

Scheme of Teaching and Examination for
6th Semester of 3 Years Diploma in Mechanical Engineering

Duration of Semester : **14 Weeks**
 Student Contact Hours : **36 Hrs (Max.)**
 Total Marks : **800**
 Effective from : 2017 -18 Session

Sl. No.	Name of Subject	Subject Code	Subject	Teaching Scheme			Examination Scheme					
				L	T	P	Hours of Exam	Full Marks of Subject	Final Exam / committee marks	Internal Assessment	Pass Marks Final / Ext. Exam	Pass Marks in Subjects
1.	Industrial Engineering & Management	601	Theory	3	-	-	3	100	80	20	26	40
2.	Design of Machine Elements	MEC 604	Theory	3	-	-	3	100	80	20	26	40
3.	Industrial Fluid Power	MEC 605	Theory	3	-	-	3	100	80	20	26	40
4.	Measurements & Automation	MEC 606	Theory	3	-	-	3	100	80	20	26	40
5.	Elective II	MEC 607/608/609/610	Theory	3	-	-	3	100	80	20	26	40
6.	Industrial Fluid Power Lab	MEC 611	Practical	-	-	2	4	50	40	10	-	20
7.	Measurements & Automation Lab	MEC 612	Practical	-	-	2	4	50	40	10	-	20
8.	Design of Machine Elements Lab	MEC 613	Sessional	-	-	2	-	50	30	20	-	25
9.	Elective II Lab	MEC 614/615/616/617	Sessional	-	-	2	-	50	30	20	-	25
10.	Project Work	603	Sessional	-	-	4	-	50	30	20	-	25
11.	Professional Practices	602	Sessional	-	-	4	-	50	30	20	-	25
Total Hours of Teaching per week :				15		16						

Elective (Mechatronics – MEC 607/ Ref. & Air Conditioning –MEC 608/ Machine Tool Design.-MEC 609/ Alt. Source of Energy- MEC 610)

Total Marks : Theory : Practical : Sessional :
 L : Lecture, T : Tutorial P : Practical

- Note:
1. Period of Class hours should be of 1 hrs duration as per AICTE norms.
 2. Remaining Hrs every week has been marked for students for Library and Student Centered Activities.
 3. Drawing / Graphics / Practical / Sessional examinations will be held at parent institution.
 4. Board will depute examiner for Practical examination.
 5. Regarding sessional examination the parent institution will form a three member committee and this committee will examine the sessional records and hold viva of the examinee for 60 % marks allotted to the subject. Marks for remaining 40 % will be provided by the Faculty concerned on the basis of evaluation of each job / work throughout the semester.

Subject : Industrial Engineering & Management (Common Paper)

Subject Code : 601

Full Marks : 80+20= 100

L	T	P
3	0	0

Rationale:

After completion of three years of technical training, Polytechnic students are expected to enter in to the World of Work. The business environment is altogether different and new to the students. A proper introduction and understanding of Business Processes is therefore essential for all Polytechnic students. Management is a subject which deals with basics of Management science required to understand the processes the in Industrial & Commercial environment. This will enable the students of Polytechnic to become familiar and to understand various Business Organizational structures, their functioning and the Role these technicians will have to play in these setups with responsibilities.

Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, equipment and energy. Polytechnic students must be able to analyze the use and cost of the resources of the organization in order to achieve the objective, i.e. to increase productivity, profits etc. and carryout the policies efficiently and effectively.

Objective:

The students will able to:

1. Familiarize environment in the world of work.
2. Explain the importance of management process in Business.
3. Identify various components of management.
4. Describe Role & Responsibilities of a Technician in an Organizational Structure.
5. Apply various rules and regulations concerned with Business & Social responsibilities of the technician.

Detailed Syllabus

1. **Productivity :** **02 Hrs**
Production and productivity, importance of productivity, factors affecting productivity, means of increasing productivity.
2. **Plant Layout and Material Handling :** **02 Hrs**
Definition of plant layout, objectives of good plant layout, principles of plant layout, types of plant layout, flow pattern, steps in planning the layout for a new enterprise, definition of material handling, functions and principles of material handling, material handling devices.
3. **Work Study :** **04 Hrs**
Definition, concept and need for work study, objectives of method study and work measurement, basic procedure/steps in method study, recording technique, critical examination, principles of motion economy, stop watch procedure for collecting time study data, including performance rating and allowances, work sampling.
4. **Production Planning and Control (PPC) :** **04 Hrs**
Definition and objectives of PPC, functions of PPC, routing, scheduling, loading, dispatching, production control definition and objectives, principle of sound production control system.
5. **Material, Purchase and Stores Management :** **04 Hrs**
Definition, functions & objectives of materials management, inventory control, economic order quantity (EOQ), ABC analysis. Objectives of purchasing department, buying techniques, purchasing procedure (steps involved in one complete purchasing cycle); functions of stores department, location and layout of stores, receipt and issue of materials.
6. **Quality Control and TQM :** **04 Hrs**
Meaning of quality and quality control, dimensions of quality, quality circle, concept and definition of TQM, elements of TQM, Kaizen, 5 'S' and six sigma.
7. **Management :** **04 Hrs**
Various definition, concept of management, levels of management, administration and management, scientific management by F. W. Taylor. Principles of management (14 principles of Henry Fayol). Functions of management - planning, organizing, coordinating, directing, controlling, decision making.

