

# STATE BOARD OF TECHNICAL EDUCATION, BIHAR

## Scheme of Teaching and Examinations for VI SEMESTER DIPLOMA IN MECHANICAL ENGG. ( Effective from Session 2016-17 Batch )

### THEORY

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME							
			Periods per Week	Hours of Exam.	Teacher's Assessment (TA) Marks A	Class Test (CT) Marks B	End Semester Exam.(ESE) Marks C	Total Marks (A+B+C)	Pass Marks ESE	Pass Marks in the Subject	Credits
1.	Management (Common)	1600601	03	03	10	20	70	100	28	40	03
2.	Design of Machine Elements	1625602	04	03	10	20	70	100	28	40	04
3.	Industrial Fluid Power	1625603	03	03	10	20	70	100	28	40	03
4.	Production Technology	1625604	03	03	10	20	70	100	28	40	03
5.	Elective-(Any One)	1625605	03	03	10	20	70	100	28	40	03
Elective- (i) Alternate Energy Sources & Management (1625605A)				(ii) Material Handling Systems (1625605B)		(iii) Refrigeration & Air-Conditioning (1625605C)			(iv) CAD-CAM & Automation (1625605D)		
<b>Total :-</b>			<b>16</b>				<b>350</b>	<b>500</b>			

### PRACTICAL

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME						
			Periods per Week	Hours of Exam.	Practical (ESE)		Total Marks (A+B)	Pass Marks in the Subject	Credits	
					Internal(A)	External(B)				
6.	Industrial Fluid Power Lab	1625606	02	03	15	35	50	20	01	
7.	Elective-(Any One) Lab	1625607	03	03	15	35	50	20	01	
Elective- (i) Alternate Energy Sources & Management Lab (1625607A)				(ii) Material Handling Systems Lab (1625607B)		(iii) Refrigeration & Air-Conditioning Lab (1625607C)		(iv) CAD-CAM & Automation Lab (1625607D)		
<b>Total :-</b>			<b>05</b>				<b>100</b>			

### TERM WORK

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME					
			Periods per Week	Marks of Internal Examiner (X)	Marks of External Examiner (Y)	Total Marks (X+Y)	Pass Marks in the Subject	Credits	
8.	Design of Machine Elements -TW	1625608	03	15	35	50	20	01	
9.	Industrial Project -TW	1625609	06	15	35	50	20	03	
10.	Professional Practices VI -TW	1625610	03	15	35	50	20	02	
<b>Total :-</b>			<b>12</b>			<b>150</b>			
<b>Total Periods per week Each of duration One Hour</b>				<b>33</b>	<b>Total Marks = 750</b>				<b>24</b>

# MANAGEMENT (COMMON)

<b>Subject Code 1600601</b>	<b>Theory</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>100</b>	<b>03</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>70</b>	
	<b>03</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>	
	<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>	

## CONTENTS : THEORY

Chapter	Name of the Topic	Hours	Marks
<b>Unit-01</b>	<p><b>Overview Of Business</b></p> <p>1.1. Types of Business</p> <ul style="list-style-type: none"> <li>• Service</li> <li>• Manufacturing</li> <li>• Trade</li> </ul> <p>1.2. Industrial sectors</p> <p><b>Introduction to</b></p> <ul style="list-style-type: none"> <li>• Engineering industry</li> <li>• Process industry</li> <li>• Textile industry</li> <li>• Chemical industry</li> <li>• Agro industry</li> </ul> <p>1.3 <b>Globalization</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Advantages &amp; disadvantages w.r.t. India</li> </ul> <p>1.4 Intellectual Property Rights (I.P.R.)</p>	<b>02</b>	<b>02</b>
<b>Unit-02</b>	<p><b>Management Process</b></p> <p>2.1 What is Management?</p> <ul style="list-style-type: none"> <li>• Evolution</li> <li>• Various definitions</li> <li>• Concept of management</li> <li>• Levels of management</li> <li>• Administration &amp; management</li> <li>• Scientific management by F.W.Taylor</li> </ul> <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"> <li>• Planning</li> <li>• Organizing</li> <li>• Directing</li> <li>• Controlling</li> </ul>	<b>07</b>	<b>10</b>

<p><b>Unit-03</b></p>	<p><b>Organizational Management</b></p> <p>3.1 Organization :-</p> <ul style="list-style-type: none"> <li>• Definition</li> <li>• Steps in organization</li> </ul> <p>3.2 Types of organization</p> <ul style="list-style-type: none"> <li>• Line</li> <li>• Line &amp; staff</li> <li>• Functional</li> <li>• Project</li> </ul> <p>3.3 Departmentation</p> <ul style="list-style-type: none"> <li>• Centralized &amp; Decentralized</li> <li>• Authority &amp; Responsibility</li> <li>• Span of Control</li> </ul> <p>3.4 Forms of ownership</p> <ul style="list-style-type: none"> <li>• Proprietorship</li> <li>• Partnership</li> <li>• Joint stock</li> <li>• Co-operative Society</li> <li>• Govt. Sector</li> </ul>	<p><b>07</b></p>	<p><b>10</b></p>
<p><b>Unit-04</b></p>	<p><b>Human Resource Management</b></p> <p>4.1 Personnel Management</p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Definition</li> <li>• Functions</li> </ul> <p>4.2 Staffing</p> <ul style="list-style-type: none"> <li>• Introduction to HR Planning</li> <li>• Recruitment Procedure</li> </ul> <p>4.3 Personnel- Training &amp; Development</p> <ul style="list-style-type: none"> <li>• Types of training</li> <li>➤ Induction</li> <li>➤ Skill Enhancement</li> </ul> <p>4.4 Leadership &amp; Motivation</p> <ul style="list-style-type: none"> <li>• Maslow's Theory of Motivation</li> </ul> <p>4.5 Safety Management</p> <ul style="list-style-type: none"> <li>• Causes of accident</li> <li>• Safety precautions</li> </ul> <p>4.6 Introduction to -</p> <ul style="list-style-type: none"> <li>• Factory Act</li> <li>• ESI Act</li> <li>• Workmen Compensation Act</li> <li>• Industrial Dispute Act</li> </ul>	<p><b>08</b></p>	<p><b>14</b></p>

