
 MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES																
COURSE NAME : DIPLOMA IN MECHANICAL ENGINEERING																
COURSE CODE : MC																
DURATION OF COURSE : 8 SEMESTERS										WITH EFFECT FROM 2013-14						
SEMESTER : EIGHT										DURATION : 16 WEEKS						
PATTERN : CORRESPONDANCE - SEMESTER										SCHEME : G						
SR. NO	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									SW (17908)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)		
								Max	Min	Max	Min	Max	Min	Max	Min	
1	Management	MAN	21030	06	01	--	1&½	50#*	20	--	--	--	--	--	--	
2	Design of Machine Elements	DME	21038	10	01	26	04	100	40	--	--	25#	10	25@	10	
3	Elective (ANY ONE)															
	Refrigeration & Air Conditioning	RAC	21039	07	01	24	03	100	40	--	--	--	--	50@	20	50
	Renewable Energy Sources & Management	RES	21040	07	01	24	03	100	40	--	--	--	--	50@	20	
4	Project	PRO	21041	--	--	36	--	--	--	--	--	50#	20	50@	20	
TOTAL				23	03	86	--	250	--		--	75	--	125	--	50
TOTAL CONTACT HOURS DURING RESIDENT SESSION: 112 HRS [15 days * 8 hrs per day]																
Total Marks : 500																
@ - Internal Assessment, # - External Assessment, No Theory Examination, \$ - Common to all branches, Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work																
NOTE:																
1. HOURS MARKED BY * FOR INTERNAL PRACTICAL EXAMINATION TO BE CONDUCTED AT RESSIDENT SESSION.																
2. ONE TEST OF 25 MARKS TO BE CONDUCTED AT RESIDENT SESSION AND MARKS TO BE SUBMITTED TO GPDL PUNE.																
3. 240 HOURS FOR SELF STUDY AT HOME.																
4. ALL PRACTICALS/ORAL EXAMS [EXTERNAL ASSESSMENT INDICATED BY #] TO BE CONDUCTED AT EXAM CENTRE.																
5. ORAL EXAMINATION [INTERNAL ASSESSMENT @] TO BE CONDUCTED AT EXAM CENTRE.																
6. INTERNAL ASSESSMENT @ OF TERM WORK WILL BE DONE AT RESIDENT SESSION.																

 MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES																	
COURSE NAME : DIPLOMA IN MECHANICAL ENGINEERING																	
COURSE CODE : MG																	
DURATION OF COURSE : 8 SEMESTERS										WITH EFFECT FROM 2013-14							
SEMESTER : EIGHT										DURATION : 16 WEEKS							
PATTERN : PART TIME - SEMESTER										SCHEME : G							
SR. NO	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME										SW (17908)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
								Max	Min	Max	Min	Max	Min	Max	Min		
1	Management	MAN	21030	03	--	--	1&½	50#*	20	--	--	--	--	--	--	50	
2	Design of Machine Elements	DME	21038	04	--	02	04	100	40	--	--	25#	10	25@	10		
3	Elective (ANY ONE)																
	Refrigeration & Air Conditioning	RAC	21039	03	--	02	03	100	40	--	--	--	--	25@	10		
	Renewable Energy Sources & Management	RES	21040	03	--	02	03	100	40	--	--	--	--	25@	10		
4	Project	PRO	21041	--	--	04	--	--	--	--	--	50#	20	50@	20		
TOTAL				10	--	08	--	250	--	--	--	75	--	125	--		50
Student Contact Hours Per Week: 18 Hrs. THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH. Total Marks : 500 @ - Internal Assessment, # - External Assessment, No Theory Examination, \$ - Common to all branches Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work ➤ Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subjects is to be converted out of 50 marks as sessional work (SW). ➤ Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms. ➤ Code number for TH, PR, OR, TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.																	

Course Name : All Branches of Diploma in Engineering & Technology

Course Code : CI/CC/EG/EC/CL/GC/MG/MC/IL/XC

Semester : Eight

Subject Title : Management

Subject Code : 21030

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	--	1&½	50#*	--	--	--	50

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Management concepts are universal and it is a multidisciplinary subject. They are equally applicable to different types industries like Manufacturing, Service and Trade as well as different kind of business activities like industry, army, school, hospital, retail shops etc. Also, at the end of diploma course polytechnic students are expected to enter in to the Industrial Environment. This environment is altogether different and new to the students. A proper introduction and understanding of management fundamentals is therefore essential for all these students.

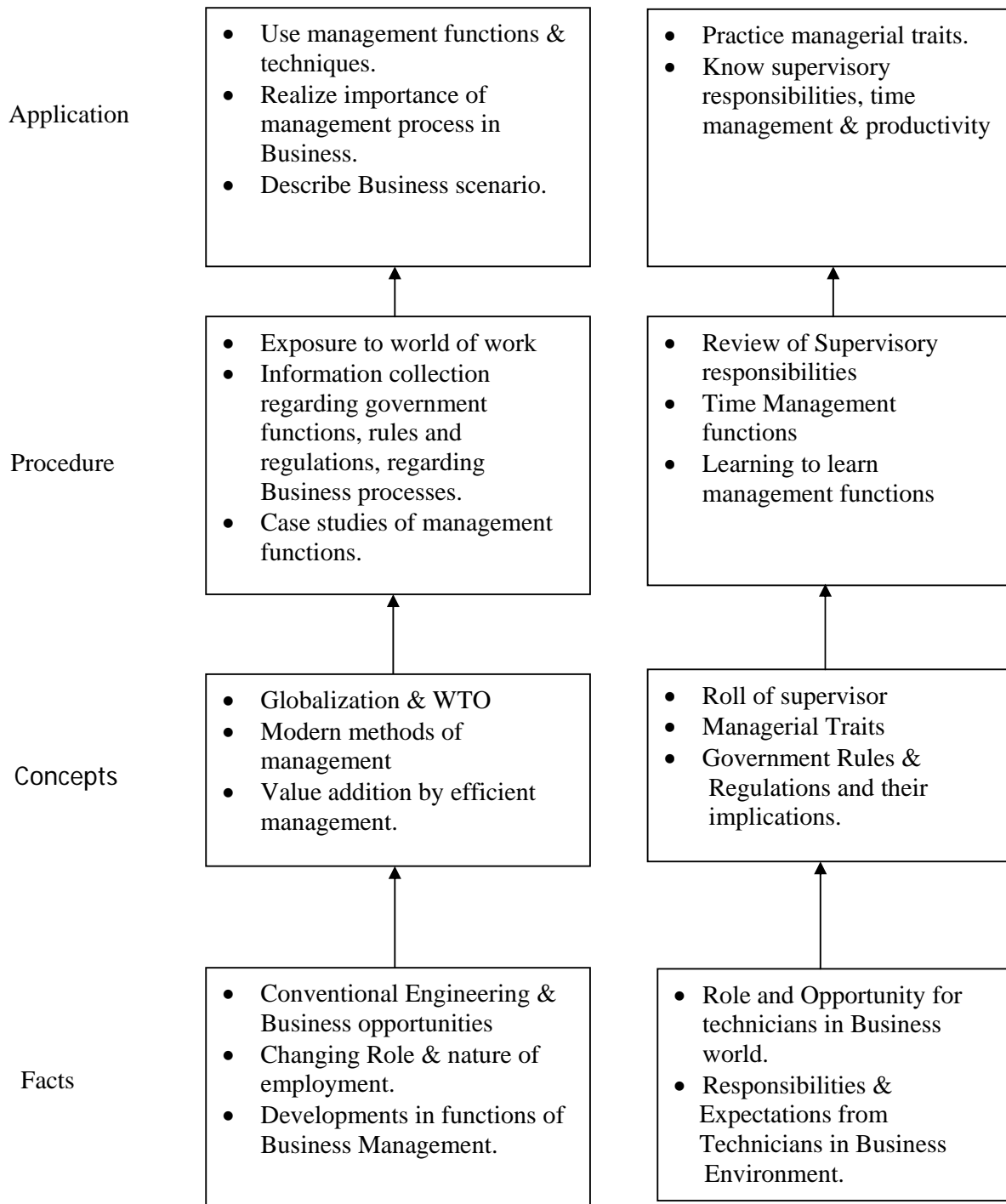
Contents of the this subject will enable the students to address various issues related to human resource, finance, materials, legislations etc. by use of basic principles of management. This will ensure that students will play their role effectively to enhance the quality of business output in total.

