The students will be given five assignments each for 10 marks.

At the end of the course, there will be a written test of 25 marks and a viva voce of 25 marks.

There will be assessment for a total of 100 marks. Based on the marks obtained, they will be awarded with a grade similar to other credit courses. Though it is an audit course, obtaining passing grade is essential.

Course Objectives:

The course aims to

1. To understand of the relation between engineering and society/environment
2. To be aware of ethics and responsibility of engineers as professionals
3. To be able to make ethical judgments and solve problems
4. To develop attitudes required of engineers and values shared by engineers

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Realize the role of engineers towards society and environment
2. Become aware of ethical practices and responsibility as a professional
3. Take ethical judgments and solve problems
4. Engineers attitude development and sharing of values

Curriculum Content	Hours

UNIT 1 **07**

ENGINEER, SOCIETY AND ENVIRONMENT:

Understanding of the relation between engineering and society/Environment, Understanding of the effects and impacts of science and technology on human society, Understanding the effects and impacts of science and technology on the natural environment, Understanding the characteristics of the modern globalized world.

UNIT 2 **07**

ETHICS AND ENGINEERING PROFESSION:

Understanding of ethics and responsibilities of engineers as Professionals, Understanding of the roles and responsibilities of engineers in Society, Understanding of the basic concepts and theories of ethics, Understanding the relation between law and ethics and having basic legal literacy, Understanding of the nature of professional ethics, Understanding of the purposes and roles of codes of ethics and those of conduct set by engineering societies and associations, Understanding of the social responsibility (SR) of organizations (companies in particular), Understanding of ethics in specific areas (and knowledge of concrete cases), Understanding the nature of ethics in research and development

UNIT 3 **07**

ETHICAL PERCEPTION AND PROBLEM SOLVING:

Ability to make ethical judgments and solve problems, Understanding and application of methods to identify related factors in ethical issues and to make a structural analysis of them, Understanding and application of methods to analyze technical factors in ethical

issues and make structural analysis of them, Understanding and application of methods to analyze organizational factors and provide organizational solutions, Ability to design one's conduct to solve ethical problems Based on the abilities to analyze factors gained through, Comprehensive problem-solving capability

UNIT 4 **07**

ENGINEER'S ATTITUDE AND SOCIAL RESPONSIBILITY:

Attitude required of engineers and values shared by engineers, Attitude to think autonomously and independently based on an understanding of the responsibility of an engineer, Attitude to accept a diversity of values (recognizing the existence of the various value systems different from their own as well as the multiplicity of values), Attitude to share values (such as safety emphasized in the codes of ethics) to which engineers should assign paramount importance, Attitude and willpower to act on ethical judgments of their own.

Reference Books:

1. Charles D.Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. Seth, M. L., "Principles of Economics", Lakshmi Narain Agarwal, Agra.
3. Agarwal, A. N., "Indian Economy", Vikas Publishing House Pvt. Ltd., New Delhi.
4. Datta R. and Sundharam, "Indian Economy", K. P. M., S. Chand and Co. Ltd., New Delhi
5. Prof. M P Raghavan, "Professional Ethics in Engineering", SCITECH Publication(India) Pvt.Ltd, Second Edition

Equivalence of Pre Revised and Revised Structure
Final Year B. Tech. (Mechanical Engineering) Semester VII and VIII

The above detailed syllabus is a revised version of the Final Year B. Tech (Mechanical Engineering) Program being conducted by the Shivaji University at the Technology Department of the University. This syllabus is to be implemented from June 2019, (Academic year 2019-20). The prime feature of this revision is the transformation of the existing curriculum into the Outcome based curriculum as specified in NBA rules and regulations.

The Equivalence for the subjects/courses of Mechanical Engineering at Final Year B. Tech. Semester VII and VIII pre-revised and Revised Program under the faculty of Engineering and Technology is as follows.

