West Bengal State Council of Technical Education

(A Statutory Body under West Bengal Act XXI of 1995)
Kolkata Karigori Bhavan, 2nd Floor, 110 S. N. Banerjee Road, Kolkata - 700 013.

Name of the Course : Diploma in Mechanical Engineering Subject Title: **DESIGN OF MACHINE ELEMENTS**	
Course code: ME/	**Semester :** Sixth
Duration : 17 weeks	**Maximum Marks : 150**
Teaching Scheme:	**Examination Scheme:**
Theory : **4** hrs/week	**Internal Assessment**:20 Marks
Tutorial: hrs/week	**Teacher's assessment (Assignment & Quiz)**: 10 Marks
Practical : **2** hrs/week	**End Semester Exam**: 70 Marks
Credit: **5**	**Practical: Internal Sessional continuous evaluation**:25 Marks
	Practical: External Sessional Examination:25 Marks

Aim :-	
S.No	
1	To enable the student to design and draw simple machine components used in small and medium scale industries. Fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials and Theory of Machines is essential. To develop analytical abilities to give solutions to engineering design problems.
Objective :-	
S No	The student will 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

Pre-Requisite:-NIL

Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
GROUP:A		
01	Introduction to Design 1.1 Machine Design philosophy and Procedures 1.2 General Considerations in Machine Design 1.3 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) 1.4 Creep strain and Creep Curve 1.5 Fatigue, S-N curve, Endurance Limit. 1.6 Factor of Safety and Factors governing selection of factor of Safety. 1.7 Stress Concentration – Causes & Remedies 1.8 Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor. 1.9 Properties of Engineering materials, Designation of materials as per IS 1.10 Standardization, use of design data book, use of standards in design 1.11 Theories of Elastic Failures – Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory.	**10**
02	***Design of simple machine parts***	

	2.1 Cotter Joint, Knuckle Joint, 2.2 Design of Levers: - Hand/Foot Lever & Bell Crank Lever.	**08**
GROUP:B		
03	***Design of Shafts, Keys and Couplings, Spur Gears and Pulley.*** *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 line shafts supported between bearings with one or two pulleys in between or one overhung pulley* 3.2 Design of Sunk Keys, Effect of Keyways on strength of shaft. 3.3 Design of Couplings – Protected type Flange Coupling, 3.4 Spur gear design considerations. Lewis equation for static beam strength of spur gear teeth. Power transmission capacity of spur gears in bending. 3.5 Design of C.I. Pulley.	**14**
04	***Design of Fasteners*** 4.1 Stresses in Screwed fasteners, bolts of Uniform Strength. 4.2 Design of Bolted Joints subjected to eccentric loading. 4.3 Design of parallel and transverse fillet welds, axially loaded symmetrical section, Merits and demerits of screwed and welded joints	**08**
GROUP:C		
05	***Antifriction Bearings*** 5.1 Classification of Bearings – Sliding contact & rolling contact. 5.2 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.	**08**
06	***Ergonomics & Aesthetic consideration in design*** 6.1 Ergonomics of Design – Man –Machine relationship. Design of Equipment for control, environment & safety. 6.2 Aesthetic considerations regarding shape, size, color & surface finish.	**04**
07	**Estimating & Costing** 7.1 Definition of estimating and costing, elements of costing, overhead 7.2 Determination of weight of various parts such as simple bush, flanged pipe, Lathe centre, Rivets, Bolts & Nuts, Simple spanner, Simple crank & connecting Rod. 7.3 Estimation of selling price of cast part such as C.I.pulley, Coupling, and Wooden pattern of flange. 7.4 Estimation of fabricated job such as Simple chimney, Funnel, Cylindrical tank	**08**
	Total	**60**

Assignments:

Skills to be developed:

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. Analyse 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.

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.
4. Use different design data books and IS codes.

1. IS/ International Codes

a) IS 4218: 1967 ISO Metric Threads
b) IS 2693: 1964 Cast Iron Flexible Couplings
c) IS 2292: 1963 Taper keys & Keyways
d) IS 2293: 1963 Gib Head Keys & Keyways
e) IS 2389: 1963 Bolts, Screws, Nuts & Lock Nuts
f) IS 4694: 1968 Square threads
g) IS 808: 1967 Structural Steel
h) SKF Catalogue for Bearings

2. SOFTWARE

1) Think 3 CAD Software developed by acebrain.
2) E-Yantra Software, developed by FEAST.

Suggested List of Laboratory Experiments : - Nil

Suggested List of Assignments/Tutorial :

S.No 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 Problems on design of simple machine parts like Cotter Joint, Knuckle Joint, Bell Crank Lever, C.I. Pulley (One example on each component) with free hand sketches.

3 Design Project: Observe the system where transmission of power takes place through shaft, Keys, coupling, pulley and belt drive. Get the required information regarding power transmitted (power output by motor or engine etc.). By selecting suitable materials, design the shaft, key and coupling. Also select suitable Ball Bearing from Manufacture's catalogue. Prepare design report and assembly drawing indicating overall dimensions, tolerances, and surface finish. Also prepare bill of materials. (Activity should be completed in a group of five to six students) .

4. Assignments on overhead cost calculation, selling price calculation,

5. Assignments on weight and cost calculation of different parts.

6. Survey of Prime movers – Electric motors / I.C. Engines available in the market along with specifications suitable for your design project. Survey report should be prepared with the relevant catalogue.

End Semester Examination Scheme. Maximum Marks-70, Time Allotted-3 hrs							
Group	**unit**	**Objective Questions**		**Subjective Questions**			
		No. of questions to be set	**Total marks**	**No. of questions to be set**	**To answer**	**Marks per question**	**Total marks**
A	**01,02,03**	**8**		**4**	**5, taking at least one from each group**		
B	**04,05**	**6**	**20**	**3**		**10**	**50**
C	**06,07**	**6**		**3**			

List of Books:

Author	Title	Publication
Sharma & Agwarwal	Machine Design	S.K. KATARIA
A.R.Basu	**Machine Design Drawing, Estimating and Costing**	Dhanpat Rai
V.B.Bhandari	Introduction to Machine Design	Tata Mc- Graw Hill

P.Kannaiah	Machine Design	Scitech
R.S.khurmi	Machine Design	S.Chand
R.K.Jain	Machine Design	Khanna Publication
Joseph Edward Shigley	Mechanical Engg. Design	Mc- Graw Hill
PSG Coimbtore	Design Data Book	PSG Coimbtore Mechanics
Abdulla Shariff	Hand Book of Properties of Engineering Materials & Design Data for Machine Elements	Dhanpat Rai & Sons

Reference books :

Author	Title	Publication
Robert L.Mott,Jong Tang	Machine Elements in Mechanical Design	Pearson
Jack A. Collins, Henry R. Busby	Mechanical Design of Machine Elements and Machines	Willey Publications

EXAMINATION SCHEME FOR PRACTICAL SESSIONAL

Internal Examination: Examiner- Lecturer in Mechanical Engg.			
Submission of Five No. of Assignments in due time.	5 x 3 = 15		
VIVA VOCE	10		
TOTAL	25		
External Examination: Examiner- Lecturer in Mechanical Engg.			
Submission of Signed Note Book	5 x 2 = 10		
VIVA VOCE	15		
TOTAL	25		