Objective:

The students will able to:

1. Get familiarized with environment related to business processes.
2. Know the management aspects of the organisations.
3. Understand Role & Responsibilities of a Diploma engineer.
4. Understand importance of quality improvement techniques.
5. Appreciate need and importance of safety in industries.
6. Understand process of Industrial finance and its management.
7. Know the latest trends in industrial management.

Learning Structure:



Contents: Theory

Topic and contents	Hours	Marks
<p>Topic 1: Overview of Business</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State various business types and sectors ➤ Describe importance of globalisation <p>1.1. Types of Business</p> <ul style="list-style-type: none"> • Service • Manufacturing • Trade <p>1.2. Industrial sectors Introduction to</p> <ul style="list-style-type: none"> • Engineering industry • Process industry • Textile industry • Chemical industry • Agro industry • IT industry • Banking, Insurance, Retail, Hospitality, Health Care <p>1.3 Globalization</p> <ul style="list-style-type: none"> • Introduction • Advantages & disadvantages with respect to India 	02	04
<p>Topic 2: Management Process</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State various management principles ➤ Describe different management functions <p>2.1 What is Management?</p> <ul style="list-style-type: none"> • Evolution • Various definitions of management • Concept of management • Levels of management • Administration & management • Scientific management by F.W.Taylor <p>2.2 Principles of Management (14 principles of Henry Fayol)</p> <p>2.3 Functions of Management</p> <ul style="list-style-type: none"> • Planning • Organizing • Directing • Controlling • Decision Making 	08	08
<p>Topic 3: Organisational Management</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Compare different forms of organisation , ownership for a specific business ➤ Describe types of departmentation <p>3.1 Organization :</p> <ul style="list-style-type: none"> • Definition 	08	08

<ul style="list-style-type: none"> • Steps in organization <p>3.2 Types of organization</p> <ul style="list-style-type: none"> • Line • Line & staff • Functional • Project <p>3.3 Departmentation</p> <ul style="list-style-type: none"> • By product • By process • By function <p>3.4 Principles of Organisation</p> <ul style="list-style-type: none"> • Authority & Responsibility • Span of Control • Effective Delegation • Balance ,stability and flexibility • Communication <p>3.5 Forms of ownership</p> <ul style="list-style-type: none"> • Proprietorship • Partnership • Joint stock • Co-operative Society • Govt. Sector 		
<p>Topic 4: Industrial Safety and Legislative Acts</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Describe types of accidents & safety measures ➤ State provisions of industrial acts. <p>4.1 Safety Management</p> <ul style="list-style-type: none"> • Causes of accidents • Types of Industrial Accidents • Preventive measures • Safety procedures <p>4.2 Industrial Legislation - Necessity of Acts</p> <p>Important Definitions & Main Provisions of following acts:</p> <ul style="list-style-type: none"> • Indian Factory Act • Workman Compensation Act • Minimum Wages Act 	08	06
<p>Topic 5: Financial Management (No Numerical)</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Explain functions of financial management ➤ State the sources of finance & types of budgets. ➤ Describe concepts of direct & indirect taxes. <p>5.1 Financial Management- Objectives & Functions</p> <p>5.2 Capital Generation & Management</p> <ul style="list-style-type: none"> • Types of Capitals - Fixed & Working • Sources of raising Capital - Features of Short term, Medium Term & Long Term Sources <p>5.3 Budgets and accounts</p> <ul style="list-style-type: none"> • Types of Budgets 	08	08

<ul style="list-style-type: none"> • Fixed & Variable Budget - Concept • Production Budget - Sample format • Labour Budget - Sample format • Profit & Loss Account & Balance Sheet - Meaning, sample format, meaning of different terms involved. <p>5.4 Meaning & Examples of -</p> <ul style="list-style-type: none"> • Excise Tax • Service Tax • Income Tax • Value Added Tax • Custom Duty 		
<p>Topic 6: Materials Management (No Numerical)</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Describe concept of inventory, ABC analysis & EOQ. ➤ Describe purchase functions & procedures ➤ State features of ERP & MRP <p>6.1 Inventory Concept, its classification, functions of inventory</p> <p>6.2 ABC Analysis - Necessity & Steps</p> <p>6.3 Economic Order Quantity Concept, graphical representation, determination of EOQ</p> <p>6.4 Standard steps in Purchasing</p> <p>6.5 Modern Techniques of Material Management</p> <ul style="list-style-type: none"> • Material Resource Planning (MRP) - Functions of MRP, Input to MRP, Benefits of MRP • Enterprise Resource Planning (ERP) - Concept, list of modules, advantages & disadvantages of ERP 	08	08
<p>Topic 7: Quality Management</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State Principles of Quality Management ➤ Describe Modern Technique & Systems of Quality Management <p>7.1 Meaning of Quality</p> <p>Quality Management System – Activities, Benefits</p> <p>Quality Control - Objectives, Functions, Advantages</p> <p>Quality Circle - Concept, Characteristics & Objectives</p> <p>Quality Assurance – Concept, Quality Assurance System</p> <p>7.2 Meaning of Total Quality and TQM</p> <p>Components of TQM – Concept, Elements of TQM, Benefits</p> <p>7.3 Modern Technique & Systems of Quality Management like Kaizen, 5'S, 6 Sigma</p> <p>7.4 ISO 9001:2000 - Benefits, Main clauses.</p>	06	08
Total	48	50

Learning Resources:**Books:**

Sr. No	Author	Name of Book	Publisher
01	Dr. O.P. Khanna	Industrial Engineering & Management	Dhanpat Rai & Sons New Delhi
02	Banga & Sharma	Industrial Engineering & Management	Khanna Publication
03	Dr. S.C. Saksena	Business Administration & Management	Sahitya Bhavan Agra
04	W.H. Newman E. Kirby Warren Andrew R. McGill	The process of Management	Prentice- Hall

E Source:

nptel.iitm.ac.in

<http://iete-elan.ac.in/subjects/amIndustrialMgmt.htm>

Course Name : Diploma in Mechanical Engineering

Course Code : MG / MC

Semester : Eight

Subject Title : Design of machine Elements

Subject Code : 21038

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
04	--	02	04	100	--	25#	25@	150