<b>Unit-05</b>	<b>Financial Management</b> 5.1. Financial Management- Objectives & Functions 5.2. Capital Generation & Management <ul style="list-style-type: none"> <li>• Types of Capitals</li> <li>• Sources of raising Capital</li> </ul> 5.3. <b>Budgets and accounts</b> <ul style="list-style-type: none"> <li>• Types of Budgets</li> <li>➤ Production Budget (including Variance Report )</li> <li>➤ Labour Budget</li> <li>• Introduction to Profit &amp; Loss Account ( only concepts) ; Balance Sheet</li> </ul> 5.4 <b>Introduction to -</b> <ul style="list-style-type: none"> <li>• Excise Tax</li> <li>• Service Tax</li> <li>• Income Tax</li> <li>• VAT</li> <li>• Custom Duty</li> </ul>	<b>08</b>	<b>14</b>
<b>Unit-06</b>	<b>Materials Management</b> 6.1. Inventory Management (No Numerical) <ul style="list-style-type: none"> <li>• Meaning &amp; Objectives</li> </ul> 6.2 ABC Analysis 6.3 Economic Order Quantity <ul style="list-style-type: none"> <li>• Introduction &amp; Graphical Representation</li> </ul> 6.4 Purchase Procedure <ul style="list-style-type: none"> <li>• Objects of Purchasing</li> <li>• Functions of Purchase Dept.</li> <li>• Steps in Purchasing</li> </ul> 6.5 Modern Techniques of Material Management <ul style="list-style-type: none"> <li>• Introductory treatment to JIT / SAP / ERP</li> </ul>	<b>08</b>	<b>14</b>
<b>Unit-07</b>	<b>Project Management ( No Numerical)</b> 7.1 Project Management <ul style="list-style-type: none"> <li>• Introduction &amp; Meaning</li> <li>• Introduction to CPM &amp; PERT Technique</li> <li>• Concept of Break Even Analysis</li> </ul> 7.2 Quality Management <ul style="list-style-type: none"> <li>• Definition of Quality , concept of Quality , Quality Circle, Quality Assurance</li> <li>• Introduction to TQM, Kaizen, 5 'S', &amp; 6 Sigma</li> </ul>	<b>08</b>	<b>06</b>
	<b>TOTAL</b>	<b>48</b>	<b>70</b>

<b>Text/ Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Industrial Engg & Management	Dr. O.P. Khanna	Dhanpal Rai & sons New Delhi
Business Administration & Management	Dr. S.C. Saksena	Sahitya Bhavan Agra
The process of Management	W.H. Newman E.Kirby Warren Andrew R. McGill	Prentice- Hall
Industrial Management	Rustom S. Davar	Khanna Publication
Industrial Organisation & Management	Banga & Sharma	Khanna Publication
Industrial Management	Jhamb & Bokil	Everest Publication , Pune
Management	Deepak Chandra	Foundation Publishing

**DESIGN OF MACHINE ELEMENTS**  
**(MECHANICAL ENGINEERING GROUP)**

<b>Subject Code</b> <b>1625602</b>	<b>Theory</b>						<b>Credits</b> <b>04</b>	
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>				
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>100</b>		
	<b>04</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>		
	<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>		

**CONTENTS: THEORY**

	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
<b>Unit-01</b>	<p><b>Introduction to Design</b></p> <p>1.1 Machine Design philosophy and Procedures</p> <p>1.2 General Considerations in Machine Design</p> <p>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)</p> <p>1.4 Creep strain and Creep Curve</p> <p>1.5 Fatigue, S-N curve, Endurance Limit.</p> <p>1.6 Factor of Safety and Factors governing selection of factor of Safety.</p> <p>1.7 Stress Concentration – Causes &amp; Remedies</p> <p>1.8 Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety &amp; service factor.</p> <p>1.9 Properties of Engineering materials, Designation of materials as per IS and introduction to International standards &amp; advantages of standardization, use of design data book, use of standards in design and preferred numbers series.</p> <p>1.10 Theories of Elastic Failures – Principal normal stress theory, Maximum shear stress theory &amp; maximum distortion energy theory.</p>	<b>10</b>	<b>12</b>
<b>Unit-02</b>	<p><b>Design of simple machine parts</b></p> <p>1.11 Cotter Joint, Knuckle Joint, Turnbuckle</p> <p>1.12 Design of Levers:- Hand/Foot Lever &amp; Bell Crank Lever</p> <p>1.13 Design of C – Clamp, Off-set links, Overhang Crank, Arm of Pulley</p>	<b>08</b>	<b>10</b>
<b>Unit-03</b>	<p><b>Design of Shafts, Keys and Couplings and Spur Gears</b></p> <p>1.14 <i>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.</i></p> <p>1.14 Design of Sunk Keys, Effect of Keyways on strength of shaft.</p> <p>1.15 Design of Couplings – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible coupling.</p> <p>1.16 Spur gear design considerations. Lewis equation for static beam strength of spur gear teeth. Power transmission capacity of spur gears in bending.</p>	<b>12</b>	<b>14</b>
<b>Unit-04</b>	<p><b>Design of Power Screws</b></p> <p>1.17 Thread Profiles used for power Screws, relative merits and demerits of each, Torque required to overcome thread friction, self locking and overhauling property, efficiency of power screws, types of stresses induced.</p> <p>1.18 Design of Screw Jack, Toggle Jack.</p>	<b>10</b>	<b>10</b>

<b>Unit-05</b>	<b>Design of springs</b> 1.19 Classification and Applications of Springs, Spring – terminology, materials and specifications. 1.20 Stresses in springs, Wahl’s correction factor, Deflection of springs, Energy stored in springs. 1.21 Design of Helical tension and compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, railway buffers and governor springs. 1.22 Leaf springs – construction and application	<b>07</b>	<b>07</b>
<b>Unit-06</b>	<b>Design of Fasteners</b> 1.23 Stresses in Screwed fasteners, bolts of Uniform Strength. 1.24 Design of Bolted Joints subjected to eccentric loading. 1.25 Design of parallel and transverse fillet welds, axially loaded symmetrical section, Merits and demerits of screwed and welded joints	<b>07</b>	<b>09</b>
<b>Unit-07</b>	<b>Antifriction Bearings</b> 1.26 Classification of Bearings – Sliding contact & rolling contact. 1.27 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.	<b>05</b>	<b>04</b>
<b>Unit-08</b>	<b>Ergonomics &amp; Aesthetic consideration in design</b> 1.28 Ergonomics of Design – Man –Machine relationship. Design of Equipment for control, environment & safety. 1.29 Aesthetic considerations regarding shape, size, color & surface finish.	<b>05</b>	<b>04</b>
	<b>Total</b>	<b>64</b>	<b>70</b>

**Text / Reference Books:**

<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Introduction to Machine Design	V.B.Bhandari	Tata Mc- Graw Hill
Machine Design	R.K.Jain	Khanna Publication
Machine design	Pandya & Shah	Dhanpat Rai & Son
Mechanical Engg. Design	Joseph Edward Shigley	Mc- Graw Hill
Design Data Book	PSG Coimbtore	PSG Coimbtore
Hand Book of Properties of Engineering Materials & Design Data for Machine Elements	Abdulla Shariff	Dhanpat Rai & Sons
Theory and Problems of Machine Design	Hall, Holowenko, Laughlin	Mc- Graw Hill
Design of Machine Elements	D.P. Mandal	Foundation Publishing

**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

**2. IS 4694: 1968      Square threads**

- g) IS 808: 1967                      Structural Steel

**3. SKF Catalogue for Bearings**

**2. SOFTWARE**

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

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

**INDUSTRIAL FLUID POWER**  
**(MECHANICAL ENGINEERING GROUP)**

<b>Subject Code</b> <b>1625603</b>	<b>Theory</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>100</b>	<b>03</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>70</b>	
	<b>03</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>	
<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>		

**CONTENTS: THEORY**

	<b>Name of the topic</b>	<b>Hours</b>	<b>Marks</b>
<b>Unit-01</b>	<b>Introduction to oil hydraulic systems :</b> 1.1 Practical applications of hydraulic systems. 1.2 General layout of oil hydraulic systems. 1.3 Merits and limitations of oil hydraulic systems.	<b>03</b>	<b>04</b>
<b>Unit-02</b>	<b>Components of Hydraulic systems :</b> 2.1 Pumps – Vane pump, gear pump, Gerotor pump, screw pump, piston Pump. 2.2 Valves – Construction, working and symbols of Pressure control valves – pressure relief valve, pressure reducing, pressure unloading Direction control valves – Poppet valve, spool valve, 3/2, 4/2 D.C. valves, Sequence valves. Flow control valves – pressure compensated, non pressure compensated flow control valve.	<b>22</b>	<b>08</b>
	2.3 Actuators- Construction, working and symbols of Rotary Actuators - Hydraulic motors. Linear Actuators - Cylinders - single acting, double acting.		<b>04</b>
	2.4 Accessories – Pipes, Hoses, fittings, Oil filters, Seals and gaskets, Accumulators. (Types, construction, working principle and symbols of all components)		<b>06</b>
<b>Unit-03</b>	<b>Hydraulic Circuits :</b> 3.1 Meter in, Meter out circuits 3.2 Bleed off circuit 3.3 Sequencing circuit 3.4 Hydraulic circuits for Milling machine, Shaper machine, Motion synchronization circuit.	<b>07</b>	<b>06</b>
<b>Unit-04</b>	<b>Introduction to pneumatic Systems :</b> 4.1 Applications of pneumatic system 4.2 General layout of pneumatic system 4.3 Merits and limitations of pneumatic systems	<b>04</b>	<b>06</b>
<b>Unit-05</b>	<b>Components of pneumatic system :</b> 5.1 Compressor – Reciprocating & Rotary compressors. 5.2 Control Valves – Pressure regulating valves, Flow Control valves, Direction Control Valves.	<b>22</b>	<b>04</b>
	5.3 Actuators – Rotary - Air motors, Types, construction, working principle Linear- Cylinders- Types, construction & working principle.		<b>06</b>
	5.4 Accessories – Pipes, Hoses, Fittings, FRL unit (Types, construction, working principle and symbols of all components)		<b>06</b>
<b>Unit-06</b>	Pneumatic Circuits Speed control circuits. Sequencing circuits.	<b>06</b>	<b>06</b>
	<b>Total</b>	<b>64</b>	<b>70</b>

<b>Text / Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Industrial Hydraulics	Pippenger Hicks	McGraw Hill International
Oil Hydraulic system- Principle and maintenance	Majumdar S.R	Tata McGraw Hill
Pneumatics Systems Principles and Maintenance	Majumdar S.R	Tata McGraw Hill
Hydraulics and Pneumatics	Stewart	Taraporewala Publication
Industrial Fluid Power	S. Laxmikant	Foundation Publishing

**2. Catalogues:**

Various system components' manufacturers' Catalogues.

**3. CDs:**

CDs developed by various system components' manufacturers.

Industrial fluid power	Charles Hedges	Womack Educational Publications
Industrial hydraulic control	Peter Rhoner	Prentice Hall

**PRODUCTION TECHNOLOGY**  
**(MECHANICAL ENGINEERING GROUP)**

<b>Subject Code</b> <b>1625604</b>	<b>Theory</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>			<b>100</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>70</b>	<b>03</b>
	<b>03</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>	
	<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>	

**CONTENTS: THEORY**

<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
<b>Unit-01</b>	<b>Production System</b> <b>Production</b> - Definition , Types of production systems <b>Productivity</b> - Importance , Measurement of Productivity , Techniques of improving productivity <b>Elements of cost</b> - Fixed cost, Variable Cost. Break even analysis, Calculation of Break even point.	<b>06</b>	<b>06</b>
<b>Unit-02</b>	<b>Plant location, Plant layout and Material Handling</b> <b>Plant Location</b> - Importance of Site Selection, Factors affecting Site Selection, Government Policies, and relaxation for Backward Areas. <b>Plant Layout</b> - Objectives, types, design principles, characteristics of Plant Layout, Symptoms of Bad Plant Layout. Group technology , Cellular layout, <b>Material handling</b> – 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	<b>08</b>	<b>08</b>
<b>Unit-03</b>	<b>Process Planning :</b> 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,	<b>08</b>	<b>08</b>
<b>Unit-04</b>	<b>Production Planning and Control :</b> Routing, Sequencing [n job 2 machines], Scheduling, Dispatching, Meaning of Control, Progressive Control, Gantt chart. Concept of Line balancing,	<b>05</b>	<b>06</b>
<b>Unit-05</b>	<b>Work Study :</b> <b>Method Study</b> - 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. <b>Micro motion study</b> -Critical Examination, Principles of Motion Economy. Concept of ergonomics and workplace layout. <b>Work Measurement -</b> 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.	<b>14</b>	<b>14</b>
<b>Unit-06</b>	<b>Inventory Control :</b> Methods of Inventory Management, Inventory Cost relationship, Deciding Economic Batch Quantity, EOQ Model, Calculation of EOQ, Concepts of discounts. Introduction of Material Requirement Planning, Stores Function – Storage systems – One bin , Two bin system, Material issue request (MIR), bin card.	<b>09</b>	<b>12</b>
<b>Unit-07</b>	<b>Jigs and Fixtures :</b> Introduction. Difference between jig and fixture Different components of Jig/ fixture 3-2-1 principle of location. Types of locators and clamping devices. General principles of jig/fixture design. Types of jigs and fixtures.	<b>06</b>	<b>06</b>

<b>Unit-08</b>	<b>Modern Trends :</b> 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) – DMAIC cycle, Brain storming. Poka Yoke. Concept of Rapid Prototyping Concept of Flexible manufacturing system	<b>08</b>	<b>10</b>
	<b>Total</b>	<b>64</b>	<b>70</b>

<b>Text / Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Industrial Management	L.C. Jhamb	Everest
Production System, Planning, Analysis & Control	James C. Rigs	N.Y.Wiley & Sons
Industrial Engineering and Management	O.P. Khanna	Dhanpat Rai & Sons
Work Study	ILO	ILO Geneva
Jigs & Fixtures	P. H. Joshi	--
Production Engineering	P.C. Sharma	--
Introduction to Jigs and Fixtures Design	Kempster	--
Modern Production and Operations Management	Baffna , Sarin	--
Total productive maintenance	Terry Wireman	Industrial press inc.
Toyota production system	Taiichi ohno	Productivity Press
Production Technology	R.N.Pandey, S.P. Goyal	Foundation Publishing

**ELECTIVE - (ANY ONE) – (i) ALTERNATE ENERGY SOURCES AND MANAGEMENT (MECHENICAL ENGINEERING GROUP)**

<b>Subject Code 1625605A</b>	<b>Theory</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>100</b>	<b>03</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>70</b>	
	<b>03</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>	
	<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>	

<b>Contents :Theory</b>		<b>Hrs/week</b>	
<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
<b>01</b>	<b>Introduction to Energy Sources</b> 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.	<b>06</b>	<b>06</b>
<b>02</b>	<b>Solar Energy</b> 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)	<b>08</b>	<b>10</b>
<b>03</b>	<b>Wind Energy</b> 3.1 Basic Principle of wind energy conversion. 3.2 Power in wind, Available wind power formulation, Power coefficient, Maximum power 3.3 Main considerations in selecting a site for wind mills. 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.	<b>06</b>	<b>08</b>
<b>04</b>	<b>Energy from Biomass</b> 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	<b>08</b>	<b>10</b>

<b>05</b>	<b>Energy Conservation &amp; Management:-</b> 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.	<b>04</b>	<b>08</b>
<b>06</b>	<b>Energy Conservation Techniques</b> 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 <ul style="list-style-type: none"> <li>- Analysis of input</li> <li>- Reuse and recycling of waste</li> <li>- Energy education</li> <li>- Conservative technique and energy audit</li> </ul>	<b>08</b>	<b>14</b>
<b>07</b>	<b>Economic approach of Energy Conservation</b> 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.	<b>08</b>	<b>14</b>
<b>Total</b>		<b>48</b>	<b>70</b>

<b>Text/ Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Non conventional energy Resources	Dr B.H.Khan	Tata McGraw Hill
Non conventional energy sources	G. D. Rai	Khanna publication
Solar energy	S. P. Sukhatme	Tata McGraw Hill
Solar energy	H. P. Garg	Tata McGraw Hill
Power plant engineering	Arrora Domkundwar	Dhanpat Rai & co.
India- The energy sector	P.H. Henderson	University Press
Industrial energy conservation	D. A. Ray	Pergaman Press
Energy management handbook	W. C. Turner	Wiley Press
Non-conventional energy source	K. M. Mittal	-
Energy resource management	Krupal Singh Jogi	Sarup and sons
Energy Resources and Systems	Ghosh, Tushar K., Prelas, Mark	Springer
Alternate Energy Sources & Management	-	-

## **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](http://www.bee-india.nic.in))
3. Website for Akshay Urja News Bulletin. ([www.mnes.nic.in](http://www.mnes.nic.in))

**ELECTIVE - (ANY ONE) – (ii) MATERIAL HANDLING SYSTEMS**  
**(MECH. ENGG. GROUP)**

<b>Subject Code 1625605B</b>	<b>Theory</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>100</b>	<b>03</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>70</b>	
	<b>03</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>	
	<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>	

**CONTENTS: THEORY**

<b>Notes:</b> 1) Design aspects of material handling equipment are to be ignored. 2) No derivations & mathematical treatment.			
<b>Chapter</b>	<b>Name of the topic</b>	<b>Hrs/week</b>	<b>Marks</b>
<b>Unit-01</b>	<p><b>Introduction to Material Handling System</b> Main types of material handling equipments &amp; their applications, types of load to be handled, types of movements, methods of stacking, loading &amp; unloading systems, principles of material handling systems.</p>	<b>04</b>	<b>06</b>
<b>Unit-02</b>	<p><b>Hoisting Machinery &amp; Equipments</b> 2.1 Construction, working &amp; maintenance of different types of hoists such as lever operated hoist , portable hand chain hoist, differential hoists, worm geared and spur geared hoists, electric &amp; pneumatic hoists, jumper. 2.2 Construction, working &amp; maintenance of different types of cranes such as rotary cranes, trackless cranes, mobile cranes, bridge cranes, cable cranes, floating cranes &amp; cranes traveling on guide rails. 2.3 Construction, working &amp; maintenance of elevating equipments such as stackers, industrial lifts, freight elevators, passenger lifts, and mast type's elevators, vertical skip hoist elevators.</p>	<b>12</b>	<b>18</b>
<b>Unit-03</b>	<p><b>Conveying Machinery</b> 3.1 Construction, working &amp; maintenance of traction type conveyors such as belt conveyors, chain conveyors, bucket elevators, escalators. 3.2 Construction, working &amp; maintenance of traction less type conveyors such as gravity type conveyors, vibrating &amp; oscillating conveyors, screw conveyors, pneumatic &amp; hydraulic conveyors, hoppers gates &amp; feeders.</p>	<b>06</b>	<b>08</b>
<b>Unit-04</b>	<p><b>Surface Transportation Equipment</b> 4.1 Construction, function, working of trackless equipment such as hand operated trucks, powered trucks, tractors, AGV- Automatic Guided vehicle, industrial Trailers. 4.2 Construction, function, working of cross handling equipment such as winches, capstans, Turntables, Transfer tables, monorail conveyors.</p>	<b>08</b>	<b>10</b>
<b>Unit-05</b>	<p><b>Components of material handling systems</b> 5.1 Flexible hoisting appliances such as welded load chains, roller chains, hemp ropes, steel wire ropes, fastening methods of wire &amp; chains, eye bolts ,lifting tackles lifting &amp; rigging practices. 5.2 Load handling attachments. a) Various types of hooks-forged, triangular eye hooks, appliances for suspending hooks, b) Crane grab for unit &amp; piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids / molten metals 5.3 : Arresting gear &amp; Brakes. a) Arresting gear – construction &amp; working b) Construction &amp; use of electromagnetic shoe brakes Thruster operated shoe brakes, control brakes.</p>	<b>08</b>	<b>10</b>

<b>Unit-06</b>	<b>Mechanism used in material handling equipment</b> 6.1 Steady state motion, starting & stopping of motion in following mechanisms. Hoisting mechanism - Lifting Mechanism - Traveling Mechanism - Slewing Mechanism - Rope & chain operated Cross- Traverse Mechanism.	<b>06</b>	<b>10</b>
<b>Unit-07</b>	<b>Selection of material handling equipment</b> 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.	<b>04</b>	<b>08</b>
	Total	<b>48</b>	<b>70</b>

<b>Text / Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Material handling equipment	N. Rundenko	Peace Publisher, Moscow
Material handling equipment	M. P. Alexandrov	MIR Publisher, Moscow
Material handling	Y. I. Oberman	MIR Publisher, Moscow
Material handling equipment	R. B. Chowdary & G. R. N. Tagore	Khanna Publisher, Delhi
Material handling (Principles & Practice)	Allegrì T. H.	CBS Publisher, Delhi
Plant layout & materials handling	Apple j. M	JohnWiley Publishers.
Material handling Hand book	Bolz and others	--
Encyclopedia of materials handling	Daylas R. W. Pergaman, Berlin	--
Material handling	Immer J. R.	Mc Graw Hill, New York
Material handling equipment	Parameswaran M. A.	C.D.C. in Mechanical Engg., I.I.T., Chennai
Material Handling Cyclopedia	Roy V. Wright, John G. Little, Robert C. Augur	Kessinger Publishing
Manufacturing facilities design and material handling	Matthew P. Stephens	
Material Handling System	-	-

**ELECTIVE - (ANY ONE) – (iii) REFRIGERATION AND AIR  
CONDITIONING (MECH. ENGG. GROUP)**

<b>Subject Code 1625605C</b>	<b>Theory</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>100</b>	<b>03</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>70</b>	
	<b>03</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>	
	<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>	

<b>Contents: Theory</b>			
<b>Cha</b>	<b>Name of the Topic</b>	<b>Hrs/week</b>	<b>Marks</b>
<b>Unit-01</b>	<p><b>Basics of Refrigeration</b></p> <p>1.1 Definition of refrigeration.</p> <p>1.2 Necessity of refrigeration</p> <p>1.3 Methods of refrigeration:- Ice refrigeration Refrigeration by expansion of air Refrigeration by throttling of gas Vapour refrigeration system Steam jet refrigeration system Non conventional methods of refrigeration like Vortex tube, Pulse tube refrigeration, solar refrigeration</p> <p>1.4 Concept of heat engine, heat pump and refrigerator.</p> <p>1.5 Unit of refrigeration, C.O.P. and refrigerating effect.</p> <p>1.6 Major application areas of R.A.C. like domestic, commercial and industrial.</p>	<b>06</b>	<b>08</b>
<b>Unit-02</b>	<p><b>Refrigeration Cycles</b></p> <p>2.1 Reversed Carnot Cycle and its representation on PV and TS diagram.</p> <p>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.)</p> <p>2.3 Vapour Compression Cycle (V.C.C):- -principle, components, Representation on P-H and T-S diagram, effects of wet compression, dry compression, calculation of COP, Effect of superheating, under cooling, suction pressure and discharge pressure, Actual V.C.C., (simple numerical), Methods of improving COP (no description). - Introduction to multistage V.C.C., its necessity, advantages.</p> <p>2.4 Vapour Absorption system :- - Principle, components and working of aqua- ammonia system (simple &amp; practical) Li-Br Absorption System Electrolux Refrigeration System, Desirable properties of Refrigerant and absorbent used in Vapour Absorption System.</p> <p>Comparison of above Refrigeration Cycles.</p>	<b>10</b>	<b>14</b>
<b>Unit-03</b>	<p><b>Refrigerants</b></p> <p>3.1 Classification of refrigerants.</p> <p>3.2 Desirable properties of refrigerants.</p> <p>3.3 Nomenclature of refrigerants.</p> <p>3.4 Selection of refrigerant for specific applications.</p> <p>3.5 Concept of Green House Effect, Ozone depletion, Global warming.</p> <p>3.6 Eco-friendly refrigerants like R-134a, hydrocarbon refrigerants etc.</p>	<b>04</b>	<b>06</b>

<b>Unit-04</b>	<p><b>Equipment selection</b></p> <p>4.1 Components of Vapour Compression Refrigeration System</p> <p>4.1.1 Compressors:</p> <ul style="list-style-type: none"> <li>- Classification, Construction and working of open type, hermetic, centrifugal, rotary, screw and scroll compressor and their applications.</li> </ul> <p>4.1.2 Condensers:</p> <ul style="list-style-type: none"> <li>- Classification, description of air cooled and water cooled condensers, comparison and applications</li> <li>- Evaporative condensers.</li> </ul> <p>4.1.3 Expansion devices:</p> <ul style="list-style-type: none"> <li>- Types: - Capillary tube, automatic, thermostatic and their applications</li> </ul> <p>4.1.4 Evaporators and chillers: -</p> <ul style="list-style-type: none"> <li>- Classification of evaporators Construction and working of Bare tube, Plate surface, finned, shell and tube, flooded and dry expansion evaporator</li> <li>- Capacity of evaporator and their applications</li> <li>- Classification of chillers</li> <li>- Construction and working of dry expansion Chillers and flooded chillers and their applications.</li> </ul> <p>4.2 Selection criteria for Vapour compression refrigeration system components for the following applications: Water coolers, ice plants, cold storage, domestic refrigerator</p>	<b>10</b>	<b>14</b>
<b>Unit-05</b>	<p><b>Psychrometry</b></p> <p>5.1 Definition and necessity of air conditioning.</p> <p>5.2 Properties of Air, Dalton's law of partial pressure</p> <p>5.3 Psychrometric chart</p> <p>5.4 Psychrometric processes, Bypass Factor, ADP, concept of SHF, RSHF, ERSHF, GSHF</p> <p>5.5 Adiabatic mixing of Air streams</p> <p>5.6 Simple numerical using Psychrometric chart</p> <p>5.7 Equipments used for Air- conditioning like humidifier, dehumidifier, filter, heating and cooling coils.</p>	<b>06</b>	<b>08</b>
<b>Unit-06</b>	<p><b>Comfort conditions and cooling load calculations</b></p> <p>6.1 Thermal exchange of body with environment</p> <p>6.2 Factors affecting human comfort</p> <p>6.3 Effective temp. and comfort chart</p> <p>6.4 Components of cooling load- sensible heat gain and latent heat gain sources</p>	<b>04</b>	<b>06</b>
<b>Unit-07</b>	<p><b>Air- conditioning systems</b></p> <p>7.1 Classification of A.C. systems</p> <p>7.2 Industrial and commercial A.C. systems</p> <p>7.3 Summer, winter and year round A.C. systems</p> <p>7.4 Central and unitary A.C. systems</p> <p>7.5 Application areas of A.C. systems</p>	<b>04</b>	<b>08</b>
<b>Unit-08</b>	<p><b>Air distribution systems</b></p> <p>8.1 Duct systems: -</p> <ul style="list-style-type: none"> <li>- Closed perimeter system, extended plenum system, radial duct system, duct materials, requirement of duct materials, losses in ducts</li> </ul> <p>8.2 Fans and Blowers: -</p> <ul style="list-style-type: none"> <li>- Types, working of fans and blowers</li> </ul> <p>8.3 Air distribution outlets: -</p> <ul style="list-style-type: none"> <li>- Supply outlets, return outlets, grills, diffusers</li> </ul> <p>8.4 Insulation: -</p> <ul style="list-style-type: none"> <li>- Purpose, properties of insulating material, types of insulating materials, methods of applying insulation.</li> </ul>	<b>04</b>	<b>06</b>
<b>Total</b>	<b>48</b>	<b>70</b>	

<b>Text/ Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Refrigeration and Air Conditioning	R.S.Khurmi	S.Chand and Co
Refrigeration and Air Conditioning	Arora and Domkundwar	Dhanpat Rai and Sons
Refrigeration and Air Conditioning	Manohar Prasad	New Age Publications
Refrigeration and Air Conditioning	P.N.Ananthanarayanan	Tata McGraw Hill
Principles of Refrigeration	Roy Dossat	Pearson Education
Commercial Refrigeration	Edwin P. Anderson	Taraporevala Sons & Co
Refrigeration and Air Conditioning	Ahmadul Ameen	Prentice Hall-India
Refrigeration and Air Conditioning	C.P.Arora	Tata McGraw Hill
Refrigeration & Air-Conditioning	Biswajet Ranjan / Anand Pal	Foundation Publishing

**2. IS/International Codes/Publications:**

- a) ISHRAE handbooks
- b) Manohar Prasad: Refrigeration and Air Conditioning hand book, New Age Publications.

**ELECTIVE - (ANY ONE) – (iv) CAD-CAM & AUTOMATION**  
**(MECH. ENGG. GROUP)**

<b>Subject Code</b> <b>1625605D</b>	<b>Theory</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>			<b>03</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>70</b>	
	<b>03</b>	<b>—</b>	<b>—</b>	<b>TA</b>	<b>:</b>	<b>10</b>	
	<b>—</b>	<b>—</b>	<b>—</b>	<b>CT</b>	<b>:</b>	<b>20</b>	

<b>Content s: Theory</b>			
<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hrs/week</b>	<b>Marks</b>
<b>Unit-01</b>	<b>Introduction to CAD/CAM</b> Computers in industrial manufacturing. Product Cycle, CAD/CAM CAD/CAM hardware:- basic structure, CPU, Memory, I/O devices, Storage devices and system configuration.	<b>06</b>	<b>10</b>
<b>Unit-02</b>	<b>Geometric Modelling</b> 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 numerical treatment)	<b>10</b>	<b>14</b>
<b>Unit-03</b>	<b>Introduction to computer numerical Control</b> 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.	<b>05</b>	<b>08</b>
<b>Unit-04</b>	<b>Part programming</b> Fundamentals, manual part programming, NC –Words, Programming format, part programming, use of subroutines and do loops, computer aided part programming (APT).	<b>12</b>	<b>14</b>
<b>Unit-05</b>	<b>Industrial Robotics</b> 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,	<b>09</b>	<b>14</b>
<b>Unit-06</b>	<b>Automation</b> Basic elements of automated system, advanced automation functions, levels of automation. Flexible manufacturing system :-Introduction, FMS equipment, FMS application, Introduction to CIM	<b>06</b>	<b>10</b>
<b>Total</b>		<b>48</b>	<b>70</b>

<b>Text / Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
CAD/CAM Principles and Applications	P.N.Rao	Tata McGraw-Hill
CAD/CAM/CIM	RadhaKrishna P. & Subramanyam	Wiley EasternLtd
CNC Machine	B.S.Pabla and M.Adithan	New age International(P)Ltd
Computer Aided design and manufacturing	Groover M.P. & Zimmers Jr	Prentice hall of India
Computer Aided design and manufacturing	Lalit narayan,M. Rao	PHI
CAD-CAM & Automation	S.M. Kiran / S.P. Singh	Foundation Publishing

**INDUSTRIAL FLUID POWER LAB**  
**(MECH. ENGG. GROUP)**

Subject Code <b>1625606</b>	Practical			Credits		
	No. of Periods Per Week			Full Marks	:	<b>50</b>
	L	T	P/S	ESE	:	<b>50</b>
	—	—	<b>02</b>	<b>TA</b>	:	<b>15</b>
	—	—	—	<b>CT</b>	:	<b>35</b>

**CONTENTS: PRACTICAL**

Skills to be developed:

**Intellectual skills:**

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

Draw the hydraulic and pneumatic circuits using symbols

**List of Practical:**

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

**Mini Projects:**

- 1) Survey of oil used for hydraulic circuits -specifications, manufacturer's names, costs etc.
- 2) Study of any one mobile hydraulic system like in earth moving equipments and its detailed report.

OR

Study of any one stationary hydraulic system, like in any machine tool and its detailed report.

**ELECTIVE - (ANY ONE) – (i) ALTERNATE ENERGY SOURCES & MANAGEMENT LAB (MECH. ENGG. GROUP)**

<b>Subject Code 1625607A</b>	<b>Practical</b>						<b>Credits 01</b>	
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>50</b>		
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>50</b>		
	—	—	<b>03</b>	<b>Internal</b>	<b>:</b>	<b>15</b>		
	—	—	—	<b>External</b>	<b>:</b>	<b>35</b>		

**CONTENTS: PRACTICAL**

1	<ul style="list-style-type: none"> <li>To collect information about global and Indian energy market.</li> </ul>
2	<ul style="list-style-type: none"> <li>To perform an experiment on solar flat plate collector used for water heating.</li> </ul>
3	<ul style="list-style-type: none"> <li>To study construction and working of photo voltaic cell.</li> </ul>
4	<ul style="list-style-type: none"> <li>To study construction, working and maintenance of solar cooker.</li> </ul>
5	<ul style="list-style-type: none"> <li>Visit to plant of solar heating system for hotel/hostel/railway station etc.</li> </ul>
6	<ul style="list-style-type: none"> <li>To study construction and working of horizontal axis wind mill or to visit a nearest wind farm.</li> </ul>
7	<ul style="list-style-type: none"> <li>To visit a biomass/ biogas plant of municipal waste or else where.</li> </ul>
8	<ul style="list-style-type: none"> <li>Perform energy audit for workshop/Office/Home/SSI unit.</li> </ul>
9	<ul style="list-style-type: none"> <li>Study of various waste heat recovery devices.</li> </ul>

**ELECTIVE - (ANY ONE) – (II) MATERIAL HANDLING SYSTEMS LAB**  
**(MECH. ENGG. GROUP)**

<b>Subject Code</b> <b>1625607B</b>	<b>Practical</b>						<b>Credits</b>
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>50</b>	<b>01</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>	<b>:</b>	<b>50</b>	
	—	—	<b>03</b>	<b>Internal</b>	<b>:</b>	<b>15</b>	
	—	—	—	<b>External</b>	<b>:</b>	<b>35</b>	

**CONTENTS: PRACTICAL**

Skills to be developed:

**Intellectual Skills**

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

**Motors 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 any one type of conveyor – belt, Screw, pneumatic, hydraulic.
- 2) Study and demonstration of any one type of crane (working model or actual).
- 3) Study and demonstration of fork lift truck (using electric drive or diesel engine) Or hoisting equipment.
- 4) Study of preventive maintenance schedule of any one major material handling equipment using operation manual.
- 5) 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.

OR

Visit to steel industry or automobile manufacturing unit or sugar industry to observe different types of roller conveyors, Bucket elevators, overhead cranes load handling attachments, electric lifting magnet (at least 3 equipments). Write report of the visit

**List of Practice Oriented Projects:**

Note: Select any one mini project from following and submit report of the same (min. 5 pages)

1. Collect and write detail specifications of any two major material handling devices.
2. Collect and write information about manufacturer, Cost, Capacity range, availability, application of any one material handling equipment from the following.
  - a) Hoisting equipment.
  - b) Conveying equipment.
  - c) Surface transportation equipment.
3. Collect photographs of ten different types of cranes used in industries. Write name and specific utility of each.
4. Collect photographs of ten different types of conveyers used in industries. Write name and specific utility of each
5. Write name of material handling devices and their utility after visiting any big industry near by area
6. Using internet collects and writes information about six major manufacturer of material handling equipment
7. Write report about testing of overhead crane for its lifting capacity.

**ELECTIVE - (ANY ONE) – (III) REFRIGERATION & AIR-  
CONDITIONING LAB (MECH. ENGG. GROUP)**

<b>Subject Code 1625607C</b>	<b>Practical</b>			<b>Full Marks</b>			<b>Credits 01</b>
	<b>No. of Periods Per Week</b>						
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>ESE</b>			
	—	—	<b>03</b>	<b>Internal</b>			
	—	—	—	<b>External</b>			
			<b>:</b>			<b>50</b>	
			<b>:</b>			<b>50</b>	
			<b>:</b>			<b>15</b>	
			<b>:</b>			<b>35</b>	

**CONTENTS: 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
4. Perform cooling load calculations for different air conditioning applications
5. Select and use of different types of insulating material and setting procedures for applying insulations

**List of Practical:**

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

**ELECTIVE - (ANY ONE) – (IV) CAD-CAM & AUTOMATION LAB**  
**(MECH. ENGG. GROUP)**

Subject Code 1625607D	Practical			Credits		
	No. of Periods Per Week			Full Marks	:	50
	L	T	P/S	ESE	:	50
	—	—	03	Internal	:	15
	—	—	—	External	:	35

**CONTENTS: 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's:**

1. Two assignments on CAD for 2D drafting (Using AutoCAD)
2. Two assignments on CAD for 3D Modeling. (Using any 3-D Modeling software like CATIA, ProE, Solid works etc.)
3. Manufacturing one turning and one Milling component on CNC.
4. At least four assignments on part programming using subroutines do loops for turning and milling component.
5. Report writing on visit to industry having CNC machine.
6. Report writing on visit to industry having robot Application.
7. Report writing on visit to Industry having Automation in manufacturing.

**DESIGN OF MACHINE ELEMENTS -TW**  
**(MECH. ENGG. GROUP)**

<b>Subject Code</b> <b>1625608</b>	<b>Term Work</b>						<b>Credits</b> <b>01</b>	
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>	<b>50</b>		
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>Internal</b>	<b>:</b>	<b>15</b>		
	—	—	<b>03</b>	<b>External</b>	<b>:</b>	<b>35</b>		

**CONTENTS: TERM WORK**

**Term Work** 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.

<b>S.No</b>	<b>List of Assignments / Term Work :</b>
1	Assignment on selection of materials for given applications [at least five applications should be covered] using design data book. List the mechanical properties of material selected. <b>2 Hrs</b>
2	Problems on design of simple machine parts like Cotter Joint, Knuckle Joint, Bell Crank Lever, Turn Buckle, Off – Set link, Arm of Pulley (One example on each component) with free hand sketches. <b>6 Hrs</b>
3	Design Project No. 1 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 Manufacturer'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) <b>6 Hrs</b>
4	Design Project No. 2 Observe the System where transmission of power takes place through power Screws. ( e.g. Lead screw of lathe, feed screws of machine tools, Clamping screws, Toggle Jack screw, etc.) Get the required information regarding effort, clamping force, etc., and selecting suitable materials design screw, nut and different simple components in assembly. 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) <b>4 Hrs</b>
5	Assignments on design of Helical Springs, Screwed joints, Welded joints [one each] with free hand sketches. <b>2 Hrs</b>
6	CAD Drawing for project No 1 or 2 should be prepared in practical and print out should be attached along with respective drawing sheets <b>8 Hrs</b>
7	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. <b>4 Hrs</b>

**INDUSTRIAL PROJECT - TW**  
**(MECH. ENGG. GROUP)**

Subject Code <b>1625609</b>	Term Work						Credits <b>03</b>
	No. of Periods Per Week						
	L	T	P/S	Internal	:	15	
	—	—	06	External	:	35	

**CONTENTS : TERM WORK**

**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.
- B) 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.  
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) Evaluation of seminar should be as follows:-
    - Presentation: 15 marks
    - Use of A. V. aids: 05 marks
    - Question /answer: 05 marks
    - Total: 25 marks
  - d) 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.

<b>Text/ Reference Books:</b>		
<b>Titles of the Book</b>	<b>Name of Authors</b>	<b>Name of the Publisher</b>
Project management & team work	Karl Smith	Tata- Mc Graw Hill
Project management	Clifford gray & Erik Lasson	Tata- Mc Graw Hill

#### 2. Magazines:

1. Invention intelligence magazine
2. Popular mechanics Journals/ Magazines

**PROFESSIONAL PRACTICES VI - TW**  
**(MECH. +CIVIL ENGG. GROUP)**

<b>Subject Code 1625610</b>	<b>Term Work</b>					<b>Credits 02</b>	
	<b>No. of Periods Per Week</b>			<b>Full Marks</b>	<b>:</b>		<b>50</b>
	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>Internal</b>	<b>:</b>		<b>15</b>
	—	—	<b>03</b>	<b>External</b>	<b>:</b>		<b>35</b>

<b>CONTENTS : TERM WORK</b>		<b>Hrs/week</b>
<b>Serial No.</b>	<b>Activities</b>	<b>Hours</b>
<b>Unit-01</b>	<p><b>Industrial Visits</b> Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form a part of the term work. <b>Two</b> industrial visits may be arranged in the following areas / industries to observe - Material Handling System, quality control charts / production record / layout flow systems / Facilities / Hydraulic &amp; pneumatic systems / Working of Boilers and steam engineering applications.</p> <p>i) Auto / Electronic equipment manufacturing industry. ii) Cement / Sugar / Chemical / Textile / Steel rolling mills / extrusion industries. iii) Material handling in mines or ports. iv) Earth Moving Equipment Maintenance Shop.</p>	<b>17</b>
<b>Unit-02</b>	<p><i>Lectures by Professional / Industrial Expert be organized from any of the following areas (four lectures of two hour duration) student shall submit the report on each lectur:</i></p> <p>a) Battery and its charging system b) Electronic ignition system c) micro processor based instrumentation in Automobiles d) Earth moving machines. e) Tractors f) Excavators. g) Fork lift truck. h) