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Proposed Syllabus

of

(T.E. Mechanical and Automation Engineering)

Semester –V to VI

To be introduced from the academic year 2015-16
(i.e. from June 2015)

(Subject to the modifications by B.O.S. from time to time)

SHIVAJI UNIVERSITY, KOLHAPUR

STRUCTURE OF T.E. (MECHANICAL AND AUTOMATION ENGINEERING) SEMISTER V and VI

WITH EFFECTIVE FROM THE ACADEMIC YEAR 2015-16

SEMESTER V

Sr. No.	Subject	L	TUT	P	Total	TP	TW	OE	POE	Total
1	Non Conventional Energy Sources	3	-	-	3	100	--	-	-	100
2	Microprocessors and Applications	3	--	2	5	100	25	25	--	150
3	Machine Design I	3	--	2	5	100	25	--	--	125
4	Database Management Systems	3	--	2	5	100	25	--	--	125
5	Material Science and Metallurgy	3	--	2	5	100	25	---	--	125
6	Instrumentation and Control	3	--	2	5	100	25	--	25	150
7	Programming and Simulation Lab I	--	--	2	2	--	25	--	--	25
		18	**---**	**12**	**30**	**600**	**150**	**25**	**25**	**800**

L: Lecture, TUT: Tutorial P: Practical, TP: Theory Paper, TW:Term Work POE/OE: Practical/ Oral Exam

UNLESS SPECIFIED THE THEORY EXAMINATION DURATION WILL BE OF 03 HOURS.

[Note: - Examination scheme and term work marks strictly as per above structure]

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STRUCTURE OF T.E. (MECHANICAL AND AUTOMATION ENGINEERING) SEMISTER V and VI

WITH EFFECTIVE FROM THE ACADEMIC YEAR 2015-16

SEMESTER VI

Sr. No.	Subject	L	TUT	P	Total	TP	TW	OE	POE	Total
1	Principles of Management	3	-	-	3	100	--	-	-	100
2	Heat and Mass Transfer	3	--	2	5	100	25	--	25	150
3	Machine Design II	3	--	2	5	100	25	25	--	150
4	Manufacturing Automation	3	--	2	5	100	25	--	--	125
5	Applied Hydraulics and Pneumatics	3	--	2	5	100	25	---	--	125
6	Finite Element Analysis	3	--	2	5	100	25	--	--	125
7	Programming and Simulation Lab II	--	--	2	2	--	25	--	--	25
		18	**---**	**12**	**30**	**600**	**150**	**25**	**25**	**800**

L: Lecture, TUT: Tutorial P: Practical, TP: Theory Paper, T/W:Term Work POE/OE: Practical/ Oral Exam

@ Industrial training of minimum two (2) weeks should be done after T.E. (II) in summer vacation and it's assessment will be done in B.E. (I) based on report submitted.

UNLESS SPECIFIED, THE THEORY EXAMINATION DURATION WILL BE OF 03 HOURS.

[Note: - Examination scheme and term work marks strictly as per above structure]

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T.E (Mechanical and Automation) Part-I
1. NONCONVENTIONAL ENERGY SOURCES

Teaching Scheme: Lecture: 3 hours per week

Examination scheme: Theory paper: 100 marks

Course Objectives:

1. To understand various environmental legislation in India and fossil fuel based systems.
2. To Study Solar Thermal System.
3. To understand concept of Photovoltaic cell and the various aspects of fuel cells.
4. To Understand Design considerations for wind mills and Power from wind and biomass.
5. To Study the various aspects of Ocean energy and Geothermal Energy.
6. To understand various Energy Management techniques.

Course Outcomes:

On completion of this course, student will be able to:

1. Summarize the characteristics environmental legislation in India.
2. Describe the various Solar Thermal System.
3. Describe effects of Photovoltaic cell and fuel cells.
4. Understand fundamental knowledge of wind energy and biomass.
5. Understand fundamental knowledge of oceanic energy and tidal energy.
6. Understand the need of hybrid system and energy management.

SECTION-I

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UNIT I. Introduction:

Fossil fuel based systems, Impact of fossil fuel based systems, World scenario of Energy Resources, Indian Scenario of Energy Resources now and Renewable energy – sources and features, Distributed and dispersed energy system. **(04)**

UNIT II. Solar Thermal System:

Solar potential, Solar radiation spectrum, Solar radiation geometry, Solar radiation data, Radiation measurement, Technologies of thermal energy collection, Types of Solar Collectors, Collection efficiency, Testing of Solar collectors – IS code, Applications of Solar Energy, Solar Pond, Solar Energy storage & types. **(06)**

UNIT III. A) Solar Photovoltaic systems:

Operating Principle, Photovoltaic cell concepts, Photo-cell materials, Cell module array, Series and parallel connections, Maximum power point tracking, Applications. **(06)**

B) Fuel Cells:

Introduction, Principle and operation of fuel cells, classification and types of fuel. Fuel for fuel cells, performance characteristics of fuel cells, application of fuel cells. **(04)**

SECTION-II

UNIT IV. A) Wind Energy:

Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, characteristics of wind generators, Design considerations for wind mills, Operation and maintenance of wind mills, present status. **(04)**

B) Biomass:

Introduction, Energy plantation, Combustion and fermentation, Anaerobic digester, Biomass gasification, Pyrolysis, various applications of Biomass energy, Bio-fuel – Relevance, types, and applications. **(04)**

UNIT V. A) Ocean energy – Tidal energy :

Introduction to OTEC, open and closed cycle OTEC systems, prospects in India. **(03)**

B) Geothermal Energy:

Types of geothermal resources, Methods of harnessing, Types of geothermal systems, sites of geothermal energy in India and in world. Environmental impact. **(02)**

UNIT VI.A) Hybrid Systems:

a. Need for Hybrid systems, b. Range and type of hybrid systems, c. Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, hybrid electric vehicles, etc. **(03)**

B) Energy Management:

Overview, National Energy, Strategy of India. Energy planning, Energy conversion opportunities and measures. Energy Auditing: Scope, types and case studies. Energy Costing for Solar systems. **(04)**

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With above study, students are expected to perform minimum five of the following assignments.

1. Demonstration and measurement of solar radiation.
2. Test and Trial on Solar flat plate collector.
3. Performance evaluation of PV cell.
4. Energy Audit – Case Study of an organization.
5. Visit to Wind Power plant.
6. Study and demonstration of fuel cell, applications.
7. Visit to Biodiesel plant.

REFERENCE BOOKS:

1. Solar Energy by Dr. S.P.Sukhatme Tata McGraw Hill.
2. Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers.
3. Energy Technology by S. Rao, Dr. B.B.Parulekar Khanna Publishers.
4. Energy Engineering by R.S. Kulkarni & Dr. S.V. Karmare.
5. Non Conventional Energy Sources by Dr. L. Umanand.
6. Introduction to Non Conventional Energy Resources by Raja, SciTech Publications.