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

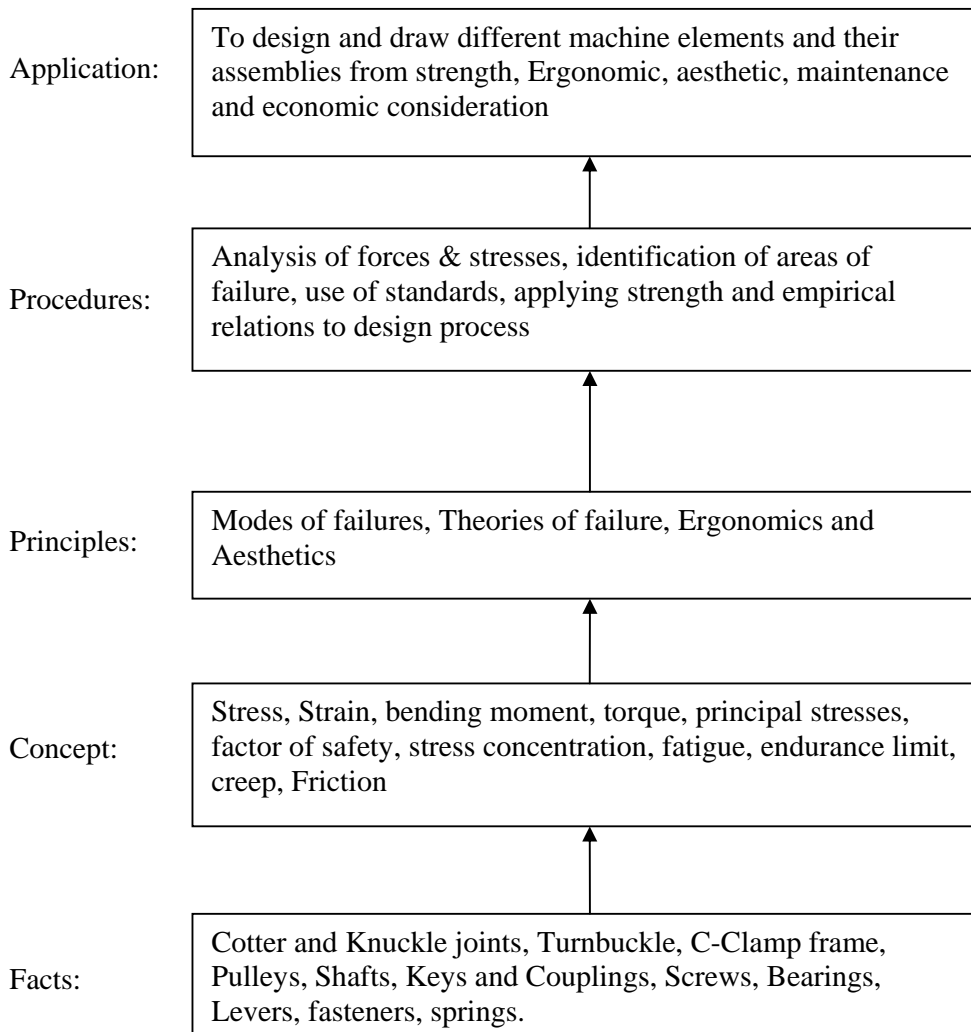
Rationale:

It is an applied technology subject. A diploma holder in mechanical discipline, is expected to design and draw simple machine components used in industries. Fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials and Theory of Machines is essential. Subject aims at developing analytical abilities to give solutions to engineering design problems.

Objectives:

The student will be able to:

1. Analyze the various modes of failure of machine components under different load patterns.
2. Design and prepare part and assembly drawings.
3. Use design data books and different codes of design.
4. Select standard components with their specifications from manufacturer's catalogue.
5. Develop drawings on CAD software.

Learning Structure:

Contents: Theory

Topic and content	Hours	Marks
<p>Topic 1: Introduction to Design</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State the need for the design ➤ List all parameters related to design ➤ Apply basic concepts in design procedure <p>1.1 Basic Design Considerations 04 Marks</p> <ul style="list-style-type: none"> • Design philosophy and Procedures • General Considerations in Design • 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 Numericals) • Concept of Creep, Fatigue, S-N curve, Endurance Limit. <p>1.2 Factors in Design 04 Marks</p> <ul style="list-style-type: none"> • Factor of Safety and Factors affecting its selection • Stress Concentration – Causes & Remedies • Converting actual load or torque into design load/torque using design factors <p>1.3 Properties of Engineering materials 04 Marks</p> <ul style="list-style-type: none"> • Designation of materials as per IS and introduction to International standards, advantages of standardization, use of design data book, use of standards in design and preferred numbers series. <p>1.4 Theories of Elastic Failures 04 Marks</p> <ul style="list-style-type: none"> • Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory. <p>1.5 Modern Design considerations 04 Marks</p> <ul style="list-style-type: none"> • Design for safety, Ecology, societal consideration & Concept of Product Design, System Design & Creativity in Design, Ergonomics and aesthetic considerations in design 	12	20
<p>Topic 2: Design of Joints, Levers & Offset Links</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Design a joint for a given load to be transmitted ➤ Calculate dimensions of lever/link using allowable bending and shear stress <p>2.1 Design of Cotter Joint, Knuckle Joint, Turnbuckle 06 Marks</p> <p>2.2 Design of Levers:- Hand/Foot Lever & Bell Crank Lever, 06 Marks Lever for lever safety valve, Design of Off-set links, C - Clamp, Overhang Crank.</p>	08	12

<p>Topic 3. Design of Shafts, Keys and Couplings</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Design the diameter of a shaft on the basis of equivalent twisting/bending moment and allowable shear stress ➤ Design the section of most commonly used rectangular key on the basis of torque transmitted, allowable shear stress and crushing stress ➤ Design a rigid/flexible coupling for connecting two shaft on the basis of torque and allowable shear stress ➤ Design spur gear by taking into account effective tooth load <p>3.1 Design of shaft 06 Marks</p> <ul style="list-style-type: none"> • Types of Shafts, Shaft materials, Standard Sizes, • Design of shafts (Hollow and Solid) using strength and rigidity criteria, • ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley <p>3.2 Design of key 04 Marks</p> <ul style="list-style-type: none"> • Types of keys • Design of rectangular, parallel sunk keys, • Effect of Keyways on strength of shaft. <p>3.3 Design of Couplings 06 Marks</p> <ul style="list-style-type: none"> • Flanged couplings – unprotected and protected types • Bush-pin type flexible coupling. <p>3.4 Design of spur gear 08 Marks</p> <ul style="list-style-type: none"> • Lewis equation for static beam strength of spur gear teeth • Power transmission capacity of spur gears in bending • Gear tooth failure modes – Scoring, scuffing Pitting & Teeth Breakage 	14	24
<p>Topic 4: Design of Power Screws</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Draw the different thread profiles used in power screws and state their merits and demerits ➤ Bring out the difference between self locking and overhauling ➤ Design the screw jack/toggle jack under a given loading conditions. <p>4.1 Basic concepts</p> <p>Thread Profiles used for power Screws, relative merits and demerits of each, Self locking and overhauling properties Torque required to overcome thread friction, efficiency of power screws, types of stresses induced. 06 Marks</p> <p>4.2 Design of Screw Jack, Toggle Jack (only screw and nut). 06 Marks</p>	10	12
<p>Topic 5: Design of springs</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Classify the springs on the basis of different criteria ➤ Design Helical spring based on given load conditions <p>5.1 Classification and Applications of Springs, Spring - terminology, materials specifications. Stresses in helical tension and compression springs, Wahl's correction factor, Deflection of springs, Energy stored in springs. 04 Marks</p> <p>5.2 Design of Helical tension and compression springs subjected to concentric applied loads like I.C. engine valves, weighing balance, railway buffers</p>	08	12

and governor springs. 5.3 Leaf springs - construction and applications	06 Marks 02 Marks		
Topic 6: Design of Threaded and Welded Joints Specific Objectives: ➤ State the applications of fasteners ➤ Design threaded/welded joints under different load conditions		08	12
6.1 Stresses in Screwed fasteners, bolts of Uniform Strength, Design of Bolted Joints subjected to eccentric loading.	06 Marks		
6.2 Design of parallel and transverse fillet welds, axially loaded symmetrical section, Merits and demerits of screwed and welded joint	06 Marks		
Topic 7: Antifriction Bearings Specific Objectives: ➤ Classify the bearings ➤ Select rolling bearings, for specific applications, using manufacturers catalogue. Classification of Bearings – Sliding contact & rolling contact. Terminology of Ball bearings – life load relationship, basic static load rating and basic dynamic load rating, limiting speed. Selection of ball bearings using manufacturer's catalogue.		04	08
Total		64	100

Skills to be developed in Practicals

Intellectual Skills:

1. Understand the basic philosophy and fundamentals of Machine Design.
2. Apply and use the basic knowledge of earlier subjects like mechanical Engineering materials, strength of materials and theory of machines.
3. Analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
4. Understand the modes of failures of m/c components and decide the design criteria and equations.
5. Understand the concept of standardization and selecting standard components.
6. Understand the methods of computer aided design practices.
7. Use of different design data books and IS codes.