Final Year B. Tech. Semester VII (Mechanical Engineering)

Sr. No	Final Year B. Tech. (Mechanical Engineering) Semester VII Pre-revised syllabus	Final Year B. Tech. (Mechanical Engineering) Semester VII Revised syllabus	Remark
1.	Credits = 24	Credits = 24	No change in credits
2.	Refrigeration and Air-conditioning	Refrigeration and Air-conditioning	Slight modification in the content
3.	Machine Design – III	Machine Design III	Slight modification in the content
4.	Hydraulics and Pneumatics	Hydraulics and Pneumatics	Slight modification in the content
5.	Manufacturing Engineering III	Manufacturing Engineering III	Slight modification in the content
6.	Elective I	Elective I	
	Finite Element Analysis	Finite Element Analysis	Slight modification in the content
	Cryogenics	Cryogenics	Slight modification in the content
	Operations Research	Operations Research	Slight modification in the content
	Tribology	Tribology	Slight modification in the content
	Production Management	Production Management	Slight modification in the content
	Laboratory Refrigeration and Air-conditioning	**Laboratory** Refrigeration and Air-conditioning	Slight modification in the content
	Laboratory Hydraulics and Pneumatics	**Laboratory** Hydraulics and Pneumatics	Slight modification in the content
	Laboratory	**Laboratory**	Slight modification in the

	Manufacturing Engineering III	Manufacturing Engineering III	content
	Laboratory Major Project Phase I	**Laboratory** Major Project Phase I	Slight modification in the content
	Laboratory Report on Industrial Training	**Laboratory** Report on Industrial Training	Slight modification in the content
	Audit Course Constitution of India	Audit Course Constitution of India	Slight modification in the content
For above Theory Courses 2 to 6 the Continuous Internal Evaluation pattern is changed as below.			
	CIE = 50 (UT I = 25, UT II = 25)	CIE = 50 (UT I = 20, UT II = 20, Course work* =10)	Revised CIE marks distribution.

Audit course have not been assigned any credits. The students will be evaluated for these courses by the concerned course in charge. There will be grade conferred to the student. The grade will be based on conversion of marks obtained out of 50. (Obtaining passing grade is essential). Please refer to chart in the detail examination scheme. The chart shows the marks range and the respective grade.

* **Course work:** It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement programme outcomes. The practical work and its journal is not part of course work.

Final Year B. Tech. Semester VIII (Mechanical Engineering)

Sr. No	Final Year B. Tech. (Mechanical Engineering) Semester VIII Pre-revised syllabus	Final Year B. Tech. (Mechanical Engineering) Semester VIII Revised syllabus	Remark
1.	Credits = 24	Credits = 24	No change in credits
2.	Automobile Engineering	Automobile Engineering	Slight modification in the content
3.	Power Plant Engineering	Power Plant Engineering	Slight modification in the content
4.	Mechatronics and Robotics and Robotics	Mechatronics and Robotics	Slight modification in the content
5.	Total Quality Management	Total Quality Management	Slight modification in the content
6.	Elective II*	Elective II*	
	Computational Fluid Dynamics	Computational Fluid Dynamics	Slight modification in the content
	Vibration and Noise	Vibration and Noise	Slight modification in the content
	Nanotechnology	Nanotechnology	Slight modification in the content
	Machine Tool Design	Machine Tool Design	Slight modification in the content
	Flexible Manufacturing Systems	Flexible Manufacturing Systems	Slight modification in the content
7.	**Laboratory** Automobile Engineering	**Laboratory** Automobile Engineering	Slight modification in the content
8.	**Laboratory** Power Plant Engineering	**Laboratory** Power Plant Engineering	Slight modification in the content
9.	**Laboratory** Mechatronics and Robotics and Robotics	**Laboratory** Mechatronics and Robotics	Slight modification in the content
10.	Major Project Phase II	Major Project Phase II	Slight modification in the content
11.	Audit Course Human Values and Professional Ethics	Audit Course Human Values and Professional Ethics	Slight modification in the content
For above Theory Courses 2 to 6 the Continuous Internal Evaluation pattern is changed as below.			
	CIE = 50 (UT I = 25, UT II = 25)	CIE = 50 (UT I = 20, UT II = 20, Course work* =10)	Revised CIE marks distribution.

Audit course have not been assigned any credits. The students will be evaluated for these courses by the concerned course in charge. There will be grade conferred to the student. The grade will be based on conversion of marks obtained out of 50. (Obtaining passing grade is essential). Please refer to chart in the detail examination scheme. The chart shows the marks range and the respective grade.

* **Course work:** It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement programme outcomes. The practical work and its journal is not part of course work.