T.E (Mechanical and Automation) Part-I
2. MICROPROCESSORS & APPLICATIONS

Teaching Scheme:
Lecture: 3 hours per week
Practicals:-2 Hrs/week

Examination scheme:
Theory paper: 100 marks
Term work: - 25 marks
Oral Exam:25 marks

Course Objective:

1. To understand 8085 microprocessor architecture and programming.
2. To understand interrupts of 8085 and programs over interrupts.
3. To use the knowledge of interfacing of 8255with 8085.
4. To practice a program on 8085 simulator and hardware kit
5. To compare microprocessor and microcontroller.
6. To understand 8051 and PIC microcontroller architecture and programming.
7. To use the knowledge to interfacing of LED,LCD to 8051.
8. To practice a programs on 8051 simulator and hardware kit

Course Outcome:

On completion of this course, student will be able to:

1 Students will be able to know the architecture of 8085.
2 Students will be able to write programs over 8085 microprocessors.
3 Students will be able to interface 8255, 8279, 8155, DAC to 8085.
4 Students will be able to write programs on simulator of 8085.
5 Students will be able to know architecture and instruction set of 8085 and 8051.
6 Students will be able to use the knowledge of instruction set to perform practical over 8051 and PIC microcontrollers.
7 Students will be able to interface LED and LCD to 8051.
8 Students will be able to use simulators and down load the programs in Hardware kit.

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SECTION – I

UNIT I

Introduction to 8085 Microprocessor: **(9)**

CPU Architecture, Register Organization, 8085 Instruction Set, Addressing modes. Stack &Subroutines, Instruction Cycle, Interrupts of 8085(Hardware and software).

UNIT II

Interfacing: **(9)**

Memory interfacing, I/O interfacing, Memory mapped I/O, I/O mapped I/O, Peripheral Interfacing – Programmable I/O-8255 Interface, ADC – 0809, DAC – 0808, Seven segment LED, 4 x 4 Matrix keyboard , stepper motor.

UNIT III **(9)**

Introduction to MCS51

Introduction toMCS51Family, Architecture, Functional Pin out diagram, Programming Model, Memory Organization, Addressing Modes, Instruction Set: Classification, Reset Circuit, Machine Cycle, Oscillator Circuit, Introduction to Assembly Language Programming.

SECTION-II

UNIT IV **(9)**

Hardware overview:

Input / Output Ports, Counters & Timers, Serial Communication, Interrupt.

Note: Structure of Above, Related S.F.R, Instruction, Associated Programs.

UNIT V **(8)**

Interfacing & Application

Interfacing: RAM ROM, LCD, ADC, DAC, Keyboard, stepper motor Minimum System Design &Application: Interfacing of Temperature Sensor (LM35) 8051 Connection to RS232.

UNITVI **(8)**

Embedded 'C' Programming for 8051:

Data types and time delay, I/O Programming, Logic operations, Data conversions, accessing code ROM space, Data serialization.

TERM WORK

Minimum 8 experiments out of following.

1 Arithmetic & Logical operations using 8085
2 Data transfer & Exchange using 8085
3 Data conversions using 8085
4 Interface Stepper motor using 8085
5 Interface ADC& DAC using 8085
6 Interface keyboard using 8085
7 Arithmetic & Logical operations using 8051
8 Data transfer & Exchange using 8051
9 Data conversions using 8051
10 Interface Stepper motor using 8051
11 Interface DAC using 8051
12 Timer & counter operation in 8051 using Embedded C
13 Interface LCD to 8051 using Embedded C
14 Serial Communication with 8051 using Embedded C

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Textbooks:

1 Ramesh S Gaonkar -'Microprocessors Architecture, Programming and applications with 8085A
2 The 8051 Microcontroller & Embedded Systems By Muhammad Ali Mazidi & Janice Gillispie Mazidi Pearson Edition L.P.E.

REFERENCE BOOKS:

1 Kenneth L Short –'Microprocessors and Programmed logic'Prentice Hall of India , New Delhi, 2nd Indian Reprint, 2004.
2 Douglas V Hall-'Microprocessors and Digital Systems" Edition. 2nd ed. Published. New York: Gregg Division, McGraw-Hill, c1983
3 The8051Microcontroller by Ayala 3rdEdition, Pen ram International *Publications*, 1999.

T.E. (MECHANICAL AND AUTOMATION) PART-I
3. MACHINE DESIGN-I

Teaching Scheme:
Lectures:-3 Hrs/week
Practicals:-2 Hrs/week

Examination Scheme:
Theory: - 100 marks
Term work: - 25 marks

Course Objectives:

1. To explain the basic technical knowledge of design and general design procedure.
2. To describe the design procedure of machine elements subjected to static loading.
3. To describe various theoretical methods of stress and strain determination for mechanical systems under various loads.
4. To explain the design procedure for mechanical components, systems or process to meet desired needs within realistic constraints.

Course Outcomes: At the end of this course, student will be able to

1. Summarize basic concepts in Mechanical Design .
2. Apply the systematic engineering design process including, problem definition, information collection, concept generation & selection, and design configuration to design of mechanical systems and elements.
3. Analyze the effect of stress and strain on mechanical components; and quantify failure modes for mechanical parts.
4. Apply knowledge to solve step by step design problems for lifelong learning.

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SECTION-I

UNIT NO-I **(05)**

Concept of Machine design, Types of loads, Factor of safety- its selection & significance,Theories of elastic failure & their applications, General design procedure, Review & selection ofvarious engineering materials properties & B.I.S. coding of various materials, Factors governingselection of Engineering materials.

UNIT NO-II **(08)**

Bolted joint subjected following conditions – i) Bolted joints in shear ii) Bolted joints subjected to load perpendicular to the axis of bolt iii) Bolted joints subjected to eccentric load on circular base, Design of various types of welding joints under different static load conditions, eccentrically loaded. Design of knuckle joint, Turn buckle.

UNIT NO-III **(07)**

Design of solid & hollow shafts, transmission & line shafts, splined shafts, Types of Couplings, Design of Muff, Rigid flange & Flexible bushed pin type flanged coupling, Design of keys & splines, Levers etc.

SECTION-II

UNIT NO-IV **(09)**

Various types of springs and their applications, Design of Helical, Compression & Tensionsprings subjected to static loading, Stresses induced in helical springs. Fundamental equation of motion, Torque analysis, Stresses in flywheel rim & spokes. Design of solid & rimmed flywheels.

UNIT NO-V **(06)**

Forms of threads, Design of power screw & nuts, Types of induced stresses, Efficiency of power screw, Self locking and overhauling properties, Introduction to re-circulating bal screw.

UNIT NO-VI **(05)**

Design of pulley – Flat & V belt pulley, Selection of flat belt, V belt and rope drives as per the standard manufacturer's catalogue, Introduction to timing belts.

TERM WORK:

Minimum Eight assignment based on the above syllabus.

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REFERENCE BOOKS:

1. Design of Machine Elements by V.B.Bhandari., Tata McGraw Hill Publi.
2. Machine Design An Integrated Approach By R.L Norton, Pearson Education Publication
3. Design of Machine Element by J.F. Shigley, McGraw Hill Publi.
4. Design of Machine Element by M.F.Spotts, Pearson Education Publication
5. PSG Design data Book
6. Fundamentals of Machine Component Design by J Marshek,Willey Eastern Ltd

T.E (Mechanical and Automation) Part-I
4. DATABASE MANAGEMENT SYSTEMS

Teaching Scheme:
Lecture: 3 hours per week
Practicals:-2 Hrs/week

Examination Scheme:
Theory paper: 100 marks
Term work: - 25 marks

Course Objectives:

1) To describe Database and Database management system.
2) To study various Data models and its components.
3) To apply Normal forms to database.
4) To study storage and implementation techniques.

Course Outcomes:

1) Apply conceptual database modeling methods such as entity-relationship model to design a relational database.
2) Describe the basic concepts of the relational model and understand its mathematical foundation.
3) Use the SQL language to define, query and manipulate a relational database.
4) Apply database design methods on functional dependencies and normal forms to evaluate the quality of a relational database design.
5) Use and apply various storage and implementation techniques.

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SECTION-I

UNIT-I: Introductory Concepts of DBMS: **(5)**
Introduction, Comparison of File System, Database Management system, Characteristic Features of Database Management Systems. Application of DBMS, Data Independence, Database System Architecture – levels, Mapping, Database users and DBA.

UNIT-II: ER Model: **(5)**
Entity – Relationship model, constraints, keys, Design issues, E-R Diagram, Extended E-R features-Generalization, Specialization, Aggregation, Translating E-R model into Relational model.

UNIT-III: Relational Model: **(8)**
The relational Model, The catalog, Types, Keys, Relational Algebra, Fundamental operations, Additional Operations-, SQL fundamentals, DDL,DML Concepts, Stored Procedures, Stored Functions, Database Integrity – Triggers.

SECTION-II

UNIT-IV: **(8)**

Functional Dependencies, Non-loss Decomposition, First, Second, Third Normal Forms, Dependency Preservation, Boyce/Codd Normal Form, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

UNIT-V: Storage and File Structure: **(5)**

Physical storage media, Storage access, File Organization, Organization of Records in Files, Data Dictionary Storage.

UNIT-VI: Implementation Techniques: **(8)**

Indexing and Hashing, Basic Concepts, Ordered Indices, B+ Tree Index Files, B-Tree Index Files, Static Hashing, Dynamic Hashing, Comparison of Indexing &Hashing, Multiple Key Access- Grid Files

TERMWORK:

1	Study of Entity Relationship Model
2	Study of Relational Model
3	Study of DDL and DML. & implement basic SQL commands(create table, insert,delete,update)
4	Queries based on String, Set operations, aggregate functions, Group by, Order by clause.
5	Queries based on joins-equijoin, Inner join, outer joins & view creation
6	Constraints- creating table using all constraints (primary key, foreign key Not Null, unique clause)
7	Study of Normalization and Normal forms.
8	Study & Implementation static & dynamic of hashing

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Text Books:

[1] Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 5th Edition, Tata McGraw Hill, 2006
[2] Elmsari and Navathe, "Fundamentals of Database Systems", 4th Ed., A. Wesley, 2004
[3] DATABASE MANAGEMENT. SYSTEMS. THIRD EDITION. Raghu Ramakrishnan.

References Books:

[1] C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.
[2] J. D. Ullman, "Principles of Database Systems", 2nd Ed., Galgotia Publications, 1999.

T.E (Mechanical and Automation) Part-I
5. Material Science and Metallurgy

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hrs. per week	Theory Paper: 100 Marks
Practical: 2 Hrs. per week	Term Work: 25 Marks

Course Objectives:

1. To Study the basic concepts of Metal Structure
2. To impart fundamental knowledge of Ferrous and Non Ferrous Metal Processing
3. To study applications of different Metals and Alloys
4. To know fundamentals of material science.
5. To develop futuristic insight into Metals.

Course Outcomes:

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

1. Understand basic concept of metal structure.
2. Understand fundamental knowledge of Ferrous and Non Ferrous Metal.
3. Make selection of metals and alloys for different applications.
4. Understand need of heat treatment and various heat treatment processes.

SECTION-I

Unit I Metals and Alloy Systems: **(6)**

Introduction to Metallic and Non-metallic materials and its classification (metals/alloys, polymers and composites)

a) Metals, Metallic bonds, Crystal structure (SC, BCC, FCC, HCP), Imperfections in crystals

b) Alloy formation by crystallization, Nucleation and growth, Cooling curves, Dendritic structure and coring.

c) Lever arm principles, Destructive Testing methods: Tensile, Compressive, Impact, Fatigue, Creep, Hardness (Rockwell, Brinell and Vickers)

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Unit II **(10)**

Study of Phase Diagrams: (With respect to typical compositions, Properties and Applications for the following alloys.)

a) Fe- Fe3C equilibrium diagram - Ferrous alloys (Plain carbon steels, cast iron)

b) Alloy steels- Free cutting steels, HSLA high carbon low alloy steels, creep resisting steels, Stainless steels- different types. Tool steels- types,

c) Selection of materials on the basis of properties and applications, Specifications based on -IS, BS, SAE, AISI,

d) Copper based alloys brasses Cu- Zn, Bronzes Cu- Sn, Cu-Ni.

e) Aluminium based alloys Al- Cu(Duralumin).

Unit III **(5)**

Smart Materials.

Shape memory alloys, Electroactive polymers, Piezoelectric materials, magnetostrictive materials, sensors and actuators based on LBHS (Low bandwidth high strain) smart materials.

SECTION-II

Unit IV **(5)**

Principles of Heat Treatment:

a) Transformation of Pearlite into austenite upon heating.
b) Transformation of austenite into Pearlite, Bainite and Martensite on cooling.
c) TTT –Diagram and CCT - Diagrams

Unit V **(8)**

Heat Treatment Processes:

a) Annealing – Full, Sub critical, Spherodising.
b) Normalizing
c) Hardening - Quenching Baths, Hardening types, mechanism of quenching media, hardnabilty concept and methods
d) Tempering – Types, Structural transformations during tempering.
e) Precipitation hardening – stages, common alloys, variables, theories.
f) Surface hardening – Flame and induction
g) Chemical heat treatments – Carburizing, nitriding, cyniding, carbon nitriding Heat treatment defects and remedies.

Unit VI **(5)**

Powder Metallurgy:

a) Advantages, Limitations and Applications of Powder Metallurgy
b) Powder manufacturing types- Mechanical, Physical, Chemical and Electro- Chemical
c) Mixing/ Blending- (Double cone and Y- Cone mixers)
d) Compaction- types- Conventional, Isostatic, HERF, Powder rolling and extrusion
e) Sintering- Types liquid stage and solid stage sintering
f) Finishing operations: Sizing, Machining, Infiltration and Impregnation

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TERM WORK:

Any 8 Experiments of following:

1) Tensile testing of Mild Steel (M.S.)
2) Hardness testing (Rockwell and Brinell)
3) Impact testing (Izod and Charpy) of M.S.
4) Study of non destructive testing (NDT).
5) Macroscopic Examinations Spark Test.
6) Examination of microstructure of steels and Cast Irons.
7) Examination of microstructure of Non ferrous alloys (Brass, Duralimin, Babbit)
8) Study of Heat treatment of steels (Annealing, Normalizing, Hardening on medium/ high carbon steels
9) Jominy end - quench test for hardenability
10) Observation of various industrial heat treatments processes during industrial visits.

TEXT BOOKS:

1. “Introduction to physical metallurgy”, S.H.Avner, Mcgraw Hill Book Company Inc, Edition, 2nd , 1974.
2. “Mechanical metallurgy”, G.E Dieter, Mc GRAW Hill Publishers.
3. “Material science and engineering”, W.D Callister, Wiley India Pvt.Ltd., 5th Edition.
4. “Material science and metallurgy for engineers”, V.D.Kodgire, Everest Publishers Pune,12th Edition.
5. “Heat Treatments Principles and Practices”, T.V. Rajan / C.P. Sharma, Prentice Hall of India Pvt Ltd, New Delhi,
6. “Material Science and Engineering”, V Raghwan, Prentice Hall of India Pvt. Ltd., New Delhi ,3rd Edition, 1995.

RFERENCE BOOKS:

1. “Engineering Metallurgy”, R.A. Higgins, Viva Books Pvt. Ltd., New Delhi, 1st Edition ,1998
2. “Physical Metallurgy for Engineers ”, D.S.Clark, W. R. Varney, AN East West Press Pvt. Ltd. , New Delhi, 2nd Edition,1962
3. “Heat Treatment of Metals”, J L Smith and SC Bhatia , CBS Publisheres and distibutors, New Delhi, 1st edition, 2008.
4. Smart Materials and structures, Gandhi, Thompson and Gandhi.
5. Smart structures and materials, Bryan Culshaw.

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T.E (Mechanical and Automation) Part-I
6. INSTRUMENTATION AND CONTROL

Teaching Scheme:
Lecture: 3 hours per week
Practicals:-2 Hrs/week

Examination scheme:
Theory paper: 100 marks
Practical Oral Exam: 25
Term work: - 25 marks

Course objective:

1. To understand the principles and use of instruments for measurement of different parameters.
2. To understand the concept of feedback control systems and their applications.

Course outcome:

On completion of this course, student will be able to:

1. Understanding terminologies of Mechanical Measurements.
2. Gaining knowledge of instruments and their applications.
3. Usage of control of mechanisms of mechanical systems.

SECTION-I

UNIT-I MEASUREMENTS **(5)**

General concepts - Units and standards - Measuring instruments - sensitivity, readability, range accuracy, precision - static and dynamic response - repeatability hysteresis - systematic and random errors - correction - calibration.

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UNIT-II: INSTRUMENTS **(7)**

Transducer, Modifying (intermediate) and Terminal stages - Mechanical and electrical transducers- preamplifiers - charge amplifiers - filters - attenuaters - D' Arsonval CRO - Oscillographs records - micro processor based data logging, processing and output.

UNIT-III: PARAMETERS FOR MEASUREMENT **(7)**

Dimension, displacement velocity, acceleration, impact - Force, torque, power – strain pressure humidity- temperature - flow-Time, frequency and phase angle - noise and sound level. Radiotracer techniques - Flow visualization - shadow-graph interferometer, Schlieren, Laser Doppler anemometer. Measurement of vibration parameter.

SECTION-II

UNIT-IV: AUTOMATIC CONTROL SYSTEMS **(6)**

Basic elements - feedback principle implication of measurements - Error detectors final actuating elements - Two position, multi position, floating, pro-portional controls relays – seNO amplifiers seNO motors - mechanical, Electrical, magnetic, electronic, hydraulic, pneumatic systems.

UNIT-V: APPLICATION OF CONTROL SYSTEMS **(5)**

Governing of speed kinetic and process control- pressure, temperature, fluid level, flow thrust and flight control - photo electric controls. Data acquisition & conversion.

UNIT-VI: **(7)**

Measurement of weight- Load cell method, strain gauge, LVDT; piezoelectric, pneumatic and hydraulic load cell, null balance method. Conveyor belt weighting for on line measurement of viscosity, definition of absolute and kinematic viscosity, industrial viscosity meter.

TERMWORK

1. Study of Instruments and their representation.
2. Study of static and dynamic characteristic of instrument.
3. Study of Transducer elements.
4. Study of Mechanical measurements a) Displacement Measurement b) Force Measurement c) Torque Measurement.
5. Measurement of thermal parameters: Temperature: Industrial thermo couples, Resistance thermometer, Radiation temperature measurement.
6. Measurement of hydraulic parameters: a) Pressure b) vacuum c) Flow.
7. Use of vibration analyzer for vibration analysis.
8. Study of noise meter and noise analysis.
9. Microprocessor & computer application in measurements.

TEXT BOOKS:

1. Doeblin. E.O., "Measurement Systems, Application and Design", 4th Edition. Mc GrawHillint. Edition, 1990.
2. Nagarath. I.J. and Gopal. M., "Control Systems Engineering", 2ndEdition John Wiley &Sons, Ch.1-4, 1982
3. B.C. Nakra and K.K .Choudhary, "Instrumentation, Measurement and analysis" ,Tata McGraw Hill Publications Pvt Ltd.
4. Rangan and Sharma, "Instruments, devices and system", Tata Mc McGraw Hill Publications Pvt Ltd.

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REFERENCES:

1. Holman. J.P. and N.J.Gajda Jr., "Experimental Methods for Engineers", McGraw Hill Int.Edition, 5thEdition, 1989.
2. Beckwith. T.G and Buck. N.L., "Mechanical Measurements", Addision Wesley Pub, Co.,1969.
3. Bureau. W.H., "What the printer should know about paper", GATF, 1983.
4. Casey.J.P., "Edition. Pulp and Paper, Chemistry & Chemical Technology", Wiley Interscience Publication, 1981.

T.E (Mechanical and Automation) Part-I
7. PROGRAMMING AND SIMULATION LAB-I

Teaching Scheme:
Practicals:-2 Hrs/week

Examination Scheme:
Term work: - 25 marks

Course objectives:

1 To train the students to write part programming using G-codes and M-codes for machining operations.
2 To train the students to write programming for robot control and PLC.

Course outcomes:
On completion of this course, student will be able to:

1 Write CNC programming using G-code and M-code.
2 Write programming for robot control.
3 Use PLC for actuation.

TERMWORK:

LIST OF EXPERIMENTS

1. Part programming for CNC lathe
2. Simulation and machining practice in CNC lathe
3. Part programming for CNC Milling machine
4. Practice in CNC milling machine
5. Programming exercise for robot
6. Programming of PLC using ladder logic diagram
7. Experiments using PLC.

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T.E (Mechanical and Automation) Part-II
1. Principles of Management

Teaching Scheme:
Lecture: 3 hours per week

Examination scheme:
Theory paper: 100 marks

Course Objectives:

1. To understand the basic functions of management.
2. To grasp the concepts of human behavioral patterns.
3. To know the principles of financial management.
4. To become conversant with objectives and methodology of marketing and material management.
5. To get acquainted with elements of engineering economics.

Course Outcomes:

On the successful completion of the course, the students will able to,

1. List and explain the various functions of management.
2. Provide the fundamental concepts of human behaviour.
3. Apply the marketing and material management techniques through case studies.
4. Prepare the elementary budget statement for small scale enterprises.
5. Explain the basic economic terms.

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SECTION-I

UNIT I Function of Management: (10)

Planning – Need, Objective, Strategy, Policies, Procedures. Levels of Planning, Decision, Forecasting. Organising – Principles of Organisation.Departmentation.Organizational relational relationship, Authority, Responsibility, Delegation, Span of control.
Staffing- Nature, Purpose, Scope, Human resource management, Policies, Recruitment procedure training and development, appraisal methods**.**
Leading-Communicationsprocess, Barriers, remedies, Motivation, Importance.Theories, Herzberg's theory, Maslow's theory, McGregor's theory, Leadership style.
Controlling-Process, Requirement for control Management, Accountability.

UNIT II Human Behaviour at Work: (4)

Concepts of organisational behaviour, key elements. Individual Behaviour in the organisation. Group behaviour-Types of groups, Group development, group member roles, Confilots in group**.**

UNIT III Financial Management: **(6)**

Sources of finance, Financial Institutions, Financial statement, Balance sheet and P. & L. Account (contents only)

Use and Importance.-Elamants of cost, Allocation of overheads. Costing Techniques (Elementary treatment only).Break even analysis and its applications.

SECTION-II

UNIT IV Marketing Management: **(6)**

Marketing Concepts, Objective, and Types of markets. Market Segmentation, Market strategy-4AP's of market. Market research, Salesmanship, Advertising.

UNIT V Materials Management: **(6)**

Scope, Advantage of materials management, functions, Purchasing objectives, 5-R Principles of purchasing, EOQ. Vendor development, Just in time inventory, Inventory cost relationships. ABC analysis, MRP, Make or Buy decision.

UNIT VI Engineering Economics and Industrial Safety: **(6)**

Introduction to basic economics terms. Types of depreciation, reasons for depreciation. Evaluation criteria for investment decisions. Industrial Safety-Reason for accidents, Prevention of accidents, promotion of safety mindedness. Introduction to Management information system (MIS), Business Process Re-engineering (BPR).

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Termwork:

Minimum Eight assignments on above topics.

Reference Books:

1. Management- James A.F.Stoner.R.Edward Freeman Printice Hall of India. New Delhi.
2. Management Today Principle and Practice Gene Burton amd Manab Thakur,Tata McGraw Hill Publishing Co.New Delhi.
3. Essentials of Management –Koontz and O'Donell.
4. Human Behaviour at Work Organisational Behaviour,Keith Davis,Tata McGraw Hill Pub.Co.New Delhi.
5. Business Process Re-engineering-Jaya Raman M.S And Others, Tata McGraw Hill Pub.Co.New Delhi.
6. Industrial Engineering and Management-O.P Khanna.
7. Business Management-J.P.Bose, S.Talukdar.New central Agency (P) Ltd.
8. Management Information System, Conceptual foundation.- W.S.Jawdekar, Venus Publications.

T.E (Mechanical and Automation) Part-II
2. HEAT AND MASS TRANSFER

Teaching Scheme:
Lecture: 3 hours per week
Practicals:-2 Hrs/week

Examination scheme:
Theory paper: 100 marks
POE Exam: 25 Marks
Term work: - 25 marks

Course objectives:

1. To demonstrate basic knowledge of heat transfer by understanding differences between conduction, convection and radiation modes of heat transfer.
2. To develop ability among the students to understand steady and unsteady state heat transfer by conduction.
3. To provide students with the knowledge of various laws of thermal radiation and their application to estimate heat flow rates in case of radiation heat transfer.
4. To make students able to understand the significance of dimensionless numbers in order to solve the problems in natural and forced convection.
5. To make students able to apply the principles of heat transfer to analyze and design heat exchangers.

Course outcomes:

a. Students will be able to demonstrate the basic concepts and laws of heat and mass transfer.
b. Students will be able to apply the one dimensional conduction equations to the system of plane and composite walls, cylinders and spheres in order to estimate the heat flow rates.
c. Students will be able to design and conduct experiments related to heat transfer.
d. Students will be able to demonstrate the significance of dimensionless parameters in estimating the heat flow rates.
e. Students will be able analyze, design and evaluate the performance of heat exchangers form heat transfer perspective.

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SECTION – I

Unit I: Modes of Heat Transfer **(02)**

Introduction to heat transfer, modes of heat transfer, basic laws governing heat transfer, thermal conductivity and effect of temperature on thermal conductivity of various materials.

Unit II: Conduction Heat Transfer

Chapter II.1 –Steady state heat conduction **(06)**

Mechanism of heat conduction, Fourier's law of heat conduction, heat conduction through plane wall, cylinder and sphere; electrical analogy of heat conduction, generalized heat conduction equation in Cartesian co-ordinate, its reduction to Fourier, Laplace and Poisson's equations. Generalized heat conduction equation in cylindrical and spherical coordinates (no derivation) and its reduction to one dimension, critical radius of insulation for cylinder and sphere, one dimensional steady state heat conduction with uniform heat generation for wall & cylinder.

Chapter II.2 – Extended Surfaces (03)

Types and applications of fins, Heat transfer through rectangular and circular fins. Fin effectiveness and efficiency, error estimation in temperature measurement in thermo well. Applications of microfins.

Chapter II.3 – Unsteady State Heat Conduction (02)

Systems with negligible internal resistance, Biot and Fourier number and their significance, Lumped Heat capacity Analysis. Use of Hiesler and Grober Charts. (No mathematical Treatment).

Unit III: Radiation Heat Transfer (08)

Nature of thermal radiation, definitions of absorbitivity, reflectivity, transmissivity, monochromatic emissive power. Total emissive power and emmissivity, Concept of black body & gray body, Kirchoff's law, Wein's law and Planck's law. Deduction of Stefan Boltzman equation. Lambert cosine rule, Intensity of radiation. Energy exchange by radiation between two black surfaces with non-absorbing medium in between and in absence of reradiating surfaces. Geometric shape factor. Energy exchange by radiation between two gray surfaces without absorbing medium and absence of reradiation and Radiosity. Radiation network method, network for two surfaces which see each other and nothing else.

SECTION-II

Unit IV:Convection HeatTransfer (01)

Natural and forced convection, Concept of hydrodynamic and thermal boundary layer, local and average convective coefficient for laminar and turbulent flow over flat plate and through pipe, dimensional analysis, Buckingham's Pi theorem.

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Chapter IV.1 –Forced Convection (04)

Dimensional analysis applied to forced convetion, Physical significance of dimensionless numbers, Reynolds analogy for laminar flow, Numerical correlations to solve various problems, Flow over Tube bundles.

Chapter IV.2 – Natural Convection (04)

Dimensional analysis applied to natural convection, Physical significance of dimensionless numbers, Numerical correlations to solve natural convection problems, Combined free and forced convection problems.

Unit V: Boiling and condensation (02)

Pool boiling curves, Forced boiling, Techniques for enhancement of boiling, Nusselt's theory of condensation, Condensation number, Filmwise and dropwise condensation.

Unit VI:

Chapter 6.1--Heat Exchangers (06)

Classification & Types of Heat exchangers, Fouling factor, and Overall heat transfer coefficient, Analysis by LMTD and NTU method for parallel and counter flow, Design consideration for Heat exchangers. Heat pipe.

Chapter 6.2 --Mass Transfer (02)

Introduction, Modes of mass transfer, Analogy between heat and mass transfer, Mass diffusion (Mass basis, Mole basis), Fick's law of diffusion, Significance of various dimensions numbers.

Term Work

List of experiments

Any 10 Experiments based on following list plus two computer application assignments. (Experiment must be set simultaneously and the no. of students in each group working on a setup shall not exceed 05 students).

1. Determination of thermal conductivity of insulating powder.
2. Determination of thermal conductivity of composite wall or lagged pipe.
3. Determination of thermal conductivity of metals at different temperatures
4. Determination of heat transfer coefficient for natural convection.
5. Determination of heat transfer coefficient for forced convection.
6. Determination of emissivity.
7. Determination of Stefan Boltzmann constant.
8. Boiling heat transfer.
9. Condensation heat transfer.
10. Trail on heat exchangers.
11. Heat pipe demonstration/trial.
12. Determination of mass transfer coefficient in Solid.
13. Two computer programs assignments.

Instructions for Practical Exam:

1. Four to five experiments shall be selected for practical examination.
2. The number of students for each practical set up would not be more than 04 Students.
3. Oral will be based on the practical performed in the examination and the experiments included in the Journal.

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REFERENCE BOOKS:

1. Heat Transfer by J.P. Holman, McGraw Hill Book Company, New York.
2. Fundamentals of Heat and Mass Transfer by R.C. Sachdev, Willey Eastern Ltd.
3. Heat Transfer – A Practical approach by – Ynus -A – Cengel (Tata McGraw Hill)
4. A Text Book on Heat Transfer by Dr. S. P.Sukhatme, Orient Longman Publi., Hyderabad
5. Heat Transfer by Chapman A.J. McGraw Hill Book Company, New York.
6. Heat and Mass Transfer, S.C. Arrora and S. Domkoundwar, Dhanpat Rai and Sons, Delhi.
7. Fundamentals of Heat and Mass Transfer by C.P. Kothandaraman
8. Heat and Mass Transfer by R.K. Rajput, S. Chand & Company Ltd., New Delhi. 110055
9. Heat and Mass Transfer by Dr. D. S.Kumar, S.K. Kataria & Sons, Delhi.
10. Heat Transfer by P.K. Nag, Tata McGrawhill Publishing Company Ltd., New Delhi.
11. Fundamentals of Heat & Mass Transfer (Fifth Edi.), Frank P. Incropera, David P. Dewitt, Wisley India.

T.E. (MECHANICAL AND AUTOMATION) PART-II
3. MACHINE DESIGN-II

Teaching Scheme:
Lecture: 3 hours per week
Practicals:-2 Hrs/week

Examination scheme:
Theory paper: 100 marks
Term work: - 25 marks
Oral Exam: 25 Marks

Course Objectives:

1. To equip with the fundamental considerations of designing the mechanical components.
2. To formulate the design problems of mechanical elements.
3. To get acquainted with the engineering design of gears and bearings.
4. To enable the utilization of standard codes and data for designing the mechanical elements.

Course Outcomes:

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

1. Formulate simple problems of component design.
2. Solve problems of the gear and bearing design.
3. Apply techniques to provide efficient solutions to design the standard mechanical components against varying loads.
4. Identify the techniques of providing the optimum efficiency to be applied on individual mechanical component.
5. Choose the approved (ISO/ISI) code for selection of proper material for design of mechanical components.

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SECTION-I

UNIT I **(7)**

General principles of designing for manufacture, such as use, manufacture & design functions. Design for casting, forging and machining, design for assembly and designing with plastics. Stress concentration - causes & remedies, fluctuating stresses, S-N. diagram under fatigue load, endurance limit, notch sensitivity, endurance strength- modifying factors, design for finite and infinite life under reversed stresses, cumulative damage in fatigue failure, Soderberg and Goodman diagrams, modified Goodman diagram.

UNIT II **(7)**

Introduction to Tribological consideration in design, Rolling Contact Bearing-Types, static and dynamic load capacities, Stribeck's equation. equivalent bearing load, load-life relationship, bearing life, load factor, Selection of bearing from manufactures catalogue. Ball and Roller bearing, Design for variable load and speed, Bearings with probability of survival other than 90 % . Lubrication and mountings, dismounting and preloading of bearings.

UNIT III **(6)**

Sliding contact bearings -Bearing material and their properties: Sintered bearing materials, bearing types and their constructional details.

Hydro-dynamic lubrication-Basic theory, thick and thin film lubrication, Reynolds's equation, Sommerfield Number, Design considerations in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables, Heat balance in journal bearings, Temperature rise, Introduction to hydro static bearings.

SECTION-II

UNIT IV **(6)**

Design considerations of gears, material selection, types of gear failure. **Spur Gears-** Gear tooth loads, No. of teeth, face width, strength of gear teeth, Determination of static beam strength (Lewis equation). Barth equation, Determination of wear strength (Buckingham's equation), Estimation of module based on beam strength and wear strength.

UNIT V **(6)**

Helical Gears-Formative number of teeth in helical gears, force analysis, Determination of beam strength and wear strength of helical gears, effective load and design of helical gear, Herringbone gears.

UNIT VI **(8)**

Bevel Gear- Straight tooth bevel gear terminology and geometrical relations. Guideline for selection of dimensions and minimum number of teeth, Force analysis, Mounting of bevel gear and bearing reactions, Beam and wear strength, Dynamic tooth load, Design of straight tooth bevel gears based on beam and wear strength, Introduction to design of spiral bevel and hypoid gears.

Worm Gears-Terminology and geometrical relations. Standard dimensions and recommendation of worm gearing, Force analysis, Friction, Efficiency of worm gear drive, Design of worm drive as per IS 7443-1974 based on beam strength and wear strength rating, Thermal consideration in worm drive, Worm and worm wheel material.

TERM WORK:

A) Minimum two design projects

A detail design report and A 2 Size sheet containing working drawing of details and assembly of project based on any relevant mechanical system consisting of

i) Spur gear/ Helical gear.

ii) Bevel gear / Worm and worm wheel.

B) Minimum four assignments based on the above syllabus.

C) Industrial visit based on above syllabus.

TEXT BOOKS :

1. Design of Machine Elements by V.B.Bhandari., Tata McGraw Hill Publi.
2. Machine Design, An Integrated Approach By R.L Norton, Pearson Education Publication.

3. Design of Machine Element by J.F. Shigley, McGraw Hill Publication.
4. Design of Machine Element by M.F.Spotts, Pearson Education Publication
5. PSG Design data Book
6. Mechanical Analysis & Design by H.Burr & Cheatam, Prentice Hall Publication
7. Fundamentals of Machine Component Design by J Marshek,Willey Eastern Ltd

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T.E (Mechanical and Automation) Part-I
4. MANUFACTURING AUTOMATION

Teaching Scheme:
Lecture: 3 hours per week
Practicals:-2 Hrs/week

Examination scheme:
Theory paper: 100 marks
Term work: - 25 marks

Course Objective:

1. To introduce the concepts of advance automation functions and levels of automation.
2. To introduce the aspects of assembly automation including transfer lines.
3. To introduce the importance of robots and robotic work cells in industrial automation.
4. To introduce basic components of a robots and robotic work cells.
5. To introduce the importance and procedure of robot programming concept.
6. To introduce the application of robot programming for simple industrial applications.

Course Outcome:

After completing the study the students will be able to

1. Understand and discuss the concepts of advance automation functions
2. Understand the process of assembly automation including transfer lines .
3. Understand the robots and their application areas in industrial automation.
4. Understand robot anatomy and basic components in a robotic work cell including actuators and sensor systems .
5. Understand the robot programming concept.

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SECTION – I

UNIT 1 **(3)**

Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

UNIT II **(5)**

Material Handling Systems: Overview of Material Handling Systems-Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

UNIT III **(5)**

Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS,FMS and its Planning and Implementation, Flow lines and Transfer Mechanisms, product design for automatic assembly.

SECTION-II

UNIT IV **(6)**

Control Technologies in Automation: Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Sensors, Actuators and other Control System Components.

UNIT V **(7)**

(A) **Evaluation of Automatic Production:** product manufacturability, orientation devices- active and passive devices, parts orientation and escapement.

(B) **Pneumatic and Hydraulic Components and Circuits:** Boolean algebra, pneumatic sensors and amplifiers, jet destruction devices, logic devices, Schmitt triggering devices.

UNIT VI **(6)**

Modelling and Simulation for Manufacturing Plant: Automation: Introduction / need for system Modelling, Building Mathematical Model of a manufacturing Plant, Modern Tools-Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control.

TERM WORK

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1 Minimum Two assignments on contents of each chapter (12 assignments).
2 One Industrial visit for observing Industrial Automation.

REFERENCE BOOKS:

1. Handbook of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons.
2. Automation, Production Systems and Computer Integrated Manufacturing, M.P.Groover, Pearson Education.
3. Industrial Automation: W.P. David, John Wiley and Sons.
4. Computer Based Industrial Control, Krishna Kant, EEE-PHI
5. An Introduction to Automated Process Planning Systems, Tiess Chiu Chang & Richard A. Wysk
6. Manufacturing assembly Handbook:- Bruno Lotter
7. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
8. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI.
9. Automatic process control system and Hardware - R.P. Hunter, Prentice Hall.

T.E. (MECHANICAL AND AUTOMATION) Part-II
5. APPLIED HYDRAULICS AND PNEUMATICS

Teaching Scheme:
Lecturers: 3 Hrs/ Week
Practicals: 2 Hrs/ Week

Examination Scheme:
Theory: 100 Marks
Term work: 25 Marks

Course Objectives:-

1) Discuss fundamentals and applications of fluid power systems.
2) State ISO/JIC symbols used for hydraulic and pneumatic system.
3) Demonstrate hydraulic and pneumatic system elements.
4) Discuss hydraulic and pneumatic circuits with its applications.
5) Describe troubles and safety regulation in hydraulics and pneumatics.

Course Outcomes :-

1) Explain fundamentals and applications of fluid power systems.
2) Draw and use different ISO/JIC conventions used in hydraulic and pneumatic systems.
3) Explain construction and working of hydraulic and pneumatic system elements.
4) Design hydraulic and pneumatic circuit for different applications.
5) Use safety regulations and troubleshooting to solve problems found in hydraulic and pneumatic systems.

SECTION-I

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UNIT-I:
Introduction to Fluid Power: (4)
Application of hydraulics and pneumatics in various fields of engineering, standard symbolic representation (ISO/JIC symbols) of different components, Advantages and disadvantages of hydraulic systems, Future of fluid power industry in India, Types and selection of fluids.

UNIT-II:
Hydraulic System Elements (12)
Pumps- Types of pumps and its selection. Various control valves used in Hydraulics System, Requirements of Pressure control, Different types of actuators, seals, fluid power plumbing requirements, hoses and connections, type and purpose of strainer, filter, accumulator and Intensifiers, reservoir, heat exchangers.

UNIT-III:
Hydraulic Circuits: (6)
Pressure regulating circuit, speed control circuit, accumulator circuit, booster and intensifier circuit, motion synchronizing circuit, servo circuit. Hydraulic servo- system for rotary and linear motion. Maintenance and safety of hydraulic system. Trouble shooting and remedial measures in Hydraulic.

SECTION-II

UNIT-IV (8)
a) Introduction to Pneumatics:
Application of pneumatics in engineering, basic requirements of pneumatic system,

comparison with hydraulic system

a) Elements of Pneumatic System:

Air compressor - Types, selection criteria, capacity control, piping layout, fittings and connectors, pneumatic control, Direction control valves, two way, three way, four way check valves, flow control valves, pressure control valves, speed regulators. Quick exhaust valves, solenoid, pilot operators, Cylinders- Types and their mountings, Air motors- Types, comparison with hydraulic and electric motor. Filters- Types of filters, regulators, lubricators (FRL unit), mufflers, dryers.

UNIT-V:

Pneumatic circuits- **(4)**

Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion, time delay circuit & their applications. Maintenance and safety of pneumatic system.

UNIT-VI: **(6)**

a) Introduction to Pneumatic servo system, Hydro-Pneumatics, Electro-Pneumatics Applications, Advantages and Disadvantages of above systems. Programmable logic controllers-introduction, architecture hardware. Components-basics of PLC programming – Programming timers counters-master and jump controls- data manipulations and instructions.
b) Introduction to fluidics – study of simple logic gates, turbulence, amplifiers. Pneumatic sensors, applications.

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TERM WORK

1) Study of ISO/JIC Symbols for hydraulic and pneumatics systems.
2) Study of different types of valves used in hydraulic and pneumatic system.
3) Study of accumulators/actuators/intensifiers/hydraulic and pneumatic power brakes.
4) Design of hydraulic / pneumatic system and related components for any industrial application
5) At least five circuit preparations on hydraulic trainer kit.
6) At least five circuit preparations on pneumatic trainer kit.
7) At least two Circuit preparations using Fluid simulation software.
8) Industrial visits are recommended for applications of pneumatic and hydraulic system and their reports.

RECOMMENDED BOOKS:

1. D. A. Pease, Basic fluid Power-PHL.
2. Joji P., Pneumatic Controls, Wiley India Pvt. Ltd.
3. J. J. Pipenger- Industrial hydraulic- McGraw Hill.
4. H. L. Stewart- Hydraulic and Pneumatic- Industrial press.
5. Goodwin- power Hydraulics.
6. B. Lal- Oil Hydraulics- Intl. Literature.
7. Yeaple- Fluid power design Handbook.
8. S. R. Mujumdar- Oil hydraulics Systems- Principles and Maintenance.
9. S. R. Mujumdar- Pneumatic Systems- Principles and Maintenance.
10. R. S. Warring- Pneumatic Handbook.
11 Jagadeesha T, Thammaiah Gowda, Fluid Power Generation, Transmission and

Control, Wiley Publication.
12. H. S. Stewart- Practical Guide to Fluid Power.
13. Fluid Power with Application 6th edition, A Esposito

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T.E (Mechanical and Automation) Part-I
6. FINITE ELEMENT ANALYSIS

Teaching Scheme:
Lecture: 3 hours per week
Practicals:-2 Hrs/week

Examination scheme:
Theory paper: 100 marks
Term work: - 25 marks

Course Objective:

1. Describe necessity of FEM and its procedure.
2. Formulation of element characteristic.
3. Enable the students to formulate the structural analysis using FEM.
4. Enable the students to perform engineering simulations using Finite Element Method software packages.

Course Outcome:

1. Understand the concept of finite element method for solving machine design problems.
2. Formulate and solve manually problems in 1-D structural systems involving bars, trusses, beams and frames.
3. Develop 2-D FE formulations involving triangular, quadrilateral elements and higher order elements.
4. Apply the knowledge of FEM for stress analysis, model analysis, heat transfer analysis and flow analysis.

SECTION – I

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UNIT I
(7)

Basic concepts of FEM-Historical back ground-Relevance and scope for FEM-Need for approximation-Weighted residual, Ritz and Galerkin method-Variational formulation.

UNIT II
(6)

General procedure of FEM- Discritization, Interpolation, shape function, formulation of element characteristic matrices, assembly and solution.

UNIT III
(7)

Formulation of element characteristic matrices and vectors for elasticity problems- One dimensional elasticity, Two-dimensional elasticity, Three-dimensional elasticity, Axisymmetric elasticity. Formulation of element characteristic matrices and vectors for Field problems. Thermal problems-one dimensional, Two dimensional and three dimensional heat transfer-Axisymmetric heat transfer-Torsion problems.

SECTION-II

UNIT IV
(6)

Higher order and Isoparametric formulations-Natural coordinate system and Numerical Integration- Higher order one dimensional, two dimensional and three dimensional elements- Structural beam, plate and shell elements- Isoparametric elements-Isoparametric formulation.

UNIT V (7)

Result Interpretation & Verification of FEA results-Sources of error, Discritization error, mesh refinement, model validity and accuracy. Sub structuring technique, Thumb rules for viewing the results, Nodal, Elemental, Average, Un average stresses, Post processing techniques.

UNIT VI (6)

Dynamic Analysis- Bending of plates; Eigen value and time dependent problems.

TERM WORK

Minimum 10 experiments to be performed using any analysis software.

1. Rod element subjected to tension & comparison with analytical answer
2. Cantilever Beam element exercise and comparison with analytical answer
3. Plane Stress analysis of Bracket/ Plate
4. Static structural analysis of Allen Wrench
5. Thermal analysis of 1-D problem like composite wall
6. Steady state thermal analysis cylinder
7. Thermal analysis of turbine blade
8. Linear buckling analysis of column.
9. Dynamic analysis of dropping an aluminium container on a steel table top.
10. Harmonic analysis of spring mass system.
11. Contact analysis of pinhole with pin
12. Non linear analysis of plate subjected cyclic load.
13. Transient thermal analysis of a casting process.

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REFERENCE BOOKS:

1. O. C. Zienkewitz and Taylor, The Finite Element Method, Vol. I and II, McGraw Hill, 2013
2. J. N. Reddy, An Introduction to Finite Element Method, McGraw Hill, 2013.
3. S. S. Rao, The Finite Element Method in Engineering, Pergamon press, 2013
4. M. J. Fagan., The Finite Element Analysis: Theory And Practice, Longman Scintific and Technology, 1992.
5. R. D. Cook, Davis S. Malkus, Michael E. Plesha and Robert J. Witt, Concepts and Applications of Finite Element Analysis, 4th Edition, Wiley Student Edition, Wiley. 2015.
6. Huebner, K. H., and E. A. Thornton. The Finite Element Method for Engineers,2nd ed. New York: John Wiley and Sons, 1982
7. Baker, A. J. Finite Element Computational Fluid Mechanics. New York: McGraw-Hill, 1983.

T.E (Mechanical and Automation) Part-II
7. PROGRAMMING AND SIMULATION LAB-II

Teaching Scheme:
Practicals:-2 Hrs/week

Examination Scheme:
Term work: - 25 marks

Course objectives:

1. To give exposure to software tools needed to analyze engineering problems.
2. To expose the students to different applications of simulation and analysis tools.

Course outcomes:

1.To make use of software for simulation and analysis for various applications in the field of manufacturing engineering.

TERMWORK:

(A). SIMULATION

1. Simulations basics, dealing with matrices, Graphing-Functions of one variable and two variables.
2. Use of Simulations to solve simple problems in vibration.
3. Mechanism Simulation using software.

(B). MODELING and ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

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