Name of the Course : DIPLOMA IN PRODUCTION ENGINEERING / TECHNOLOGY (SUBJECT TITLE: INDUSTRIALMANAGEMENT)		
Course code:		**Semester :** Six
Duration : 17 week		**Maximum Marks : 100**
Teaching Scheme		**Examination Scheme**
Theory : 3 hrs/week		Semester Exam: **70** Marks
Tutorial: hrs/week		Teacher's Assessment (Assignment & Quiz): **10** Marks
Practical : 4 hrs/week		Internal Assessment: **20** Marks
Credit: 3		
Aim :-		
	To study the techniques for improvement in productivity of the people and equipment. to plan the production schedule accordingly organize material supply for the manufacturing activities. To minimize the direct and indirect cost by optimizing the use of resources available. To learn accounting process, inventory control and process planning. Modern manufacturing system employ techniques such as JIT, TPM , FMS, 5'S', kaizen which should be known to the technician.	
Objective :-		
S No	The student 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	
Pre-Requisite:-Nil		
Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
GROUP:A		
01	**Overview Of Business** 1.1. Types of Business □ Service □ Manufacturing □ Trade 1.2. Industrial sectors Introduction to □ Engineering industry □ Process industry □ Textile industry □ Chemical industry □ Agro industry 1.3 Globalization □ Introduction □ Advantages & disadvantages w.r.t. India 1.4 Intellectual Property Rights (I.P.R.)	04
02	**Management Process** 2.1 What is Management? □ Evolution □ Various definitions □ Concept of management □ Levels of management □ Administration & management □ Scientific management by F.W.Taylor 2.2 Principles of Management (14 principles of Henry Fayol) 2.3 Functions of Management □ Planning	04

	□ Organizing □ Directing □ Controlling 2.4 Social responsibility and Environmental dimension of management.	
GROUP:B		
03	**Organizational Management** 3.1 Organization :- □ Definition □ Steps in organization 3.2 Types of organization □ Line □ Line & staff □ Functional □ Project 3.3 Departmentation □ Centralized & Decentralized □ Authority & Responsibility □ Span of Control 3.4 Forms of ownership □ Propriotership □ Partnership □ Joint stock □ Co-operative Society □ Govt. Sector	06
04	**Human Resource Management** 4.1 Personnel Management □ Introduction □ Definition □ Objectives □ Functions 4.2 Staffing □ Introduction to HR Planning □ Recruitment Procedure 4.3 Personnel– Training & Development □ Types of training □ Induction □ Skill Enhancement 4.4 Grievance handling 4.5 Leadership & Motivation □ Maslow's Theory of Motivation 4.6 Safety Management □ Causes of accident □ Safety precautions 4.7 Introduction to – □ Factory Act □ ESI Act □ Workmen Compensation Act □ Industrial Dispute Act	10
GROUP:C		
05	**Financial Management** 5.1. Financial Management- Objectives & Functions 5.2. Capital Generation & Management □ Types of Capitals	08

	□ Sources of raising Capital 5.3. Budgets and accounts □ Types of Budgets □ Production Budget (including Variance Report) □ Labour Budget □ Different financial ratios. □ Introduction to Profit & Loss Account (only concepts) ; Balance Sheet 5.4 Introduction to – □ Excise Tax □ Service Tax □ Income Tax □ VAT □ Custom Duty	
06	**Materials Management** 6.1. Inventory Management (No Numerical) □ Meaning & Objectives 6.2 ABC Analysis 6.3 Economic Order Quantity(EOQ) 6.4 Stores function, Stores system, BIN card, Materials issue request(MIR), Pricing of materials □ Introduction & Graphical Representation 6.4 Purchase Procedure □ Objects of Purchasing □ Functions of Purchase Dept. □ Steps in Purchasing 6.5 Modern Techniques of Material Management □ Introductory treatment to JIT / SAP / ERP	08
07	**Safety Engineering** 7.1 Accidents-causes of accidents, Welfare measures. 7.2 Need for safety 7.3 Organization for safety 7.4 Safety committee 7.8 Safety programmes 7.9 Safety measures	05
	Total	45

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Dr. O.P. Khanna	Industrial Engg & Management		Dhanpat Rai & sons New Delhi
V.Arun Viswanath, Anoop. S. Nair, S.L.Sabu	Industrial Engineering and Management		SCITECh Publication(s) Pvt. Ltd
A. Bhat & A. Kumar	Management Principles, Processes & Practices		Oxford University Press
Dr. S.C. Saksena	Business Administration & Management		Sahitya Bhavan Agra
W.H. Newman E.Kirby Warren Andrew R. McGill	The process of Management		Prentice- Hall
Rustom S. Davar	Industrial Management		Khanna Publication

Banga & Sharma	Industrial Organisation & Management		Khanna Publication
Jhamb & Bokil	Industrial Management		Everest Publication , Pune
N V S Raju	Industrial Engg & Management		Cengage

Reference books :- Nil
Suggested List of Assignments/Tutorial :-

1. Preparation of financial budget of any organization.
2. Preparation of chart for fire safety.
3. Preparation of chart for personal, Tools & Equipments and products safety.
4. Preparation of chart to avoid accident.
5. Preparation of chart to show the different financial ratios.
6. Preparation of chart to show the different types of organization.

End Semester Examination Scheme. Maximum Marks-70, Time Allotted-3 hrs							
Group	**unit**	**Objective Questions**		**Subjective Questions**			
		No. of questions to be set	**Total marks**	**No. of questions to be set**	**To answer**	**Marks per question**	**Total marks**
A	**01,02**	**7**		**3**			
B	**03,04**	**7**	**25**	**3**	**5, taking at least one from each group**	**10**	**50**
C	**05,06,07**	**11**		**4**			

Suggested List of Laboratory Experiments :- Nil

Suggested List of Assignments/Tutorial :- Nil

Name of the Course : Mechanical Engineering **Subject: FLUID POWER**				
Course code: ME		**Semester: Sixth.**		
Duration: 17 weeks		**Maximum Marks : 150**		
Teaching Scheme		**Examination Scheme:**		
Theory : **3** hrs/week		Internal Assessment: **20** Marks		
Tutorial: hrs/week		Teacher's Assessment (Assignment & Quiz): **10** Marks		
Practical : **2** hrs/week		End Semester Exam: **70** Marks		
Credit: **4**		Practical: Internal Sessional continuous evaluation: **25** Marks		
		Practical: External Sessional examination: **25** marks		
Aim :-				
S. No.				
1	To impart the basic concept of Fluid power system.			
2	To understand the applications of Hydraulic and Pneumatic Systems in industries as clean source of motive power, convenient way of power transmission and easer way of automation.			
3	To understand the limitations of Hydraulic and Pneumatic Systems.			
Objective :-				
S. No.	The Students should be able to:			
1	• Identify various components of Hydraulic & Pneumatic Systems.			
2	• Know the working principle of various components used for Hydraulic & Pneumatic Systems.			
3	• Select appropriate components required for simple Hydraulic and Pneumatic Circuits.			
4	• List probable causes of faults or defects in the components of Hydraulic & Pneumatic Circuits.			
Pre-Requisite: Elementary knowledge on Physics, Thermal Engineering and Fluid Mechanics & Machinery.				
Contents			Hrs/week	
FLUID POWER				
Chapter		**Name of the Topic**	**Hours**	**Marks**
		GROUP-A		
01	1.0 1.1 1.2 1.3 1.4	**Introduction to Fluid Power Systems:** Introduction, components and General layout of Fluid Power Systems. Comparison of Hydraulic & Pneumatic System. Practical applications of Fluid Power Systems. Advantages and Limitations of Fluid Power Systems.	**10**	
02	2 2.0 2.1 2.2 2.2.1 2.2.2 2.2.3 2.3 2.3.1	**Components of Hydraulic Systems:** Types, Construction, Working Principle and Symbols of the following Components: Pumps – Vane pump, Gear pump, and Piston pump. Valves – Pressure control valves – Pressure relief valve, Pressure reducing valve, Pressure unloading valve. Direction control valves – Poppet valve, Spool valve, 3/2, 4/2 &4/3 D.C. valves, Sequence valves, valve actuation. Flow control valves – Pressure compensated, Non Pressure compensated flow control valve. Actuators – Rotary Actuators - Hydraulic motors	**13**	