Motor Skills:

1. Draw the components assembly as per the designed dimensions.
2. Modify drawings and design as per requirement.
3. Use the different design software.

List of Practicals:

1. Analyse the various modes of failure of machine components under different load patterns
2. Understand different codes used for design of machine elements.
3. Select the material for given applications using design data book.
4. Design and draw mechanical joints for given load.
5. Design and draw mechanical levers for given load.
6. Design project - 1
Design and prepare the drawing on drawing sheet of transmission system by observing transmission of power through shaft, keys, coupling, pulley and belt drive etc.
7. Design project - 2

Design and prepare the CAD drawing of transmission system by observing transmission of power through Power screw.

8. Design of springs.
9. Design of fasteners.

Learning Resources:

1. Books:

Sr. No.	Title	Author	Edition	Publisher
1	Machine Design	RS Khurmi and Gupta	14th	S. Chand
2	Machine Design	VB Bhandari	3rd	Tata McGraw Hill
3	Machine Design	U C Jindal	2 reprint	Pearson Education India
4	Mechanical Engg. Design	Richard G Budynas,J. Keith Nisbett	9th	Tata McGraw Hill
5	Theory and problems of Machine Design	Hall,Holowenko, Laughlin	Reprint 2005	McGraw Hill
6	Design Data Book	PSG	8th	PSG College of Technology Coimbatore
7	Fundamentals of Machine Components Design	Robert C.Juvinall Kurt M Marshek	3rd	Wiley India Edition

2. IS Codes:

- 1) IS 4218: 1967 ISO Metric Threads
- 2) IS 2693: 1964 Cast Iron Flexible Couplings
- 3) IS 2292: 1963 Taper keys & Keyways
- 4) IS 2293: 1963 Gib Head Keys & Keyways
- 5) IS 2389: 1963 Bolts, Screws, Nuts & Lock Nuts
- 6) IS 4694: 1968 Square threads
- 7) IS 808: 1967 Structural Steel
- 8) SKF Catalogue for Bearings

Course Name : Diploma in Mechanical Engineering

Course code : MG / MC

Semester : Eight

Subject Title : Refrigeration & Air Conditioning (Elective)

Subject Code : 21039

Teaching and Examination Scheme

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

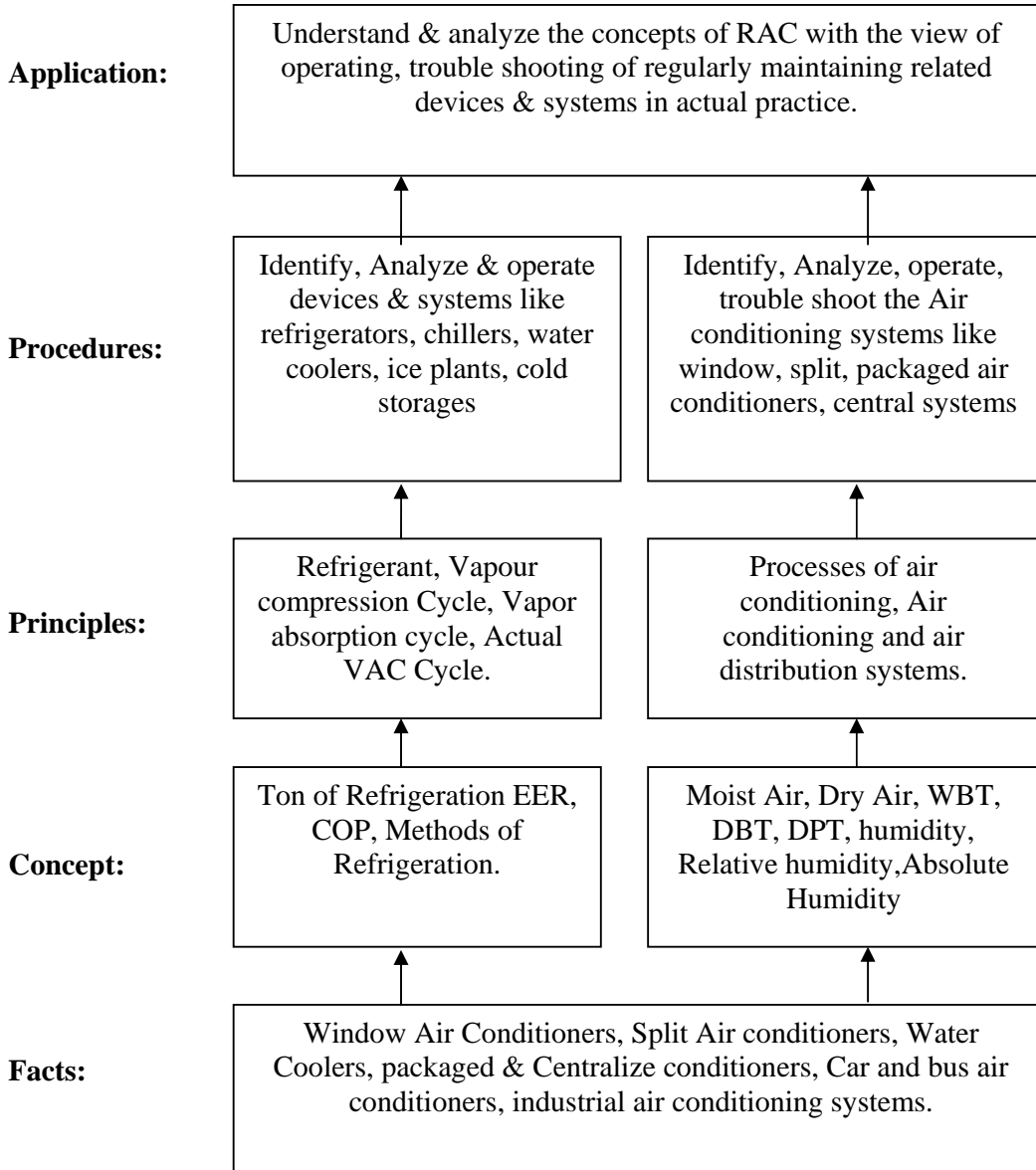
Refrigeration & Air conditioning has a wide application in varied areas of domestic, commercial and industrial applications. With advance in technology & development of new Refrigerants. Refrigeration & Air conditioning finds prominent positions from house hold applications like refrigerators, air conditioners to advance cryogenic systems maintaining subzero temperatures in industrial and Research areas. Air conditioning of building, industries, malls has also emerged as one of the most advanced areas of applications in this field. This field has a unique application potential in every sector. Refrigeration & Air conditioning is one of the most demanded job areas for diploma Engineers with a good scope for the self employment. Considering this, diploma Engineers should study and practically learn this subject in detail. They must know fundamentals, processes, system and applications of Refrigeration & Air conditioning. Practical skills in this areas like maintenances, fault handlings & repairs must also be acquired by diploma Engineers.