8. **Organizational Management :**

04 Hrs

Organization - definition, steps in forming organization. Types of organization. Types of organization - line, line and staff, functions, project type. Departmentation- Organized and decentralized, authority and responsibility, span of control (management). Forms of ownership - proprietorship, partnership, joint stock company, co-operative society, govt. sector.

9. **Human Resource Management :**

06 Hrs

Personnel Management – Introduction, definition, function. Staffing – Introduction to HR, Introduction to HR Planning, Recruitment procedure. Personnel- Training & Development – Types of training, Induction, Skill enhancement. Leadership & Motivation – Leadership- Styles & types, Motivation- Definition, Intrinsic, & Extrinsic, Maslow's theory of Motivation and its significance. Safety Management – Causes of accident, Safety Procedures. Introduction, Objectives & feature of Industrial Legislation such as – Factory act, ESI act, Workman compensation act, Industrial dispute act and salary & wages.

10. **Financial Management :**

04 Hrs

Financial Management- Objectives & Functions. Capital Generation & Management- Types of capitals, Sources of finance. Budgets and accounts- Types of budgets, Production budget (including variance report), Labour budget, Introduction to Profit & Loss Accounts (Only concept), Balance sheet etc.

11. **Entrepreneurship :**

04 Hrs

Concept and definition of entrepreneur and entrepreneurship, factors influencing entrepreneurship, entrepreneurial characteristics, need for promotion of entrepreneurship and small scale industries, steps in setting up a small scale industrial enterprise.

References Books :

1. Industrial Engineering and Management by O. P. Khanna
2. Industrial Engineering and Production Management by M. Mahajan.
Publisher :Dhanpat Rai Publication (P) Ltd. New Delhi
3. Business Administration and Management by Dr. S. C. Saksena
Publisher :Sahitya Bhawan, Agra.

Subject : Design of Machine Elements
Subject Code : MEC604
Full Marks : 80+20=100
Hours : 42

Content-

Chapter	Name of the Topic	Hours
01	Introduction to Design 1.1 Fundamentals: -Types of loads, concepts of stress, Strain, Stress–Strain Diagram for Ductile and Brittle Materials, Types of Stresses such as Tension, Compression, Shear, Bearing pressure Intensity, Crushing, bending and torsion, Principle Stresses (Simple Numerical) 1.2 Fatigue, Creep, S-N curve, Endurance Limit. Factor of Safety and Factors governing selection of factor of Safety. Stress Concentration–Causes & Remedies 1.3 Converting actual load or torque into design load or torque using design factor like velocity factor, factor of safety & service factor. Properties of Engineering materials, Designation of materials as per IS and introduction to International standards & advantages of standardization, use of design data book . 1.4 Theories of Elastic Failures– Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory.	08
02	Design of Shafts, Keys and Couplings 3.1 Types of Shafts, Shaft materials, Standard Sizes, Design of Shafts (Hollow and Solid) using strength and rigidity criteria, ASME code of design for shafts supported between bearings with one or two pulleys in between or one over hung pulley 3.2 Design of Sunk Keys, Effect of Key ways on strength of shaft. 3.3 Design of Couplings– Muff Coupling, Flange Coupling, Bush-pin type flexible coupling.	08

03	Design of simple machine parts 2.1 Cotter Joint, Knuckle Joint, 2.2 Design of Levers:-Hand/Foot Lever & Bell Crank Lever 2.3 Design of C– Clamp, Off-set links, Over hang Crank, Arm of Pulley	06
04	Design of Power Screws and Spur Gear 4.1 Thread Profiles used for power Screws, relative merits and demerits of each, self-locking and over hauling property. Torque required to over come thread friction, efficiency of power screws, types of stresses induced. 4.2 Design of Screw Jack, Toggle Jack. 4.3 Spur gear design considerations. Lewis quation for static beam strength of spur gear teeth.	08
05	Design of springs 5.1 Classification and Applications of Springs, Spring– Terminology, materials and specifications. Stresses in springs, Wahl’s correction factor, Deflection of springs, Energy store din springs. 5.2 Design of Helical springs subjected to uniformly applied loads. 5.3 Leafsprings–constructionandapplication	05
06	Design of Fasteners 6.1 Riveted Joints-Design of riveted joints, efficiency and frictional resistance of riveted joints, 6.2 Welded Joints- Representation of welds, Design of welded joints for static loads, strength of welds at varying load. 6.3 Stresses in Screwed fasteners, bolts of Uniform Strength. Design of Bolts subjected to fatigue loading.	05
07	Ergonomics & Aesthetic consideration in design 7.1 Ergonomics of Design–Man–Machine relationship. Design of Equipment for control, environment &safety. Aesthetic considerations regarding shape, size, color & surface finish.	02
Total		42

Subject : Design of Machine Elements Lab

Subject Code : MEC613

List of Assignments:

1. Assignment on selection of materials for given applications [at least two applications should be covered] using design data book. List the mechanical properties of material selected.
2. Assignment on design of simple machine parts like Cotter Joint, Knuckle Joint, Turn Buckle, (One example on each component) with free hand sketches.
3. Assignment on design of simple machine parts like Bell Crank Lever, off-Set link, Arm of Pulley (One example on each component) with free hands ketches.
4. Assignment on design of Screw Jack, Toggle Jack. (One example on each)
5. Assignment on design of Helical Springs, screwed joints, Welded joints [one each] with free hand sketches.
6. Assignment on various aspects of aesthetic design.