	2.3.2 2.4 2.4.1	Linear Actuators – Cylinders - single acting, double acting & mountings. Accessories – Pipes, Hoses, fittings, Oil filters, Seals and gaskets, Intensifier, Accumulators.		
03	3.0 3.1 3.2 3.3 3.4	**Hydraulic Circuits:** Meter in, Meter out circuits & pump unloading cut Bleed off circuit Sequencing circuit Hydraulic circuits for Milling machine, Shaper machine, Motion synchronization circuit.	**12**	
		GROUP-B		
04	4 4.0 4.1 4.2 4.3 4.3.1 4.3.2 4.4	**Components of Pneumatic System:** Types, Construction, Working Principle and Symbols of the following Components: Compressor **–** Reciprocating & Rotary compressors. Control Valves – Pressure regulating valves, Flow Control valves and Direction Control Valves. Actuators – Rotary actuator - Air motors. Linear actuator- Cylinders- single acting, double acting. Accessories – Pipes, Hoses, Fittings, FRL unit.	**10**	
05	5.0 5.1 5.2	**Pneumatic Circuits:** Speed control circuits. Sequencing circuits.	**10**	
		Sub Total:	**45**	
		Internal Assessment Examination & Preparation of Semester Examination	**6**	
		Total	**51**	

Practical:

Skills to be developed:

Intellectual Skill :

1. Prepare simple Hydraulic & Pneumatic Circuits.
2. Compare the performance of Hydraulic & Pneumatic Systems.
3. Identify the faults & suggest remedies in Hydraulic & Pneumatic Circuits.
4. Select proper Circuit considering its Application.

Motor Skills :

1. Connect different Components as per given Drawing.
2. Perform repairing and replacement of defective components in the Circuit.
3. Draw the Hydraulic and Pneumatic Circuits using Symbols.

List of Practical:

1. Study of Vane pump/ Gear pump generally used in Hydraulic System.
2. Study of Direction Control Valve generally used in Hydraulic / Pneumatic System.
3. Study of Rotary / Linear (single acting / double acting) Actuator generally used in Hydraulic / Pneumatic System.
4. Study of FRL Unit generally used in Pneumatic System.
5. Study of Hydraulic Trainer System & Pneumatic Trainer system

6. Design, Prepare & operate of Meter in and Meter out Circuit.
7. Design, Prepare & operate of Sequencing Circuit.
8. Design, Prepare & operate of Hydraulic Circuit for Shaper Machine.
9. Design, Prepare & operate of Pneumatic Circuit for Speed Control of Double Acting Cylinders.
10. Design, Prepare & operate of Pneumatic Circuit for Speed Control of Pneumatic Motor.
11. Design, Prepare & operate a pneumatic circuit for lifting & then holding a load.

Note: At least **FIVE (05)** nos. of Practical / Study are to be conducted.

Text Books

Name of Authors	**Titles of the Book**	**Edition**	**Name of the Publisher**
A. Esposito	Fluid Power with Application		Pearson
S.R. Majumdar	Oil Hydraulic System- Principle and maintenance		Tata McGraw Hill
S.R. Majumdar	Pneumatics Systems- Principles and Maintenance		Tata McGraw Hill
Jagadeesha	Fluid Power Generation ,Transmission & Control		Wiley
P.joji	Pneumatic Controls		Wiley
Ilango & Soundararajan	Introduction to Hydraulics and Pneumatics, 2nd ed		Prentice Hall India
Stewart	Hydraulics and Pneumatics		Taraporewala Publication
Farel Bradbury	Hydraulic System & Maintenance		ILIFFE Books, London
Charles Hedges	Industrial Fluid Power		Womack Educational Publications
Peter Rhoner	Industrial Hydraulic Control		Prentice Hall
Hicks Pippenger	Industrial Hydraulics		McGraw Hill International

Suggested List of Assignments / Tutorial :-

1. Draw Hydraulic Meter in and Meter out Circuits by using Symbols.
2. Draw Pneumatic Sequencing circuit by using Symbols.
3. Draw Hydraulic Circuit for Shaper Machine by using Symbols.
4. Draw Hydraulic Circuit for Speed Control of Hydraulic Motor by using Symbols.

EXAMINATION SCHEME: END SEMESTER EXAMINATION

GROUP	MODULE OR CHAPTER	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	12	ANY 20	1	20	7	FIVE, (AT LEAST ONE FROM EACH GROUP)	10	50
B	4,5	08				3			

EXAMINATION SCHEME FOR PRACTICAL SESSIONAL

Internal Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Five No. of Experiments / Study attended & respective lab note submitted in due time.	5 x 3 = 15		
VIVA VOCE	10		
TOTAL	25		
External Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Submission of Signed Lab Note Book (for five experiments / study)	5 x 2 = 10		
On spot experiment / study (one for each group consisting 15 students / explanation on study item)	10		
VIVA VOCE	5		
TOTAL	25		

West Bengal State Council of Technical Education

(A Statutory Body under West Bengal Act XXI of 1995)
Kolkata Karigori Bhavan, 2nd Floor, 110 S. N. Banerjee Road, Kolkata - 700 013.

Name of the Course : Diploma in Mechanical Engineering Subject Title: **REFRIGERATION AND AIR CONDITIONING (Elective-II)**	
Course code: ME/	**Semester :** Sixth
Duration : 17 weeks	**Maximum Marks : 100**
Teaching Scheme:	**Examination Scheme:**
Theory : 3 hrs/week	**Internal Assessment**: 10 Marks
Tutorial: hrs/week	**Teacher's assessment (Assignment & Quiz)**: 05 Marks
Practical : 2 hrs/week	**End Semester Exam**: 35 Marks
	Practical: Internal Sessional continuous evaluation:25 Marks
	Practical: External Sessional Examination:25 Marks
Credit: 4	

Aim :-	
S.No	
1	This subject is classified as an Applied Technology. The 21st century predicts revolutionary developments in Refrigeration and Air Conditioning. Refrigeration and Air conditioning is one of the most meaningful job areas for diploma holders in Mechanical Engineering. Considering the wide and increasing use of Refrigeration and Air conditioning for domestic, commercial and industrial applications and the challenges put by the use of Refrigeration and air conditioning equipments in existing stage, it is absolutely necessary that Diploma Engineers should learn this subject. They should know the processes, equipments, systems of Refrigeration and Air Conditioning with their functioning, maintenance, repairs and measures to meet the challenges of the near future in this area.
S No	The student will able to
	1. Describe types, working principles and construction of Refrigeration and Air Conditioning systems. 2. Calculate performance of refrigeration and air conditioning system. 3. Use various charts and tables used in refrigeration and air conditioning. 4. Enlist properties of refrigerants, their applications and effects on environment. 5. Identify various components and controls used in refrigeration and air conditioning. 6. Describe various air conditioning systems and their applications. 7. Estimate cooling and heating loads. 8. Identify and describe different components of air distribution system.

Pre-Requisite:-		
S.No	Elementary knowledge on thermal engineering & Power engineering	
1		
Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
	Group A	
01	**Basics of Refrigeration** 1.1 Definition of refrigeration. 1.2 Necessity of refrigeration 1.3 Concept of heat engine, heat pump and refrigerator. 1.5 Unit of refrigeration, C.O.P. and refrigerating effect. 1.6 Major application areas of R.A.C. like domestic, commercial and industrial.	03
02	**Refrigeration Cycles** 2.1 Reversed Carnot Cycle and its representation on PV and TS diagram & determination of COP. 2.2 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.) 2.3 Vapour Compression Cycle (V.C.C): - - Principle, Components, Representation on P-H and T-S diagram, COP, , Effect of superheating, under cooling, suction pressure and discharge pressure, (simple numerical), Actual V.C.C. - Introduction to multistage V.C.C., its necessity, advantages. 2.4 Vapour Absorption system : - - Flow diagram and working principle of aqua- ammonia system (simple & practical) - Flow diagram and working principle of Electrolux Refrigeration System, - Desirable properties of Refrigerant and absorbent used in Vapour Absorption System. - Comparison of above Refrigeration Cycles.	14
03	**Refrigerants** 3.1 Classification of refrigerants. 3.2 Desirable properties of refrigerants. 3.3 Nomenclature of refrigerants. 3.4 Selection of refrigerant for specific applications. 3.5 Concept of Green House Effect, Ozone depletion, Global warming. 3.6 Eco-friendly refrigerants like R-134a, hydrocarbon refrigerants.	06
04	**Equipment selection** 4.1 Components of Vapour Compression Refrigeration System 4.1.1 Compressors: - Classification, Construction and working of open type, hermetic, centrifugal, rotary, screw and scroll compressor and their applications. 4.1.2 Condensers: - Classification, description of air cooled and water cooled condensers,	10

	comparison and applications - Evaporative condensers. 4.1.3 Expansion devices: - Types: - Capillary tube, automatic, thermostatic and their applications 4.1.4 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 **4.2** Draw the flow diagram of the following Vapour compression refrigeration system and label the type of components & refrigerant used: Water coolers, ice plants, cold storage, domestic refrigerator	
Group B		
05	**Psychrometry** 5.1 Definition and necessity of air conditioning. 5.2 Properties of Air, Dalton's law of partial pressure 5.3 Psychrometric chart 5.4 Discussion on Psychrometric processes using Psychrometric chart & flow diagram, Concept of Bypass Factor, ADP, SHF, RSHF, ERSHF, and GSHF. 5.5 Adiabatic mixing of Air streams 5.6 Simple numerical using Psychrometric chart 5.7 Equipments used for Air- conditioning like humidifier, dehumidifier, filter, heating and cooling coils	8
06	**Air- conditioning systems** 7.1 Classification of A.C. systems 7.2 Industrial and commercial A.C. systems 7.3 Summer, winter and year round A.C. systems 7.4 Central and unitary A.C. systems 7.5 Application areas of A.C. systems	**04**
		45

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.
4. Observe working of test rigs and calculate coefficient of performance.

Motor skills:

1. Handle various tools used for refrigeration and air conditioning plant maintenance
2. Use of temperature, pressure, energy measuring devices
3. Draw the layout of central Air conditioning plant

List of Practical:

Group A: (Any five)

1. Trial on water cooler 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 and Air distribution system (e.g. frozen food industry/ice- cream industry/mushroom plants/textile industries).

Assignments:

1. Prepare a chart mentioning name VCC equipments and their applications.
2. Prepare a chart mentioning different Refrigerants & their specific application.
3. Prepare Air distribution system of central air conditioning system.
4. Two problems on VCC.
5. Two problems on Air refrigeration cycle.
6. One problem on each Psychrometric process using Psychrometric chart.
7. Flow diagram of simple air craft cooling system

Examination Schedule: Internal practical Sessional examination
Examiner: **Lecturer / Jr. Lecturer**

Attending classes, practicing programs & submitting respective assignment in time (both groups)		4x5 =20	
Viva - voce		5	
Total:		25	
Examination Schedule: External practical Sessional examination Examiner: **Lecturer / Jr. Lecturer**			
For submission of assignment in scheduled time		2x5= 10	
On spot activity		10	
viva voce		05	
Total		25	

.
Reference books :- Nil
Suggested List of Laboratory Experiments :- Nil
Suggested List of Assignments/Tutorial :- as mentioned in list of practical

List of Books:

Sr. No	Author	Tit;e	Publisher
01	R.S.Khurmi	Refrigeration and Air Conditioning	S.Chand and Co
02	R.K. Rajput	Refrigeration and Air Conditioning	S.K.KATARIA
03	Arrora and Domkundwar	Refrigeration and Air Conditioning	Dhanpat Rai and Sons
04	Manohar Prasad	Refrigeration and Air Conditioning	New Age Publications
05	P.N.Ananthanarayanan	Refrigeration and Air Conditioning	Tata McGraw Hill
06	Roy Dossat	Principles of Refrigeration	Pearson Education
07	Edwin P. Anderson	Commercial Refrigeration	Taraporevala Sons & Co
08	Arora	Refrigeration and Air Conditioning	P.H.I
09	C.P.Arora	Refrigeration and Air Conditioning	Tata McGraw Hill
10	P.L.Ballany	Refrigeration and Air Conditioning	Khanna publishers

GROUP	Chapter	ONE OR TWO SENTENCE ANSWER QUESTIONS				GROUP	Chapter	SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS			TO BE SET	*TO BE ANSWERED*	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3,4	6	10	1	1 x 10 = 10	A	1,2,3,4	6	**FIVE,** TAKING AT LEAST TWO FROM EACH GROUP	5	5 X 5 = 25
B	5,6	4				B	5,6	4			

West Bengal State Council of Technical Education

(A Statutory Body under West Bengal Act XXI of 1995)
Kolkata Karigori Bhavan, 2nd Floor, 110 S. N. Banerjee Road, Kolkata - 700 013.

Name of the Course : Diploma in Mechanical Engineering Subject Title: **CAD-CAM & AUTOMATION**	
Course code: ME/	**Semester :** sixth
Duration : 17 weeks	**Maximum Marks : 100**
Teaching Scheme:	**Examination Scheme:**
Theory : 3 hrs/week	**Internal Assessment**: 10 Marks
Tutorial: hrs/week	**Teacher's assessment (Assignment & Quiz)**: 05 Marks
Practical : 2 hrs/week	**End Semester Exam**: 35 Marks
	Practical: Internal Sessional continuous evaluation:25 Marks
Credit: 4	**Practical: External Sessional Examination**:25 Marks

Aim :-	
S.No	
1	The need of today's manufacturing industrial world is based on best quality & precision oriented shorter manufacturing cycle time .To satisfy this need the use of CAD/CAM & automation is inevitable .To satisfy industrial need, diploma engineer should be able to cope with CAD/CAM technology. With this intention this subject is introduced in the curriculum.
S No	The student will able to
1	1. Understand the fundamentals & use CAD. 2. Conceptualize drafting and modelling in CAD. 3. Prepare CNC part programming. 4. Operate CNC machines. 5. Conceptualize automation and FMS.
Pre-Requisite:-	
S.No	
1	Knowledge on engineering graphics, engineering drawing, mechanical engineering drawing, basic idea on manufacturing technology, transducer & sensor, fluid power. .

Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
Group A		
01	**Introduction to CAD/CAM** Computers in industrial manufacturing. Product Cycle, CAD/CAM CAD/CAM hardware:- basic structure, CPU, Memory, I/O devices, Storage devices and system configuration.	**05**
02	**Geometric Modelling** Requirement of geometric modelling, Types of geometric models. Geometric construction method-sweep, solid modelling- Primitives & Boolean operations, free formed surfaces (Classification of surface only) (No	**10**

	numerical treatment)	
	Group B	
03	**Introduction to computer numerical Control** Introduction - NC, CNC, DNC, Advantages of CNC, The coordinate system in CNC, Motion control system - point to point, straight line, Continuous path (Contouring). Application of CNC.	**05**
04	**Part programming** Fundamentals, manual part programming, NC –Words, Programming format, part programming, use of subroutines and do loops, computer aided part programming (APT).	**12**
	Group C	
05	**Industrial Robotics** Introduction, physical configuration, basic robot motions, technical features such as - work volume, precision and speed of movement, weight carrying capacity, drive system, End effectors, robot sensors. Application – Material transfer, machine loading, welding, spray coating, processing operation, assembly, inspection.	**08**
06	**Automation** Basic elements of automated system, advanced automation functions, levels of automation. Flexible manufacturing system :-Introduction, FMS equipment, FMS application, Introduction to CIM	**05**
		45

Practical:

Skills to be developed:

Intellectual Skills:

1. Interpret the various features in the menu of solid modeling package.
2. Synthesize various parts or components in an assembly.
3. Prepare cnc programmes for various jobs.
4. Understand the concept of finite element method.
5. Prepare a report of visits.

Motor skills:

1. Operate a turning center and a machining center.
2. Operate and use solid modeling packages for drawing of assemblies.
3. Draw sketches of assemblies for converting into solid models.
4. Handle various tools used in cnc.

List of Practical: ((Any five)

1. Two assignments on CAD for 2D drafting (Using AutoCAD)
2. Two assignments on CAD for 3D Modelling. (Using any 3-D Modelling software like CATIA, ProE, Solidworks, Solid Edge etc.)
3. Two assignments on CAM Software.

4. Manufacturing one turning and one Milling component on CNC.
5. At least four assignments on part programming using subroutines do loops for turning and milling component.
6. Report writing on visit to industry having CNC machine.
7. Report writing on visit to industry having robot Application.
8. Report writing on visit to Industry having Automation in manufacturing.

Examination Schedule Internal practical Sessional:

Attending classes, practicing programs / practical task & submitting respective assignment in time		20	
Viva - voce		5	
Total:		25	
Examination Schedule: External practical Sessional examination Examiner: **Lecturer**			
For submission of assignment in scheduled time		10	
On spot activity		10	
viva voce		05	
Total		25	

.

Reference books :- Nil

Suggested List of Laboratory Experiments :- Nil

Suggested List of Assignments/Tutorial :- as mentioned in list of practical

List of Books:

Sr. No	Author	Title	Publication
01	P.N.Rao	CAD/CAM Principles and Applications	Tata McGraw-Hill
02	RadhaKrishna P. & Subramanyam	CAD/CAM/CIM	Wiley EasternLtd
03	B.S.Pabla and M.Adithan	CNC Machine	New age International(P)Ltd
04	H.K.SHIVANANDA, M.M.BENAL	Flexible Manufacturing System	New age International(P)Ltd

05	Groover M.P. & Zimmers Jr	Computer Aided design and manufacturing	Prentice hall of India
06	K. Sareen C. Grewal	CAD & CAM Theory and Concepts	S. Chand
07	J.S.Narang	CNC Machine & Automation	Dhanpat Rai & C0

GROUP	**Chapter**	**ONE OR TWO SENTENCE ANSWER QUESTIONS**				**GROUP**	**Chapter**	**SUBJECTIVE QUESTIONS**			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS			TO BE SET	***TO BE ANSWERED***	MARKS PER QUESTION	TOTAL MARKS
A	1,2	3	10	1	1 X 10 = 10	A	1,2	3	**FIVE,** TAKING AT LEAST ONE FROM EACH GROUP	5	5 X 5 = 25
B	3,4	4				B	3,4	5			
C	5,6	3				C	5,6	2			

Name of the Course : DIPLOMA IN MECHANICAL ENGINEERING **Subject Title:** ALTERNATE ENERGY SOURCES AND MANAGEMENT (ELECTIVE II)		
Course code:	**Semester :** Sixth	
Duration : 17 weeks	**Maximum Marks : 100**	
Teaching Scheme	**Examination Scheme:**	
Theory : 3 hrs/week	Internal Assessment: 10Marks	
Tutorial: hrs/week	Teacher's Assessment (Assignment & Quiz): 5 Marks	
Practical : 2 hrs/week	End Semester Exam: 35 Marks	
Credit: 4	Practical: Internal Sessional continuous evaluation: 25 Marks	
	Practical: External Sessional examination: 25 Marks	
Aim :-		
S.No		
1	To develop, operate and maintain alternative energy sources systems. It is therefore essential to know basics of energy conversion, conservation, energy audit and waste heat recovery techniques.	
Objective :-		
S No	The student will able to	
1	Develop awareness for effective utilization of alternative energy sources.	
2	Identify different components of solar energy and wind energy devices.	
3	Identify and analyze biomass plant.	
4	Identify and apply energy conservation techniques for commonly used power absorbing and generating devices.	
5	Apply principles of energy conservation and energy management techniques.	
Pre-Requisite:-		
	Nil	
Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
Group:A		
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: - Prospects of alternate energy sources. - Need of Alternate energy sources	02
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 Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle 2.3 Applications of Solar energy: - - 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 and Industrial process heat. (no derivations and numericals)	08
Group:B		
	Wind Energy 3.1 Basic Principle of wind energy conversion. 3.2 Power in wind, Available wind power formulation, Power coefficient,	

03	Maximum power 3.3 Main considerations in selecting a site for wind mills. 3.4 Advantages and limitations of wind energy conversion. 3.5 Classification of wind mills 3.6 Construction and working of horizontal and vertical axis wind mills, their comparison 3.7 Main applications of wind energy for power generation and pumping.	05
04	Energy from Biomass 4.1 Common species recommended for biomass. 4.2 Methods for obtaining energy from biomass 4.3 Thermal classification of biomass a) Gasified, b) Fixed bed and fluidized 4.4 Application of gasifier 4.5 Biodiesel production and application 4.6 Agriculture waste as a biomass 4.7 Biomass digester 4.8 Comparison of Biomass with conventional fuels	05
Group:C		
05	Energy Conservation & Management**:-** 5.1 Global and Indian energy market 5.2 Energy scenario in various sectors and Indian economy 5.3 Need and importance of energy conservation and management 5.4 Concept of Payback period, Return on investment (ROI), Life cycle cost, Sankey diagrams, specific energy consumption.	05
06	**Energy Conservation Techniques** 6.1 Distribution of energy consumption 6.2 Principles of energy conservation. 6.3 Energy audit 6.4 Types of audit 6.5 Methods of energy conservation 6.6 Cogeneration and its application 6.7 Combined cycle system 6.8 Concept of energy management 6.9 Study of different energy management techniques like - Analysis of input - Reuse and recycling of waste - Energy education - Conservative technique and energy audit	08
07	**Economic approach of Energy Conservation** 7.1 Costing of utilities like steam, compressed air, electricity and water. 7.2 Ways of improving boiler efficiency 7.3 Thermal insulation, Critical thickness of insulation 7.4 Waste heat recovery systems, their applications, criteria for installing unit. 7.5 An introductory approach of energy conservation in compressed air, refrigeration, air conditioning, pumps and fans.	08
	Total	41

Practical:

Skills to be developed:

Intellectual skills:

1. Understand working of various power plants.
2. Understand constructional features and working of devices used in non conventional energy sources.
3. Understand economical and operational aspects of power plants.

4. Calculate the efficiency of power generation cycles.

Motor skills:

1. List technical details of components and subsystems of power plants.
   a)HP & LP Heater feed cycle
   b)Condenser Cooling System including Cooling Tower.
   c)Generator Cooling System.
   d)HP & LP Bypass system.
   e)Turbine sealing system.
2. Draw layouts of different power plants
3. Operate devices using solar energy inputs

EXAMINATION SCHEME

GROUP	MODULE	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2	3	10	1	10	3	FIVE AT LEAST ONE FROM EACH GROUP	5	25
B	3,4	4				4			
C	5,6,7	3				4			

Name of Authors	Titles of the Book	Edition	Name of the Publisher
R.K.Rajput	Non conventional energy Sources & utilization		S.Chand & Co
Boyle	Renewable Energy		Oxford University Press
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
P.H. Henderson	India- The energy sector		Oxford 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 -		Wheeler Publishing, New Delhi
Krupal Singh Jogi	Energy resource management		Sarup and sons
Ghosh, Tushar K., Prelas, Mark A.	Energy Resources and Systems		Springer

2. Cassettes/CD/websites:

1. CDs developed by National Power Training Institute, (Under the ministry of Power, Government of India) Opposite VNIT, South Ambazari road, Nagpur
2. Website of Bureau of Energy and Efficiency. (www.bee-india.nic.in)
3. Website for Akshay Urja News Bulletin. (www.mnes.nic.in)

Reference books :- Nil

Visit to steam power plants/nuclear power plants/wind power plants/ Hydro power plants

	and prepare a report.(Any one Plant).
	To collect information about global and Indian energy market.
	To perform an experiment on solar flat plate collector used for water heating.
	To study construction and working of photo voltaic cell.
	To study construction, working and maintenance of solar cooker.
	To study construction and working of horizontal axis wind mill or to visit a nearest wind farm.
	To visit a biomass/ biogas plant of municipal waste or else where.
	To perform energy audit for workshop/Office/Home/SSI unit.
	To study of various waste heat recovery devices.
Suggested List of Laboratory Experiments :- Nil	
Suggested List of Assignments/Tutorial :- Nil	

EXAMINATION SCHEME FOR PRACTICAL SESSIONAL

Internal Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Five No. of Experiments / Study attended & respective lab note submitted in due time.	5 x 3 = 15		
VIVA VOCE	10		
TOTAL	25		
External Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Submission of Signed Lab Note Book (for five experiments / study)	5 x 2 = 10		
On spot experiment / study (one for each group consisting 15 students / explanation on study item)	10		
VIVA VOCE	5		
TOTAL	25		

Name of the Course : Mechanical Engineering **Subject: MATERIAL HANDLING SYSTEM (ELECTIVE II)**	
Course code: ME	**Semester: Sixth.**
Duration: 17 weeks	**Maximum Marks : 100**
Teaching Scheme	**Examination Scheme:**
Theory : 3 hrs/week	Internal Assessment: 10Marks
Tutorial: hrs/week	Teacher's Assessment (Assignment & Quiz): 5 Marks
Practical : 2 hrs/week	End Semester Exam: 35 Marks
Credit: **4**	Practical: Internal Sessional continuous evaluation: 25 Marks
	Practical: External Sessional examination: 25 Marks

Aim :-	
S. No.	
1	To know the operational features of the material handling equipment & its practical application, carrying parts & products in a shop from one work station to another and from shop to another shop or taking care of stockpiling and reclaiming operations, material handling equipment/systems enable the process to go on without interruptions & at a predetermined space. To understand, select, operate and maintain the material handling equipments.
Objective :-	
S. No.	The Students should be able to:
1	• Understand constructional & operational features of various materials handling systems.
2	• Identify, compare & select proper material handling equipment for specified applications.
3	• Know the controls & safety measures incorporated on material handling equipment.
4	• Understand different material handling processes used in industries.
5	• Appreciate the role of material handling devices in mechanization & automation of industrial process.

Pre-Requisite: Nil

Contents			Hrs/week	
MATERIAL HANDLING SYSTEM (ELECTIVE II)				
Chapter		**Name of the Topic**	**Hours**	**Marks**
		GROUP-A		
01	1.0 1.1 1.2	**Introduction to Material Handling System** Over view of basic principles, equipments and operations, importance of material handling equipments in relation to productivity and cost of production. Principle groups of equipment. Unit load, bulk load and their designation by code, various load handling attachments	**6**	
02	2.0 2.1 2.2 2.3	**Hoisting Machinery & Equipments** Construction, working principle and application of Hand Operated Hoists, Electric Hoists and Winch. Essential parts, operating principle of EOT Cranes. Long travel & cross travel mechanisms, break arrangement and safety arrangement of EOT Cranes. Essential parts, operating principle of Jib Crane, portal, semi-portal and mobile Crane. Basic principle of level lifting mechanism, luffing gear hoisting mechanism and slewing gear mechanism of Crane. Constructional details and applications of Bucket Elevator.	**12**	

		GROUP-B		
03	3.0 3.1	**Conveying Machinery:** Essential components, operating principle and applications of Belt Conveyors, Roller Conveyors, Screw Conveyors, Pneumatic Conveyors and Hydraulic Conveyors.	**12**	
04	4.0 4.1	**Surface Transportation Equipment:** Construction, working principle and application of trackless equipment such as Hand Operated Trucks, Powered Trucks, Tractors, AGV- Automatic Guided Vehicle and Industrial Trailers.	**10**	
05	5.0 5.1	**Selection of Material Handling Equipment:** Factors affecting choice of material handling equipment such as type of loads, hourly capacity of the unit, direction & length of travel, methods of stocking at initial, final & intermediate points, nature of production process involved, specific load conditions & economics of material handling system.	**5**	
		Sub Total:	**45**	
		Internal Assessment Examination & Preparation of Semester Examination	**6**	
		Total	**51**	

Practical:

Skills to be developed:

Intellectual Skill :

1. Understand the working principle of equipment/devices.
2. Identify & name major component of material handling device.
3. Understand role of material handling equipment in the industrial process.
4. Understand & appreciate safety instrumentation for equipment.

Motor Skills :

1. Identify & select the material handling devices for a given application.
2. Operate the working model of material handling equipment.
3. Ability to implement preventive maintenance schedule of material handling devices.

List of Practical:

1. Study & demonstration of Hand Operated Hoists / Electric Hoists / Winch.
2. Study & demonstration of any one type of conveyor – belt, Screw, pneumatic, hydraulic.
3. Study and demonstration of any one type of crane (working model or actual).
4. Study and demonstration of fork lift truck (using electric drive or diesel engine).
5. Study and demonstration of Bucket Elevator.
6. Study of preventive maintenance schedule of any one major material handling equipment using operation manual.
7. Visit to coal handling plant of thermal power plant or cement industry to observe working of different types of bulk material handling devices (at least three equipments). Write report of the visit.
8. Collect and write detail specifications of any two major material handling devices.
9. Collect photographs of ten different types of cranes used in industries. Write name and specific utility of each.
10. Collect photographs of ten different types of conveyers used in industries. Write name and specific utility of each.

Note: At least **FIVE (05)** nos. of Practical / Study are to be conducted.

Text Books

Name of Authors	Titles of the Book	Edition	Name of the Publisher
S. Ray	Introduction to Materials Handling		New Age international (P) Ltd.
T.K. Ray	Mechanical Handling of Materials		Asian Books Pvt. Ltd.
N. Rundenko	Material Handling Equipment		Peace Publisher, Moscow
M. P. Alexandrov	Material Handling Equipment		MIR Publisher, Moscow
Y. I. Oberman	Material Handling		MIR Publisher, Moscow
R. B. Chowdary & G. R. N. Tagore	Material Handling Equipment		Khanna Publisher, Delhi
T. H. Allegri	Material Handling (Principles & Practice)		CBS Publisher, Delhi
J. M. Apple	Plant Layout & Materials Handling		John Wiley Publishers.
J. R. Immer	Material Handling		Mc Graw Hill, New York

Suggested List of Assignments / Tutorial :-

1. Write with suitable diagram the essential parts and their function of Bucket Elevator.
2. Write with suitable diagram the essential parts and their function of a Fork Lift Truck.
3. Write with suitable diagram the essential parts and their function of a Screw Conveyor.
4. Write the names and their specific use of different Hand Operated Trucks used in actual industries.

EXAMINATION SCHEME: END SEMESTER EXAMINATION

GROUP	MODULE OR CHAPTER	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2,	5	10	1	10	5	FIVE, (AT LEAST TWO FROM EACH GROUP)	5	25
B	3,4,5	5				5			

EXAMINATION SCHEME FOR PRACTICAL SESSIONAL

Internal Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Five No. of Experiments / Study attended & respective lab note submitted in due time.	5 x 3 = 15		
VIVA VOCE	10		
TOTAL	25		
External Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Submission of Signed Lab Note Book (for five experiments / study)	5 x 2 = 10		
On spot experiment / study (one for each group consisting 15 students / explanation on study item)	10		
VIVA VOCE	5		
TOTAL	25		

Name of the Course : DIPLOMA IN MECHANICAL ENGINEERING Subject: PRODUCTION MANAGEMENT		
Course code:		**Semester :** Sixth
Duration : 17 week		**Maximum Marks : 100**
Teaching Scheme		**Examination Scheme**
Theory : 3 hrs/week		Semester Exam: **70** Marks
Tutorial: hrs/week		Teacher's Assessment (Assignment & Quiz): **10** Marks
Practical : hrs/week		Internal Assessment: **20** Marks
Credit: 3		
Aim :-		
	To study the techniques for improvement in productivity of the people and equipment. to plan the production schedule accordingly organize material supply for the manufacturing activities. To minimize the direct and indirect cost by optimizing the use of resources available. To learn accounting process, inventory control and process planning. Modern manufacturing system employ techniques such as JIT, TPM , FMS, 5'S', kaizen which should be known to the technician.	
Objective :-		
S No	The student will able to	
1	Understand importance of productivity and factors for improvement of productivity.	
2	Know different production systems and modern trends in manufacturing systems.	
3	Find the break even point for manufacturing a product.	
4	Prepare / modify layout of production system.	
5	Select suitable material handling devices and plant facilities.	
	Prepare process plan and specify toolings for it.	
	Prepare process chart for analysis of existing process.	
	Use pert & cpm techniques for scheduling and controlling the manufacturing activities.	
	Apply techniques of method study and work measurement for improvement of existing manufacturing methods.	
	Find the economic order quantity (eoq) for given situation.	
Pre-Requisite:-Nil		
Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
GROUP:A		
01	**Production System** **Production -** Definition , Types of production systems **Productivity -** Importance , Measurement of Productivity , Techniques of improving productivity **Elements of cost-** Fixed cost, Variable Cost. Break even analysis, Calculation of Break even point.	05
02	**Plant location, Plant layout and Material Handling** **Plant Location -** Importance of Site Selection, Factors affecting Site Selection, Government Policies, and relaxation for Backward Areas. **Plant Layout -** Objectives, types, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout. Group technology , Cellular layout, **Material handling –** Need, Principles and Types of material handling devices – conveyors , Hoist & cranes , forklift truck, trolleys, Pipes, Automated Guided Vehicles (AGV's) Selection of Material Handling systems and Devices.	05
GROUP:B		

03	**Process Planning** Planning of Processes from raw material to finished product, Factors affecting Process Planning, Deciding sequence of operations, Operation Sheet, Combined operations, Determination of Inspection Stages. Selection of Machine Techniques of assembly planning, Types of assembly. Plant Capacity, Machine Capacity, Plant Efficiency. Numerical not to be asked,	05
04	**Production Planning and Control** Routing, Sequencing [n job 2 machines], Scheduling, Dispatching, Meaning of Control, Progressive Control, Gantt chart. Concept of Line balancing,	03
GROUP:C		
05	**Work Study** **Method Study-** Objectives, Procedure, Selection of work. Recording Techniques - Process Charts – Outline process chart, Flow process chart, Two Hand process chart, Multiple activity chart, Flow diagram, String diagram, Travel chart. **Micro motion study-**Critical Examination, Principles of Motion Economy. Concept of ergonomics and workplace layout. **Work Measurement -** Objectives, procedure , Time Study, Time Study Equipments. Stop Watch Time Study, Standard Time, Work Sampling, Analytical Estimating, Predetermined Motion Time Study, Allowances, Calculation of Standard Time, Concept of Merit Rating.	08
06	**Maintenance of machine Tools:** Types of maintenance, repair cycle analysis, repair complexity, maintenance manual, maintenance records, housekeeping, Introduction to total production maintenance(TPM).	04
07	**Quality Control:** **A) Quality:** Definitions, meaning of quality of product and services, quality characteristics, quality of design, quality of conformance, quality of performance, concept of reliability, cost, quantity assurance, cost of rework and repair, quality and inspection, inspection stage. **B) Total Quality Management(TQM):** 1. Principles of total quantity management. i) customer focus. ii) Commitment by top management. iii) Continuous improvement-PDCA, Quality Circles. iv) Employee empowerment(JIDOKA). -Quality Audit: Concept of audit practices, lead assessor certification. -Six sigma: Statistical meaning, methodology of system improvement, DMAIC cycle, yellow belt, green belt, black belt certification. **C) ISO 9000 Series & other standards:**	09

	Concept, ISO 9000 series quality standards, Qs 14000, Standards certification, other Quality systems.	
08	**Modern Trends** Just In Time manufacturing – Pull and push types of manufacturing systems, Waste reduction, 5'S', inventory reduction, single piece production systems. Concept of continuous improvement (Kaizen) – DMIAC cycle, Brain storming. Poka Yoke. Concept of Rapid Prototyping Concept of Flexible manufacturing system	06
	Total	45

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Kanishka Bedi	Production & Operations Management		Oxford University Press
L.C. Jhamb	Industrial Management		Everest
James C. Rigs	Production System, Planning, Analysis & Control		N.Y.Wiley & Sons
M.T.Telsang	Production & Operation Management		S.Chand
Buffa	Modern Production & Operation Management		Wiley
A.Bhattaraya & A.Kumar	Management Principles, Processes & Practices		Oxford University Press
O.P. Khanna	Industrial Engineering and Management		Dhanpat Rai & Sons
ILO	Work Study		ILO Geneva
Terry Wireman	Total productive maintenance		Industrial press inc.
Taiichi ohno	Toyota production system		Productivity Press

Reference books :- Nil

Suggested List of Assignments/Tutorial :-

1. Making a conceptual layout of an Engg. Industry conforming ISO 9000 series.
2. Preparation of EOQ model.
3. Preparation of a flow process and operation process chart.
4. Preparation of a chart of Total Quality Management.

End Semester Examination Scheme. Maximum Marks-70, Time Allotted-3 hrs							
Group	**unit**	**Objective Questions**		**Subjective Questions**			
		No. of questions to be set	**Total marks**	**No. of questions to be set**	**To answer**	**Marks per question**	**Total marks**
A	**01,02**	**4**		**2**	**5, taking at least one from each group**	**10**	**50**
B	**03,04**	**6**	**20**	**4**			
C	**05,06,07**	**10**		**4**			

Suggested List of Laboratory Experiments :- Nil

Name of the Course : DIPLOMA IN MECHANICAL ENGINEERING (INDUSTRIAL PROJECT)	
Course code: ME	**Semester: Sixth.**
Duration: 17 weeks	**Maximum Marks : 100**
Teaching Scheme	**Examination Scheme:**
Theory : hrs/week	Practical: Internal Sessional continuous evaluation: 50 Marks
Tutorial: hrs/week	Practical: External Sessional examination: 50 Marks
Practical : 6 hrs/week	
Credit: **3**	
Aim :-	
S. No.	
1	To solve the problems involving drawings, designs, manufacturing, installation, testing and maintenance of machines. In order to cultivate the systematic methodology for problem solving using acquired technical knowledge & skills, and to enhance the generic skills & professional skills.
Objective :-	
	The Students should be able to:
	1. Identify, analyze & define the problem. 2. Generate alternative solutions to the problem identified. 3. Compare & select feasible solutions from alternatives generated. 4. Design, develop, manufacture & operate equipment/program. 5. Acquire higher-level technical knowledge by studying recent development in mechanical engineering field. 6. Compare machines/devices/apparatus for performance practices. 7. Work effectively in a team.
Pre-Requisite: Nil	

Contents:

Part A-Project

A batch of maximum 4 students will select a problem and then plan, organize & execute the project work of solving the problem in a specified duration. Student is expected to apply the knowledge & skills acquired. Batch may select any one problem/project work from following categories.

a) Fabrication of small machine / devices/ test rigs/ material handling devices/ jig & fixtures/ demonstration models, etc. Report involving aspects of drawing, process sheets, costing, Installation, commissioning & testing should be prepared and submitted.

b) Design & fabrication of mechanisms, machines, Devices, etc. Report involving aspects of designing & fabricating should be prepared & submitted

c) Development of computer program for designing and /or drawing of machine components, Simulation of movement & operation, 3D modeling, pick & place robots etc.

d) Industry sponsored projects- project related with solving the problems identified by industry should be selected. One person / engineer from industry is expected to work as co- guide along with guide from institution.

e) 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 or mechatronics field, and should not be a part of diploma curriculum. Report should be of min 60 pages.

f) Investigative projects- Project related with investigations of causes for change in performance or structure of machine or component under different constraints through experimentation and data analysis.

g) Maintenance based projects: The institute may have some machine/ equipment/ system which are lying idle due to lack of maintenance. Students may select the specific machines/equipment/system. Overhaul

it, repair it and bring it to working condition. The systematic procedure for maintenance to be followed and the report of the activity are submitted.
h) Industrial engineering based project: Project based on work study, method study, methods improvement, leading to productivity improvement, data collection, data analysis and data interpretation be undertaken.
i) Low cost automation projects: Project based on hydraulic/pneumatic circuits resulting into low cost automated equipment useful in the identified areas.
j) Innovative/ Creative projects – Projects related with design, develop & implementation of new concept for some identified useful activity using PLC, robotics, non-conventional energy sources, CIM , mechatronics, etc.
k) Environmental management systems projects: Projects related with pollution control, Solid waste management, liquid waste management, Industrial hygiene, etc, Working model or case study should be undertaken.
l) Market research/ survey based projects: Projected related with identification of extent of demand, sales forecasting, Comparative study of marketing strategies, Comparative study of channels of distribution, Impact of variables on sales volume, etc. The project involves extensive survey & market research activities information to be collected through various mechanisms/tools & report is prepared.
m) Project based on use of appropriate technology particularly benefiting rural society or economically weaker section.
n) Project can be selected other than the area specified above. Project should provide viable and feasible solution to the problem identified. Report should be of min 50 pages.

Part B- Seminar

Every student will prepare & deliver the seminar. Evaluation of seminar will be carried out by panel of at least three teaching staff from mechanical/ production /automobile department.
1. Selection of topic for the seminar should be finalized in consultation with teacher guide allotted for the batch to which student belongs.
2. Seminar report should be of min.10 & max. 20 pages & it should be certified by guide teacher and head of the department
3. for presentation of seminar, following guide lines are expected to be followed:-
a) Time for presentation of seminar: 7 to 10 minutes /student.
b) Time for question/answer : 2 to 3 minutes /student
c) use of audio visual aids or power point presentation is desirable.
4. Topic of the seminar should not be from diploma curriculum.
5. Seminar can be on project selected by batch.

Skills To Be Developed:

Intellectual Skills
1. Design the related machine components & mechanism.
2. Convert innovative or creative idea into reality.
3. Understand & interpret drawings & mechanisms
4. Select the viable, feasible & optimum alternative from different alternatives.

Motors skills
1. Use of skills learnt in workshop practical.
2. Assemble parts or components to form machine or mechanisms.
3. Classify & analyze the information collected.
4. Implement the solution of problem effectively.

Notes: 1) Project group size: Maximum 4 students
2) Project report will be of minimum 40 pages unless otherwise specified.
3) Project diary should be maintained by each student.

Text Books

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Karl Smith	Project management & team work		Tata- Mc Graw Hill
Cliffored gray & Erik Lasson	Project management		Tata- Mc Graw Hill

EXAMINATION SCHEME FOR PRACTICAL SESSIONAL

Internal Examination: Examiner- Lecturer in Mechanical Engg.			
On Project Work & submission of project within schedule time.	30		
Seminar on Project Work	10		
Viva-voce	10		
TOTAL	50		
External Examination: Examiner- Lecturer in Mechanical Engg.			
On Project Work	20		
Viva-voce	30		
TOTAL	50		

Name of the Course : Mechanical Engineering **Subject Title: Professional Practices-IV**	
Course code:	**Semester: Sixth.**
Duration :	**Maximum Marks : 50**
Teaching Scheme	**Examination Scheme**
Theory : hrs/week	Practical: Internal Sessional Continuous Evaluation: **25 Marks**
Tutorial: hrs/week	Practical: External Sessional Examination: **25 Marks**
Practical : **4** hrs/week	
Credit: **2**	

Aim :-	
Sl. No.	
1	To develop general confidence, ability to communicate and attitude, in addition to basic technological concepts through Industrial visits, expert lectures, seminars on technical topics and group discussion.
Objective :-	
Sl. No.	The student will able to:
1	• Acquire information from different sources.
2	• Prepare notes for given topic.
3	• Present given topic in a seminar.
4	• Interact with peers to share thoughts.
5	• Prepare a report on industrial visit, expert lecture
Pre-Requisite:-Nil	

Contents		Hrs/week
Chapter	**Name of the Topic**	
01	**Group Discussion : (Two topics)** The students shall discuss in group of six to eight students and write a brief report on the same as a part of term work. The topic for group discussions may be selected by the faculty members. Some of the suggested topics are: i) Solar Vehicles / Electric Vehicles. ii) Auto Vehicles – Comparison. iii) Two stroke versus four stroke engines. iv) Recycling of plastics and other waste material. v) Attributes of product design. vi) Creativity and innovativeness. vii) Energy conservation in institutes. viii) Value engineering. ix) Revolution in communication technology. x) Pneumatic tools and equipments. xi) Wear mechanisms.	10 Hrs.
02	**Seminar on technical topic:** Individual student should present a seminar on technical topic and also submit a brief report on the same as a part of term work. The seminar topic may be suggested by the faculty members.	20 Hrs.
03	**Study of Open Source Softwares:** **1]LibreOffice** **Unit:1** Installation Of LibreOffice and Introduction to LibreOffice Writer **Unit:2** Introduction to LibreOffice Calc **Unit:3** Introduction to LibreOffice Impress **Unit: 4** Introduction to LibreOffice Base **Unit: 5** Introduction to LibreOffice Math **Unit: 6** Introduction to LibreOffice Draw	30 Hrs.

	2] Scilab **Unit:1** Introduction and Installation Of Scilab and Vector Operations **Unit:2** Matrix Operations and Scripts and functions **Unit:3** Conditional Branching and Iterations and Plotting in Scilab **Unit: 4** ODES and Polynomials in Scilab **Unit: 5** SBHS and Introduction to X-Cos in Scilab	
	Total	60 Hrs.

Recommended Text Books:

It is alright to go ahead with teaching from the prescribed books as per the existing syllabus. Text books can be referred from the link given below.

Text Books link for LibreOffice:

- http://www.taming-libreoffice.com/category/books

Recommended Text Books:

Introduction to MATLAB & ITS Open Source Equivalent SCILAB and hands on demonstration:

1. Introduction and Installation Of MATLAB & SCILAB and Vector Operations
2. Matrix Operations and Scripts and functions
3. Conditional Branching and Iterations and Plotting in Scilab
4. SBHS and Introduction to X-Cos in Scilab
5. **Matlab programming by Singh (PHI)**
6. **Matlab.by Rudrapratap Oxford**

Examination Scheme:	
Internal Practical Sessional Examination	
Topic	**Marks**
1 - Performance and submission of assignment on group discussion on scheduled date.	**5**
2 - Performance and submission of assignment on seminar on scheduled date.	**5**
3 - Practice on open source software.	**10**
4 - Viva – voce.	**5**
Total:	**25**
External Practical Sessional Examination	
Topic	**Marks**
1 - Submission of signed report & assignment.	**5**
2 - On spot open source software activity.	**15**
3 - Viva voce.	**5**
Total:	**25**

Name of the Course: Diploma in Mechanical Engineering
Subject: General Viva-Voce

Course Code:	**AE**	**Semester:**	**Sixth**
Duration:	**N.A**	**Maximum Marks:**	**100**
Teaching Scheme :	**N.A**	**Examination Scheme :**	**viva-voce**
Theory:	**Nil**	**Continuous Internal Examination :**	**Nil**
Tutorial:	**Nil**	**End Semester Exam.:**	**Nil**
Practical:	**Nil**	**End Semester Examination (viva-voce):**	**100 Marks**
Credit: 3			

Aim :

The object of conducting Grand viva-voce is to assess out going students on their general understanding of all subjects (Theory, practical, laboratory etc.) taught and also on expected technical sense / ability developed being an engineer during this periods.

Examination Scheme (at semester end): Grand Viva-voce **Total Marks : 100**

- **End Semester Examination (viva-voce): - 100 marks.**

Examiner –Internal Lecturers headed by HOD (Mechanical)