General objectives: After learning of this subject students should be able to

- 1) Compare various types Refrigeration cycles
- 2) List various properties of different refrigerants and appreciate applications of Refrigerants with their ill effects on environment.
- 3) Identity various compartment & controls used in Refrigeration & Air Conditioning practice.
- 4) Able to assemble, dismantle the components of refrigeration systems along with trouble shoot the refrigeration systems

- 5) Explain Psychometric properties and calculate various parameters
- 6) Explain various air conditioning systems of their applications.
- 7) Identify & locate different components of air conditioning & distribution systems.

Learning Structure:



Theory:

Topic & Content	Hours	Marks
<p>Topic 1. Introduction to Refrigeration</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Define various terms related to refrigeration ➤ Explain various refrigeration cycles ➤ Explain properties and environmental effects of refrigerants <p>Contents:</p> <p>1.1 Introduction 06 Marks Definition, Necessity of refrigeration, Concept of heat engine, heat pump and Refrigerator, Unit of refrigeration, C.O.P., EER and refrigerating effect, Non conventional methods of refrigeration like Vortex tube, Pulse tube refrigeration, solar refrigeration</p> <p>1.2 Refrigerants: 06 Marks Classification, Desirable Properties, selection & Nomenclature of refrigerants. Concept of Green House Effect, Ozone Depletion, Global warming. Concept of Ozone Depletion Potential (ODP) & Global Warming Potential (GWP) of different Refrigerants. Eco-friendly refrigerants like R-134a, Hydrocarbon refrigerants</p> <p>1.3 Refrigeration Cycles 06 Marks <ul style="list-style-type: none"> ➤ Reversed Carnot Cycle and its representation on PV and TS diagram. <ul style="list-style-type: none"> • Air Refrigeration Cycles - Bell Coleman air refrigerator • Representation on PV and TS diagram, Types and applications like aircraft refrigeration using simple air cooling system. </p>	08	18
<p>Topic 2. Vapour Compression and Absorption Systems</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Describe vapor compression and absorption systems. ➤ Calculate different parameters of vapor compression systems <p>Contents:</p> <ul style="list-style-type: none"> • Vapor Compression Cycle - Principle, components, Representation on P-H and T-S diagram, Effects of wet compression, dry compression. 06 Marks • Calculation of COP, Effect of superheating, under cooling, suction pressure and discharge pressure, Actual V.C.C., (simple numerical), Methods of improving COP (No Numericals). Introduction to multistage V.C.C., its necessity, advantages. 06 Marks • Vapor Absorption system-Principle, components and working of aqua-ammonia system (simple & practical), Li-Br Absorption System, Electrolux Refrigeration System (No Numericals) Comparison of above Refrigeration Cycles. 06 Marks 	08	18
<p>Topic 3. Refrigeration System Equipments</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Identify refrigeration equipments in view of classification, construction and operation. ➤ List criterions of selection of equipments for various refrigeration systems 	08	16

<p>Contents:</p> <p>3.1 Compressors: Classification, Construction and working of open type, Hermetic, centrifugal, rotary, screw and scroll compressor and their applications. Compressor for car air-conditioning system (Wobble plate type) 04 Marks</p> <p>3.2 Condensers: Classification Description of air cooled and water cooled condensers, Comparison and applications, Evaporative condensers 04 Marks</p> <p>3.3 Expansion devices: Capillary tube, Automatic exp valve, Thermostatic exp. valve, Applications 04 Marks</p> <p>3.4 Evaporators and chillers: 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, flooded chillers and their applications. 04 Marks</p>		
<p>Topic 4. Psychrometry Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Define Psychrometric properties and draw processes Solve the problems with Psychrometric chart ➤ Understand Details of equipments used in air conditioning <p>Contents:</p> <p>4.1 Definition and necessity of air Conditioning, Properties of Air, Dalton's law of partial pressure, Psychrometric chart, Psychrometric processes, Bypass Factor, ADP, concept of SHF, RSHF, Adiabatic mixing of Air Streams, Simple numericals using Psychrometric Chart 08 Marks</p> <p>4.2 Air- conditioning Equipments: 08 Marks</p> <ul style="list-style-type: none"> • Humidifier dehumidifier, filters, • Heating and cooling coils. • Air washers 	08	16
<p>Topic 5. Comfort Conditions and Cooling Load Calculations Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Explain basic concepts of comfort conditions and cooling load calculations <p>Contents:</p> <p>5.1 Thermal exchange of body with environment, Factors affecting human comfort, Effective temp.</p> <p>5.2 Components of cooling load- sensible heat gain and latent heat gain sources</p> <p>5.3 Calculation of cooling load of given area.</p>	04	08
<p>Topic 6. Air Conditioning & Air Distribution Systems Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Identify various air conditioning systems <p>Contents:</p> <p>6.1 Classification of systems: 06 Marks</p> <ul style="list-style-type: none"> • Industrial and commercial Air Conditioning Systems • Summer, winter and year round Systems 	08	16

<ul style="list-style-type: none"> Central and unitary air conditioning systems 		
6.2 Air distribution systems 06 Marks <ul style="list-style-type: none"> Duct systems: Closed perimeter system, extended plenum system, Radial duct system, duct materials, requirement of duct materials, losses in ducts Fans and Blowers- Types, working of fans and blowers , Air distribution outlets, Supply outlets, return outlets, grills, and types of diffusers 		
6.3 Insulation: Purpose, properties of insulating material, Types of insulating materials, Methods of applying insulation. 04 Marks		
Topic 7. Applications of Refrigeration and Air Conditioning Systems: 08 Marks <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Explain various Refrigeration and Air Conditioning systems. <p>Contents:</p> <p>Applications of refrigeration and air conditioning in following areas:</p> <ul style="list-style-type: none"> Domestic Applications Commercial Applications Industrial Applications Automobile Air conditioning systems 	04	08
Total	48	100

Practical:**Skills to be developed:****Intellectual Skills:**

1. Identify various components of refrigeration and air conditioning equipment.
2. Analyse cooling load based on application.
3. Interpret psychometric chart to find various properties of air.

Motor Skills:

1. Handle various tools used for refrigeration and air conditioning plant Maintenance.
2. Dismantle and assemble Refrigeration compressor and components.
3. Use of temperature, pressure, energy measuring devices.
4. Draw the layout of central Air conditioning plant.
5. Conduct trial on Test rigs.

List of Practicals:

Instructions to Teachers: While conducting experiments, group of 4 – 5 students should be formed. For industrial visits group size be limited to 8 -10 students at a time.

1. Identification, Location of components on various refrigeration systems like House hold refrigerator, Window air conditioner, Split Air conditioner, Water Cooler, Deep freezer and controls used.(Concept of EER and star rating to be emphasized in relation with these equipments). Draw the block diagrams to show location of components and label them.

2. Demonstration of various Valves, controls like, solenoid valve, Thermostatic Expansion valve, capillary, L.P./H.P. cut outs, thermostats, overload protectors, Gauges used in RAC systems.
3. Trial on Vapor Compression cycle test rig to find COP.
4. Trial on Ice Plant test rig.
5. Visit to cold storage plant / Ice cream Manufacturing plant/ Ice plant and write a brief report.
6. Calculation of Relative Humidity in the area with help of Sling Psychrometer and Psychometric Chart
7. Trial on Air conditioning test rig.
8. Dismantling and assembling of hermatically sealed compressor **(To be performed by group of 4 -5 student)**
9. Dismantling and assembling of Reciprocating refrigeration compressor. **(Batch size of students should be 4-5 in a group)**
10. Dismantling and assembling of Car Air-conditioning compressor. **(Batch size of students should be 4-5 in a group)**
11. Visit to repair and maintenance workshop of Refrigeration & Air conditioning in view of use of various tools and charging procedure and write a brief report.

OR

- 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).
12. Trouble shooting chart of domestic refrigerator, window air- Conditioner, Water cooler, Automobile air conditioning systems (any two)
- (It is recommended that the teacher should introduce manufacturers catalogues of RAC equipments to the students during practical periods)**

Assignments:-

1. Detailed information search on “Green House Effect” and “Ozone layer depletion” and “Eco friendly Refrigerents”
2. Study of Air conditioning system of a Car or Bus by practically observing system in view of identification of components, circuits, Type of refrigerants , Capacity and various controls used in system. Write a brief report.
3. Cooling load calculations for cabin, classroom, laboratory, canteen and dairy Plant, milk storage, small freezers (minimum one).

Learning Resources:**1. Books:**

Sr. No.	Title	Author	Edition	Publisher
01	Refrigeration and Air Conditioning	Arora	3 rd Edition	Tata McGraw Hill
02	Refrigeration and Air Conditioning	R.S.Khurmi	Recent	S. Chand and Co.
03	Refrigeration and Air Conditioning	P. N. Ananthanarayanan	1 st Edition	Tata McGraw Hill
04	Refrigeration and Air Conditioning	Manohar Prasad	2009	New Age Publications
05	Principles of Refrigeration	Roy Dossat	4 TH	Pearson Education
06	Refrigeration and Air Conditioning	Ballany	2009	Dhanpat rai & sons

2. CDs, PPTs, Video Clips on refrigeration and air conditioning systems. Video clips on working of refrigeration and air conditioning systems, working of compressors, vapour absorption systems, alternative refrigerants.
3. ISO, IS, BS Codes on components of refrigeration and air conditioning systems. ASHRAE codes.
4. Charts, Models, Transparencies on Refrigeration and air conditioning.
5. Websites: Carrier corporation, Voltas, Usha, Fedders Loyd, Hitachi, Du-Pond, Tata Mac graw hill (student section) for refrigeration and air conditioning products.

Course Name : Diploma in Mechanical Engineering

Course code : MG / MC

Semester : Eight

Subject Title : Renewable Energy Sources & Management (Elective)

Subject Code : 21040

Teaching and Examination Scheme

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

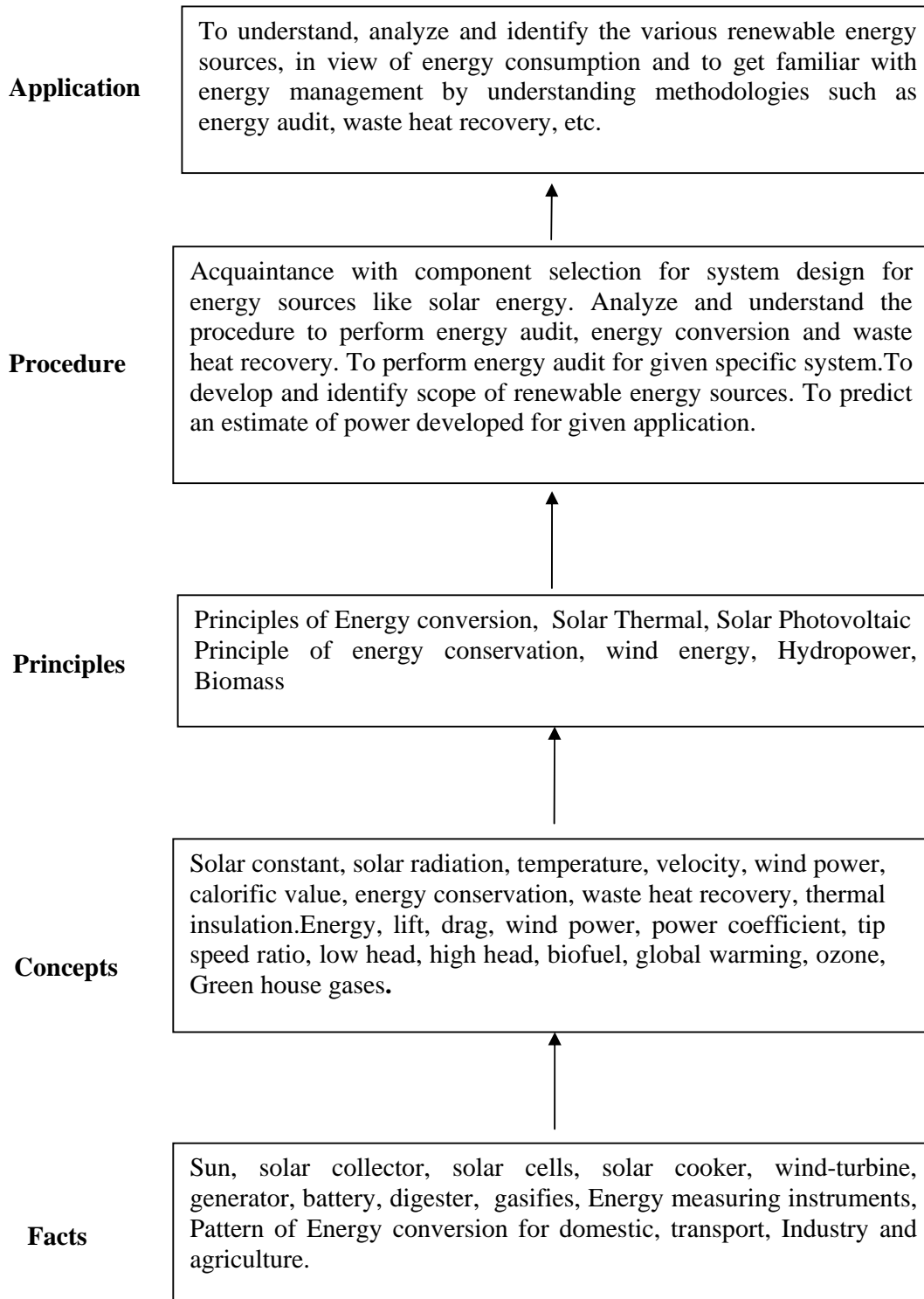
Rationale:

Energy is an important aspect in all sectors of country's economy. India as a country suffers from significant energy deficiency. The per-capita energy consumption, while increasing progressively, is significantly below global averages and in many instances below developing country averages. Increasing energy demands, shortage of fossil fuels, and the continuous increase in the level of green house gas emissions are the main driving forces to utilize various sources of renewable energy. The subject aims at enabling the students to know the basics of renewable energy, energy conversion, conservation, management techniques, energy audit and methodology.

General Objectives:

Student will be able to

1. Appreciate the need and importance of renewable energy
2. Analyze various Biomass Conversion processes.
3. Judge the Energy Saving Potential, Waste Heat Recovery, Energy Efficiency.
4. Understand the methodologies to execute preliminary energy audit.

Learning Structure:

Theory:

Topic & Content	Hours	Marks
<p>Topic 1: Introduction – Renewable Energy</p> <p>Specific Objective</p> <ul style="list-style-type: none"> ➤ Understand need of renewable energy ➤ Know the effect of use of fossil fuel on climate change and global warming ➤ Identify various renewable energy sources <p>Contents:</p> <p>1.1 Need of Renewable Energy 04 Marks</p> <p>Non renewable Energy sources - Fossil Fuels: Coal, Oil, Natural gas, Tar sands and Oil shale</p> <ul style="list-style-type: none"> • Climate Change - Green House Gases, Global Warming • Sustainable growth • Present Energy Scenario: Global and Indian • Pattern of Energy Consumption. • Different types of Energy and its utilization. <p>1.2 Renewable Energy Sources: Classification and Introduction 08 Marks</p> <ul style="list-style-type: none"> • Solar Energy - Direct Uses • Solar Thermal • Solar Photovoltaic • Solar Energy - Indirect Uses • Hydro-Power • Wind Power • Bio-Energy • Wave Power • Non-Solar Renewable Energy • Tidal Energy • Geothermal Energy. <p>1.3 Energy Storage Management 04 Marks</p> <ul style="list-style-type: none"> • Thermal Storage-sensible and latent its comparison • Electrical Storage: Introduction to battery, super capacitor, and fuel cell. 	07	16
<p>Topic 2. Solar Energy – Direct Uses</p> <p>Specific Objective</p> <ul style="list-style-type: none"> ➤ State the concept of solar radiation ➤ Describe the working principle of solar thermal systems ➤ Compare different solar photovoltaic system <p>Contents:</p> <p>2.1 Solar Radiation 08 Marks</p> <ul style="list-style-type: none"> • Sun & Earth • Solar Spectrum • Sun & Earth Movement • Solar Geometry: Concept <p>2.2 Solar Thermal Applications & Its working Principles 04 Marks</p> <ul style="list-style-type: none"> • Water Heating • Space Heating 	15	28

<ul style="list-style-type: none"> • Space Cooling and Refrigeration • Power Generation • Distillation <p>1.3 Construction Details containing capacity, size and materials of: 06 Marks</p> <ul style="list-style-type: none"> • Solar Flat Plate Collector • Solar Evacuated Flat plate Collector • Solar Concentrating Collector • Solar Cooker - Box and Concentrating • Solar Drying <p>2.4 Solar Photovoltaic Conversions: Principle of working of Solar cell 10 Marks</p> <ul style="list-style-type: none"> • Construction Details containing capacity, size & materials of Solar Photovoltaic System Applications- Solar Lantern, Solar Home System, SPV Street Light, SPV Traffic Signal, Info - display, SPV Power Pack, Stand alone SPV Power Plant, Solar Generators, Building Integrated PV Systems, SPV Pumping Systems (No derivations & numericals) 		
<p>Topic 3. Solar Energy - Indirect Uses - I</p> <p>Specific Objective</p> <ul style="list-style-type: none"> ➤ Know the site selection criteria for wind and hydro plant ➤ Classify small hydro plants ➤ Identify component of Horizontal Axis Wind Turbine <p>Contents:</p> <p>3.1 Hydro-Power 12 Marks</p> <ul style="list-style-type: none"> • Site Selection • Different Components of Small Hydroelectric Projects • Types of Turbine – Francis, Propellor • Classification of Small Hydro-electric Plants: Ultra low head, Low head, Medium/high head, Micro hydro, Mini hydro, Small hydro <p>3.2 Wind Power 08 Marks</p> <ul style="list-style-type: none"> • Concepts- Wind Energy Conversion, Lift and Drag, • Classification and Description • Components of Power Generating Horizontal Axis Wind Turbine • Site Selection Criteria. 	08	20
<p>Topic 4. Solar Energy – Indirect Uses - II</p> <p>Specific Objective</p> <ul style="list-style-type: none"> ➤ State the site selection criteria for wind and hydro plant ➤ Compare bio fuels <p>Contents:</p> <p>4.1 Bio-Energy -Photosynthesis and Carbon Cycle Concept. 08 Marks</p> <ul style="list-style-type: none"> • Bio energy Sources – Types Such as • Energy Plantation • Agricultural Crops • Wood Residues • Animal Waste • Municipal Solid Waste • Landfill Gas • Commercial and Industrial Waste <p>4.2 Biomass Conversion Routes- Thermo chemical Route and Biochemical Route 04 Marks</p>	10	16

<ul style="list-style-type: none"> • Combustion • Gasification • Pyrolysis • Anaerobic digestion • Fermentation 		
4.3 Bio fuels from Bio-Mass 04 Marks <ul style="list-style-type: none"> • Bioethnol • BioDiesel • Biogas • Algae- A new biomass 		
Topic 5: Energy Management Specific Objective <ul style="list-style-type: none"> ➤ Describe the methodology of execute preliminary energy audit ➤ Judge the energy saving potential, waste heat recovery, energy effect ➤ State the use of different energy measuring instruments Contents:		
5.1 Definition, Objectives & Need of Energy Audit 06 Marks <ul style="list-style-type: none"> • Energy Audit: Types And Methodology • Preliminary Energy Audit Methodology 		
5.2 Energy Measurement and Instruments 08 Marks <ul style="list-style-type: none"> • Lux meters: • Pyranometer, • Sunshine Recorder • Pyrheliometer • Combustion analyzer: • Fuel Efficiency Monitor: • Fyrite • Contact thermometer: • Infrared Thermometer: • Pitot Tube and manometer: • Water flow meter: • Speed Measurements: • Leak Detectors: • Hand held meters and Power Analyzer to measure electrical parameters such as kVA, kW, PF, Hertz, kVAr, Amps and Volts. 	08	20
5.3 Energy Conservation 06 Marks <ul style="list-style-type: none"> • Energy Efficiency - Boiler & Furnace Efficiency • Waste Heat Recovery Systems • Energy Loss Prevention - Thermal Insulation 		
Total	48	100

Note: Subject teachers are expected to give relevant information briefly on each of the above topic without analytical treatment.

Practicals:

Intellectual skills:

- 1) To identify concept, parts of devices etc.
- 2) To understand the construction and working principle of Renewable energy systems.
- 3) To know function, classification and discrimination of parts or equipments.

- 4) To know test procedure. Calculate and interpret test result.
- 5) To observe the faults and suggest the remedial action for repair and performance improvement.

Motor Skills:

- 1) Ability to observe / locate / operate various parts of instruments / equipments / tools.
- 2) Ability to accurately measure the various parameters.
- 3) Ability to follow the systematic procedure.
- 4) Ability to handle data and draw graphs.

List of Practical

Sr. No.	Name of Practical
1.	Collect information about global and Indian energy market from websites and prepare write up
2.	Visit to a commercial or Industrial Solar water heating Installation of atleast 500 liters per day capacity. Writing a report about collector layout, piping and fittings and measurement of performance of the system.
3.	Performance measurement of photovoltaic array used for an application such as pumping, home lighting etc. making use of energy instruments.
4.	Visit to or study of a Small Hydraulic Power plant.
5.	Performance estimation and comparison of different collector technologies used for hot water generation such as evacuated tube, flat plate collector, dish collector etc. on the experimental set up installed in the laboratory.
6.	Study construction and working of horizontal axis wind mill or to visit a nearest wind farm and write a report.
7.	Visits to a biogas plant or biomass gasification facility. Writing a report on plant structural details and components. Measurement of performance.
8.	Practical study of energy audit instruments used for measurement of electric energy, temperature, flow, exhaust gas analysis etc.
9.	Conducting walk through energy audit of a small establishment such as workshop/Office/Home/SSI unit.

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher / Edition
1	Boyle Godfrey	Renewable Energy: Power For A Sustainable Future	Oxford University Press
2	S. P. Sukhatme	Solar energy, Principles of Thermal Collection & Storage	3 rd Edition, Tata McGraw Hill
3	B. H. Khan	Non-Conventional Energy Resources	2 nd Edition, McGraw Hill Companies
4	Chetan Singh Solanki	Solar Photovoltaics Fundamentals Technologies and Applications	PHI Learning private ltd N. Delhi

5	G. D. Rai	Non conventional energy sources	Khanna publication
6	---	Guide Book for National Certification for Energy Managers and Energy Auditors, Book 1 – General Aspects of Energy Management and Energy Audit	Bureau of Energy and Efficiency (BEE)

2. CD's / PPT's etc.:

1. CDs developed by Maharashtra Energy Development Agency (MEDA), Pune. (www.mahaurja.com)
2. Dr. Govind N. Kulkarni, Documentary (DVD), Solar Energy - An Awakening, Usha Solar

3. Websites

1. Website of Bureau of Energy and Efficiency. (www.bee-india.nic.in)
2. Website of Mahaurja- (www.mahaurja.com)
3. Energy management (www.energymanagertraining.com)
4. www.bp.com

Course Name : Diploma in Mechanical Engineering

Course code : MG / MC

Semester : Eight

Subject Title : Project

Subject Code : 21041

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	04	--	--	--	50#	50@	100

Rationale:

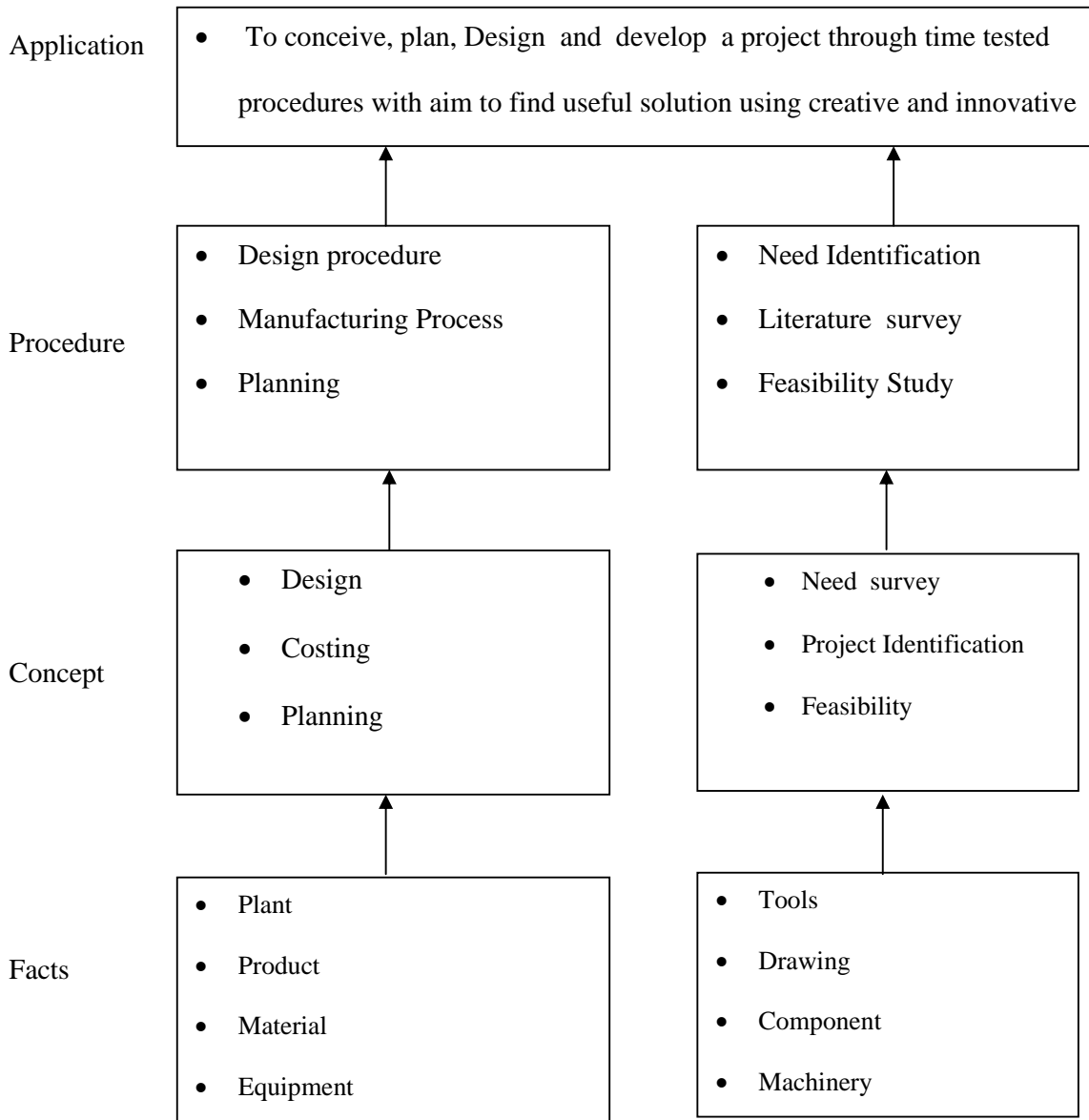
Project work allows students to use their creative and innovative ideas translating in working model, prototypes, and equipments and developing necessary hands on skills. This will allow the students to apply the previous knowledge and skills acquired during the course.

General Objectives:

The student will be able to:

1. Analyze the given problem.
2. Generate alternative solutions to the problem.
3. Compare & select feasible solutions amongst alternative generated.
4. Develop and manufacture new/modified equipments.
5. Acquire technical knowledge beyond curriculum.

Learning Structure:



Content:

Following activities related to project are required to be dealt with, during this semester

1. The Selection and preliminary work regarding Project to be done as per directives given in **PROFESSIONAL PRACTICES – V** Curriculum.
2. The identified projects be executed during the semester as per the Guidance from the project Guide by the group of students (Group size max. 4 students).
3. Maintain the project diary individually for the activities performed in the format specified below.

Project Diary format:

Sr. No.	Date	Activity Carried out	Remarks	Signature of Guide

SUGGESTED PROJECT WORK AREAS

- 1) Fabrication of small machine / devices/ test rigs/ material handling devices/ jig & fixtures/ demonstration models, etc.
- 2) Design & fabrication of mechanisms, machines, Devices, etc.
- 3) Development of computer program for designing and /or drawing of machine components, Simulation of movement & operation, 3D modeling, pick & place robots
- 4) Industry sponsored projects- project related with solving the problems identified by Industry should be selected. (One person from industry is expected to work as co- guide along with guide from institution).
- 5) Literature survey based projects: Project related with collection, tabulation, classification, analysis & presentation of the information. Topic selected must be related with latest technological developments in mechanical field, and preferably beyond curriculum.
- 6) Modification in the existing machinery / equipment for improved performance.
- 7) Maintenance based projects.
- 8) Industrial engineering based project: Project based on work study, method study, methods improvement, leading to productivity improvement.
- 9) Low cost automation projects.
- 10) Innovative/ Creative projects involving generation of new ideas and converting it into a model, gadget.
- 11) Market survey based projects.
- 12) Project based on use of appropriate technology particularly benefiting rural society or economically weaker section.
- 13) Equivalent level project can be selected from other than the area specified above.

Note:

Project should provide viable and feasible solution to the problem identified.

Report should be of 40TO 50 pages.

Font size of project report contents be as follows:

1. Main title: 16 bold Times new roman
2. Sub titles: 14 bold Times new roman
3. Running matter: 12 Times new roman, paragraph 1.5 line spacing,
4. Margin spacing 1.5 inch from left and 1 inch from other sides.

Preferably actual photographs / video clips showing progress of project work at different stages be added to project report).

Suggested framework for the project report:

The topics/ contents of the project report should be as follows:-

- Abstract
- Topic introduction/ Philosophy
- Literature Survey/ Methodology adopted
- Principle (aim objectives of the Project work)
- Data collection/ Design consideration/Basic Framework/Design / Drawing
- Manufacturing Processes and Process Sheets (if relevant)
- Assembly (if relevant)
- Performance / Calculations etc (If relevant)
- Costing
- Results and Discussion
- Conclusion
- Future Scope
- Bibliography/ References

Learning Resources:

Reference Books:

Sr. No.	Name of Book	Author	Publisher
1	Project Management	Maylor	Pearson Education
2	Project Management And Appraisal	Khatua	Oxford University Press
3	Project Management/2/e	Bhavesh Patel	Vikas Publishing House
4	Project Management 3/e	Vasant Desai	Himalaya Publishing House
5	Project Management The Managerial Approach	Gray	TMH