Books:

SN	Author	Title	Publication
01	V.B. Bhandari	Introduction to Machine Design	Tata Mc- Graw Hill
02	R.K. Jain	Machine Design	Khanna Publication
03	Pandya & Shah	Machine design	Dhanpat Rai & Son
04	Joseph Edward Shigley	Mechanical Engineering. Design	Mc-GrawHill
05	PSG Coimbtore	Design Data Book	PSG Coimbtore
06	Dr. P.C. Sharma and Dr. D.K. Aggarwal	Machine Design	S.K. Kataria & Sons
07	Abdulla Shariff	Hand Book of Properties of Engineering Materials & Design Data for Machine Elements	Dhanpat Rai & Sons

Subject : Industrial Fluid Power
Subject Code : MEC605
Hours : 42
Full Marks : 80+20= 100

Contents: Theory

Chapter	Name of the topic	Hours
01	Introduction to hydraulic systems 1.1 General layout of oil hydraulic systems. 1.2 Practical applications of hydraulic systems. 1.3 Merits and limitations of oil hydraulic systems.	03
02	Components of Hydraulic systems 2.1 Pump – Construction, working principle, applications and symbol of Vanepump, gearpump, Gerotorpump, screw pump, piston pump 2.2 Valves—Construction, working and symbols of Pressure control valves, pressure relief valve-direct, pilot operated, pressure reducing, pressure unloading, sequence valves, and counter balancing. Direction control valves—Poppet valve, spool valve, 2/2, 3/2, 4/2, 5/3 Flow control valves—pressure compensated, non-pressure compensated flow control valve. 2.3 Actuators- Construction, working and symbols of Rotary Actuators-Hydraulic motors Linear Actuators—Cylinders-single acting, double acting. 2.4 Accessories –construction, working principle and symbols of Pipes, Hoses, fittings, Oil filters, Seals and gaskets, Accumulators.	11
03	Hydraulic Circuits Draw layout of oil different hydraulic circuit and explain their working 3.1 Meter in, Meter out circuits 3.2 Bleed off circuit 3.3 Sequencing circuit—travel dependent, pressure dependent 3.4 Hydraulic circuits for Milling machine, Shaper machine, Motion synchronization circuit.	07

04	Introduction to pneumatic Systems 4.1 Generallayoutofpneumaticsystem 4.2 Applicationsofpneumaticsystem 4.3 Meritsandlimitationsofpneumatic systems 4.4 Comparison of pneumatic system and hydraulic system	04
05	Components of pneumatic system 5.1 Compressor—Construction, working and symbol of Reciprocating & Rotary compressors. 5.2 Control Valves – Construction, working and symbol of Pressureregulating valves, Flow Control valves, Direction Control Valves. 5.3 Actuators— Construction, working principle of Rotary—Airmotors, Linear-Actuator – Single acting cylinder, double acting cylinder 5.4 Accessories—Pipes, Hoses, Fittings, FR Lunit (Construction, working principle and symbols of all components)	12
06	Pneumatic Circuits Speed control circuits—for double acting cylinder --for bidirectional air motor	05
Total		42

Subject : Industrial Fluid Power Lab
Subject Code : MEC611

List of Practical:

1. Demonstration of meter in and meter out circuit.
2. Demonstration of sequencing circuit.
3. Demonstration of hydraulic circuit for shaper machine.
4. Demonstration of pneumatic circuit for speed control of double acting cylinders.
5. Demonstration of pneumatic circuit for speed control of pneumatic motor.
6. Study of trouble shooting procedures of various hydraulic and pneumatic circuits.
7. Selection of circuit components for simple hydraulic and pneumatic circuits.

Books:

Sl. No.	Author	Title	Publisher
01	Pippenger Hicks	Industrial Hydraulics	Mc Graw Hill International
02	Majumdar S.R	Oil Hydraulic system-Principle and maintenance	TataMc Graw Hill
03	Majumdar S.R	Pneumatics Systems Principles and Maintenance	TataMc Graw Hill
04	Stewart	Hydraulics and Pneumatics	Tara porewala Publication

Subject : Measurement and Automation
Subject Code : MEC606
Full Marks : 80+20=100
Hours : 42

Content-

Chapter	Name of the Topic	Hours
01	<ul style="list-style-type: none"> Significance of measurement, types of measurement, classification of instruments Static terms and characteristics-Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis and Dead zone, Drift, Sensitivity, Threshold and Resolution, Repeatability and Reproducibility, Linearity. Dynamic characteristics-Speed of response, Fidelity and Dynamic errors, Over shoot. Measurement of error- Classification of errors, environmental errors, signal transmission errors, observation errors, operational errors. 	8
02	<p>Displacement measurement:</p> <p>Capacitive transducer, Potentiometer, LVDT, RVDT, Specification, selection & application of displacement transducer.</p> <p>Temperature measurements:</p> <ul style="list-style-type: none"> Non-electrical methods-bimetal and liquid in glass thermometer, pressure thermometer Electrical methods- RTD, platinum resistance thermometer, thermistor, Thermo electric methods- elements of thermo couple, law of intermediate temperature, law of intermediate metals, thermo emf measurement. Quartz thermo meter, Pyrometers-radiation and optical 	08

03	Flow measurements: <ul style="list-style-type: none"> Variable head flow meters- Venturi, Flow nozzle, Orifice plate, Pitot tube. Variable area meter- Rota meter Variable velocity meter- Anemometer Special flow meter-Hot wire anemometer, Electromagnetic flow meter, Ultrasonic flow meter. Note: Simple numerical on above topics.	06
04	Miscellaneous Measurement: <ul style="list-style-type: none"> Force & Shaft power measurement-Tool Dynamometer (Mechanical Type), Eddy Current Dynamometer, Strain Gauge Transmission Dynamometer. Speed measurement- Eddy current generation type tachometer, incremental and absolute type, Mechanical Tachometers, Revolution counter & timer, Slipping Clutch Tachometer, Electrical Tachometers, Stroboscope Strain Measurement-Stress-strain relation, types of strain gauges, strain gauge materials, selection and installation of strain gauges load cells, rosettes. Note: Simple numerical on above topics.	08
05	Automation <ul style="list-style-type: none"> Basic elements of automated system, advanced automation functions, levels of automation. Flexible manufacturing system:-Introduction, Scope and benefits, Types, Major elements of FMS, FMS equipment, FMS application, Introduction to CIM 	04
06	ROBOTICS <ul style="list-style-type: none"> Definition, Robot anatomy, Classification of robots. Sensors -Contact and non-contact ,Touch, tactile, range and Proximity sensor. End effectors , Types of end effectors , Robot programming languages , Robot drives , Applications of robots , One specific application of industrial robot , Material handling , Automated guided vehicle system. 	08
Total		42

Subject : Measurement and Automation Lab

Subject Code : MEC612

List of Practical:

1. Measurement of strain by using a basic strain gauge and hence verify the stress induced.
2. Speed Measurement by using Stroboscope /Magnetic/Inductive Pick Up.
3. Measurement of flow by using rota meter.
4. Displacement measurement by inductive transducer.
5. Temperature control using Thermal Reed switch & Bimetal switch.
6. Temperature calibration by using Thermocouple.
7. Determination of negative temperature co efficient and calibration of at hermistor.
8. Measurement of force & weight by using a load cell.
9. Report writing on visit to industry having robot Application.
10. Report writing on visit to Industry having Automation in manufacturing.

Books:

Sr. No.	Author	Title	Publication
01	A.K. Sawhney	Mechanical Measurements &Instrumentation	Dhanpat Rai & Sons, New Delhi.
02	R.V.Jalgaonkar	Mechanical Measurement & Control	Everest Publishing House, Pune
03	D.S.Kumar	Mechanical Measurements &Control	Metropolitan Publications, New Delhi
04	C.S.Narang	Instrumentation Devices & Systems	TataMc Graw Hill Publications
05	R.K.Jain	Mechanical&Industrial Measurements	Khanna Publications, New Delhi
06	B.C. Nakraand K.K. Chaudhry	Instrumentation, Measurement and Analysis	TataMc Graw Hill Publication
07	P. Jaganathan	Robotics	Lakshmi Publication
08	Michel P. Groover	Industrial Robots-Technology, Programming and Applications	McGraw Hill

Subject : Mechatronics (Elective-II)
Subject Code : MEC607
Full Marks : 80+20=100
Hours : 42

RATIONALE:

The integration of electronics engineering, electrical engineering, computer technology and control engineering with mechanical engineering is increasingly forming a crucial part in the design, manufacture and maintenance of wide range of engineering products and processes. As a consequence there is a need for a diploma engineers to understand systems used in automation

OBJECTIVES:

Students should be able to:

1. Identify various input and output devices in an automated system.
2. Understand and draw ladder diagrams.
3. Write simple programs for PLCs.
4. Interpret and use operations manual of a PLC manufacturer.
5. Use simulation software provided with the PLC.
6. Understand interfacing of input and output device

CONTENTS: Theory

Chapter	Name of the Topic	Hours
1	Introduction to Sensors, Transducers and Actuators Principle, working and applications of-Limit switches, proximity switches like inductive, capacitive and optical (deflecting and through beam type), Thumb wheel switches, magnetic reed switches, Optical encoders-displacement measurement, rotary, incremental, opto-couplers. Actuator – solenoids – on-off applications, latching, triggering Types of relays- solid state Types of motors – DC motors, DC brushless motors, AC Motors, stepper motors, servo motors.	06

2	8085 Microprocessor Architecture, Pin configuration, working of microprocessor, and applications. Instructions and simple programmes. Introduction to ICs used for interfacing such as–Programmable peripheral devices, USART, memory, keyboard, display – LCD,LED,I/O device, ADC, DAC etc 8051 Microcontroller Architecture, Pin configuration, working of microcontroller, Applications. Comparison of microprocessor and microcontroller, advantages and disadvantages	08
3	Programmable Logic Controller (PLC) Introduction, PLC definition, PLC block diagram, Difference between relay panel and PLC, .power supply, input/output modules (analog, digital) concepts of sink/source, set/reset, latch/unlatch, advantages and disadvantages, installation , troubleshooting and maintenance	08
4	Selection of a PLC Programming equipment, Programming formats Ladder diagrams and sequence listing, large process ladder diagram construction, flowcharting as a programming method, Basic PLC functions, Register basics, timer functions, counter functions, Intermediate functions – Arithmetic functions, number comparison and number conversion functions. Data handling functions- SKIP, Master control relay, Jump, Move, Block move, Table to register and register to table move functions. FIFO and LIFO functions, File Arithmetic and Logic function.	12
5	ONS and CLR functions and their applications PLC digital bit functions and applications Sequencer functions and cascading of sequencers PLC matrix functions Discrete and analog operation of PLC, Networking of PLCs. PLC auxiliary commands and functions,	06
6	Online, offline, stop/run modes of operations, uploading/downloading between PLC and PC, Introduction to SCADA and DCS	02
Total		42

Subject : Mechatronics (Elective-II)

Subject Code : MEC614

List of Practical:

Term work shall consist of detailed report on the following experiments:

1. Identification and demonstration of different sensors and actuators.
2. Programme of addition and subtraction using 8085 microprocessor.
3. Programme of BCD operation 8085 microprocessor.
4. Study of PLC and execution of simple commands.
5. Demonstration of the working of various digital to analog and analog to digital converters.
6. Development of ladder diagram, programming using PLC for
 - a) Measurement of speed of a motor
 - b) Motor start and stop by using two different sensors
 - c) Simulation of a pedestrian traffic controller
7. Execution of programmes for
 - a) Simulation of four road junction traffic controller
 - b) Lift / elevator control
 - c) Washing machine control
 - d) Tank level control
8. Trace, interpret and demonstrate working of at least two electro pneumatic systems.
9. Trace, interpret and demonstrate working of at least two electro hydraulic systems.
10. Descriptive study of option available in SCADA & DCS.

Learning Resources:

Books:

Sr. No.	Author	Title	Publication
1	Bolton W.	Mechatronics- Electronic control systems in Mechanical and Electrical Engineering	Pearson Education Ltd.
2	Histand B.H. and	Introduction to Mechatronics and	Tata McGraw Hill
3	John W. Webb and Ronald Reis	Programmable Logic Controllers	Prentice Hall of
4	NIIT	Programmable Logic Control – Principles and Applications	Prentice Hall of
5	Kolk R.A. and Shetty D.	Mechatronics systems design	Vikas Publishing, New Delhi
6	Mahalik N.P.	Mechatronics principles, concepts and applications	Tata McGraw Hill Publishing

Subject : Refrigeration and Air Conditioning (Elective-II)
Subject Code : MEC608
Full Marks : 42
Marks : 80+20=100

CONTENTS:

Sl. No.	Name of the Topic	Hours
1.	Fundamentals of Refrigeration 1.1 a) Introduction to refrigeration. b) Application of refrigeration. c) Elements of refrigeration system d) Refrigeration system d) Unit of refrigeration, C.O.P. and refrigerating effect. e) Concept of heat engine, heat pump and refrigerator. 1.2 Methods of refrigeration:- a) Ice refrigeration b) Refrigeration by expansion of air c) Refrigeration by throttling of gas d) Vapour refrigeration system e) Steam jet refrigeration system f) Non conventional methods of refrigeration like Vortex tube, Pulse tube refrigeration, solar refrigeration.	
.	Refrigeration Cycles 2.1 a) Reversed Carnot Cycle and its representation on PV and TS diagram. b) Air Refrigeration Cycles: - - Bell Coleman air refrigerator, it's representation on PV and TS diagram, types and applications like air craft refrigeration using simple air cooling system.. - (Simple numerical on Reversed Carnot cycle.) 2.2 Vapour Compression Cycle (V.C.C): - - principle, components, Representation on P-H and T-S diagram,	

	<p>effects of wet compression, dry compression, calculation of COP, Effect of superheating, under cooling, suction pressure and discharge pressure, Actual V.C.C., (simple numerical), Methods of improving COP</p> <p>(no description).</p> <ul style="list-style-type: none"> - Introduction to multistage V.C.C., its necessity, advantages. <p>2.3 Vapour Absorption system : -</p> <ul style="list-style-type: none"> - Principle, components and working of aqua- ammonia system (simple & practical) <p>Li-Br Absorption System Electrolux Refrigeration System, Desirable properties of Refrigerant and absorbent used in Vapour Absorption System.</p> <p>Comparison of vapour compression refrigeration system and vapour absorption refrigeration system.</p>	
3.	<p>Refrigerants</p> <p>3.1 a) Classification of refrigerants.</p> <p>b) Desirable properties of refrigerants.</p> <p>3.2 a) Nomenclature of refrigerants.</p> <p>b) Selection of refrigerant for specific applications.</p> <p>3.3 a) Concept of Green House Effect, Ozone depletion, Global warming.</p> <p>b) Eco-friendly refrigerants like R-134a, hydrocarbon refrigerants etc.</p>	
4.	<p>Equipment selection</p> <p>4.1 Components of Vapour Compression Refrigeration System</p> <p>a) Compressors:</p> <ul style="list-style-type: none"> - Classification, Construction and working of open type, hermetic, centrifugal, rotary, screw and scroll compressor and their applications. <p>b) Condensers:</p> <ul style="list-style-type: none"> - Classification, description of air cooled and water cooled condensers, comparison and applications - Evaporative condensers. <p>c) Expansion devices:</p> <ul style="list-style-type: none"> - Types: - Capillary tube, automatic thermostatic expansion valve and their working principle & applications 	

	<p>d) Evaporators and chillers: -</p> <ul style="list-style-type: none"> - Classification of evaporators Construction and working of Bare tube, Plate surface, finned, shell and tube, flooded and dry expansion evaporator - Capacity of evaporator and their applications - Classification of chillers - Construction and working of dry expansion Chillers and flooded chillers and their applications. <p>4.2 Selection criteria for Vapour compression refrigeration system components for the following applications: Water coolers, ice plants, cold storage, domestic refrigerator</p>	
5.	<p>Psychrometry</p> <p>5.1 a) Definition and necessity of air conditioning.</p> <p>b) Properties of Air, Dalton's law of partial pressure</p> <p>5.2 a) Psychrometric chart</p> <p>b) Psychrometric processes, Bypass Factor, ADP, concept of SHF, RSHF, ERSHF, GSHF</p> <p>c) Simple numerical using Psychrometric chart</p> <p>d) Adiabatic mixing of Air streams</p> <p>5.3 Equipments used for Air- conditioning like humidifier, dehumidifier, filter, heating and cooling coils.</p>	
6.	<p>Comfort conditions and cooling load calculations</p> <p>6.1 a) Thermal exchange of body with environment</p> <p>b) Factors affecting human comfort</p> <p>c) Effective temp. and comfort chart</p> <p>6.2 Components of cooling load- sensible heat gain and latent heat gain sources, calculation of cooling load (No numerical)</p>	
7.	<p>7.1 Air- conditioning systems</p> <p>a) Air- conditioning cycle</p> <p>b) Classification of A.C. systems</p> <p>c) Industrial and commercial A.C. systems</p> <p>d) Summer, winter and year round A.C. systems</p> <p>e) Central and unitary A.C. systems</p> <p>7.2 Application areas of A.C. systems</p>	

<p>8.</p>	<p>Duct and Air distribution systems</p> <p>8.1 Duct systems: -</p> <p>a) Closed perimeter system, extended plenum system, radial duct system, duct materials, requirement of duct materials, losses in ducts</p> <p>b) Air distribution outlets: -</p> <p>- Supply outlets, return outlets, grills, diffusers c) Fans and Blowers: -</p> <p>- Types, working of fans and blowers</p> <p>8.2 Insulation: -</p> <p>- Purpose, properties of insulating material, types of insulating materials, methods of applying insulation</p>	
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Subject : Refrigeration and Air Conditioning Lab
Subject Code : MEC615

List of Practical:

1. Trial on water cooler test rig.
2. Trial on ice plant test rig.
3. Visit to cold storage
4. Demonstration of domestic refrigerator in View of construction, operation and Controls used.
5. Demonstration of various controls like L.P./H.P. cut outs, thermostat, overload protector, solenoid valve used in RAC.
6. Identification of components of 'hermetically sealed compressor'.
7. Visit to repair and maintenance workshop in view of use of various tools and charging procedure.
8. Cooling load calculations for cabin, classrooms, laboratory, canteen and dairy plant, milk storage, small freezers (minimum one).
9. Trial on A.C. test rig.
10. Visit to central A.C. plant in view of ducting system, insulation system and Air distribution system (e.g. frozen food industry/ice-cream industry/mushroom plants/textile industries).
11. Trouble shooting of domestic refrigerator/window air- Conditioner.

RECOMMENDED BOOKS:

1. Refrigeration and air conditioning By C.P. Arora, TMH
2. Refrigeration and air conditioning By R.S. Khurmi
3. Refrigeration and air conditioning By P.L. Ballaney, Khanna Pub
1. Refrigeration and air conditioning By S.C. Domkundwar and Arora
4. Refrigeration and air conditioning By M. Prasad, New Age International
5. Refrigeration and air conditioning By R.K. Rajput, S.K. Kataria & Sons
6. Refrigeration and air conditioning By P.N. Ananthanarayanan, Tata McGraw Hill

Subject : Machine Tool Design (Elective -II)

Subject Code : MEC609

Full Marks : 80+20=100

Hours : 42

Content-

Chapter	Name of the Topic	Hours
	<p>1.1 Introduction- (Forces, Velocities and Power Requirements during metal cutting):</p> <p>Turning: Cutting force, Cutting Speed and Feed Rate. Drilling: Cutting forces, Cutting Speed and Feed Rate. Milling: Chip Section, Cutting force, Milling with Cutter Heads.</p> <p>1.2 General Requirements of the Machine Tool:</p> <p>Accuracy of Shape, Dimensional accuracy and surface finish of the components produced. High Productivity. High Technical and Economic Efficiency.</p> <p>1.3 Design Principles:</p> <p>Stiffness and Rigidity of the Separate Constructional Elements and their Combined behaviour Under Load, Static Rigidity, Dynamic Rigidity, Natural frequencies, Damping, Mode of Vibration.</p>	10
02	<p>Standardization of Spindle Speeds and Feed Rates:</p> <p>Layout of Speed Change Gears. Saw Diagrams for Arithmetic Progression, Geometric Progression and Harmonic Progression of spindle speeds for Mechanical Stepped Drives for Machine Tools. Establishment of Gear Ratios, Layout of the Intermediate Reduction Gears, Calculation of Transmission Ratios, Pulley Diameter, Gear Wheel Diameters and Number of Teeth. Ray Diagram. Speed Diagram.</p>	08
03	<p>Electrical, Mechanical and Hydraulic Drives for the Operational Movements:</p> <p>Electric Drive and Control Equipment. Mechanical and Hydraulic Drives. Drives for Producing Rotational Movements, Stepped Drives, Step-less Drives. Drives for Producing Rectilinear Movements. Backlash Eliminator in the Feed Drive Nut.</p>	08
04	<p>Design of Constructional Elements:</p> <p>Machine Tool Structures, Structural Elements Design for Centre Lathe, Drilling Machine, Knee Type Milling Machine, Planning Machine, Boring Machine, and Grinding Machines.</p>	08
05	<p>5.1 Design of Slide ways:</p> <p>Design of slide ways for Tables, Saddles and Cross-slides. Antifriction Bearings for slide ways. Hydrostatically Lubricated slide ways.</p> <p>5.2 Design of Secondary Drives for Machine Tools:</p> <p>Design of Cutting Drives, Feed Drives and Setting Drives.</p>	08

Subject : Machine Tool Design Lab (Elective -II)

Subject Code : MEC616

List of Practical

1. Assignment on Tool geometry of an SPIT (Single point turning tool)
2. Assignment on spur gear cutting operation on milling machine.
3. Assignment on study of chips and determination of chip reduction co-efficient in mild steel by HSS toll with different depth of cut.
4. Assignment on measurement of cutting forces (P_x , P_y and P_z) in straight turning.
5. Assignment on electrical drives and control equipments for operational movement.
6. Assignment on anti-fixation bearing used in slide-ways.
7. Assignment on backlash elimination in feed- Drives Nut.

Books:

SN	Author	Title	Publication
01	N. K. Mehta	Machine Tool Design	Tata Mc-GrawHill
02	Sen and Bhattacharya	Machine Tool Design	CBS Publication
03	S. K. Basu	Machine Tool Design	Oxford and IBH
04	Acherkan	Machine Tool Design	Mir Publishing
05	F. Koenigsberger	Design Principles of Metal-Cutting Machine Tools	-----

Subject : Alt. Source Energy
Subject Code : MEC610
Full Marks : 42
Marks : 80+20=100

Contents: Theory:

Chapter	Name of the Topic	Hours
01	Introduction to Energy Sources 1.1 Introduction. 1.2 Major sources of energy: Renewable and Non-renewable. 1.3 Primary and secondary energy sources. 1.4 Energy Scenario: <ul style="list-style-type: none"> • Prospects of alternate energy sources. • Need of Alternate energy sources. 	04
02	Solar Energy 2.1 Principle of conversion of solar energy into heat and electricity 2.2 Solar Radiation: Solar Radiations at earth's surface <ul style="list-style-type: none"> • Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle 2.3 Applications of Solar energy: - <ul style="list-style-type: none"> • Construction and working of typical flat plate collector and solar concentrating collectors and their applications, • advantages and limitations • Space heating and cooling. • Photovoltaic electric conversion. • Solar distillation, Solar cooking and furnace. • Solar pumping and Green House. • Agriculture-Solar drying for foods • (no derivations and numerical) 	10

03	Wind Energy 3.1 Basic Principle of wind energy conversion. 3.2 Power in wind, Available wind power formulation, Power coefficient, Maximum power 3.3 Main considerations in selecting a site for wind mills. <ul style="list-style-type: none"> Advantages and limitations of wind energy conversion. 3.4 Classification of wind mills <ul style="list-style-type: none"> Working of horizontal and vertical axis wind mills, their comparison Main applications of wind energy for power generation and pumping. 	06
04	Energy from Biomass 4.1 Common species recommended for biomass. <ul style="list-style-type: none"> Methods for obtaining energy from biomass 4.2 Thermal classification of biomass <ul style="list-style-type: none"> Gasifier, Fixed bed and fluidized Application of gasifier 4.3 Biodiesel properties, production and application 4.4 Agriculture waste as a biomass <ul style="list-style-type: none"> Biomass digester Comparison of Biomass with conventional fuels 	06
05	Energy Conservation & Management 5.1 Energy scenario in various sectors and Indian economy 5.2 Need and importance of energy conservation and management 5.3 Concept of Payback period, Return on investment (ROI), Life cycle cost, Sankey diagrams, specific energy consumption.	04

06	Energy Conservation Techniques 6.1 Distribution of energy consumption <ul style="list-style-type: none"> • Principles of energy conservation. • Energy audit • Types of audit 6.2 Methods of energy conservation <ul style="list-style-type: none"> • Cogeneration and its application • Combined cycle system 6.3 Concept of energy management 6.4 Study of different energy management techniques like <ul style="list-style-type: none"> • Analysis of input • Reuse and recycling of waste • Energy education • Conservative technique and energy audit 	06
07	Economic approach of Energy Conservation 7.1 Costing of utilities like steam, compressed air, electricity and water. <ul style="list-style-type: none"> • Ways of improving boiler efficiency 7.2 Thermal insulation, Critical thickness of insulation 7.3 Waste heat recovery systems, their applications, criteria for Installing unit. 7.4 An introductory approach of energy conservation in compressed air, refrigeration, air conditioning, pumps and fans.	06
Total		42

Subject : Alt. Source Energy Lab
Subject Code : MEC617

List of Practical-

- 1) To collect information about global and Indian energy market.
- 2) To perform an experiment on solar flat plate collector used for water heating.
- 3) To study and analyze performance of Solar street lighting System.
- 4) To study construction and working of photo voltaic cell.
- 5) To study construction, working and maintenance of solar cooker.
- 6) Visit to plant of solar heating system for hotel/hostel/railway station etc.
- 7) To study construction and working of horizontal axis wind mill or to visit a nearest wind farm.
- 8) To visit a biomass/ biogas plant of municipal waste or elsewhere.
- 9) Perform energy audit for workshop/Office/Home/SSI unit.
- 10) Study of various waste heat recovery devices.

Books:

Author	Title	Publication
Dr B.H.Khan	Non conventional energy Resources	Tata McGraw Hill
G. D. Rai	Non conventional energy sources	Khanna publication
S. P. Sukhatme	Solar energy	Tata McGraw Hill
H. P. Garg	Solar energy	Tata McGraw Hill
Arrora Domkundwar	Power plant engineering	Dhanpat Rai & co.
P.H. Henderson	India- The energy sector	University Press
D. A. Ray	Industrial energy conservation	Pergaman Press
W. C. Turner	Energy management handbook	Wiley Press
K. M. Mittal	Non-conventional energy source	--
Krupal Singh Jogi	Energy resource management	Sarup and sons

Subject : Professional Practices (Common Paper)

Subject Code : 602

Rationale:

Most of the diploma holders join industries. Due to globalization and competition in the industrial and service sectors the selection for the job is based on campus interviews or competitive tests.

While selecting candidates a normal practice adopted is to see general confidence, ability to communicate and attitude, in addition to basic technological concepts.

The purpose of introducing professional practices is to provide opportunity to students to undergo activities which will enable them to develop confidence. Industrial visits, expert lectures, seminars on technical topics and group discussion are planned in a semester so that there will be increased participation of students in learning process.

Activities to be undertaken:

Students are expected to undertake these activities:

1. Acquire information from different sources (Print and electronic) on the topics of specialization and related to the subjects of II nd and final year. The class is to be divided in groups of not more than five to six students in a group and all groups are to be allotted topic of their choice. The topic should not be repeated to other group for originality of work to be performed by the group. This activity will develop interdependence and leadership among the students.
2. Prepare notes for given topic at point no 1. The notes will be in form of a project report, having all the sections of report. The report should not be of 30 – 50 pages.
3. Prepare presentation and Present the learning and finding on given topic in a seminar. The presentation should be prepared in Power Point module having more than 25 slides. All students should be asked to deal with suitable parts decided by the group itself.
4. Interact with peers to share thoughts. After the final presentation the students should be encouraged to interact with the faculty members, students' fellows and other experts for suggestions and advanced and structured learning.
5. Undertake industrial visit of their area and choice. Prepare a report on industrial visit. Expert lectures on the topic selected may be invited for the students and these expert lectures also the students should be asked to prepare a report and present the same in seminar or have a group discussion before the expert and faculty members.
6. Develop entrepreneurial traits. Students group may be asked to have a field survey and product assessment and analysis for a product of their choice. Prepare a report for all the inputs of their requirement and submit it for evaluation.
7. To prepare for start ups. Expert lectures for exploring this option may be arranged as this is also a viable option and much talked about option for self employment and avail the encouragement by the government.

Based on the above rationales students will advised to develop traits under guidance of dedicated faculty members / mentors.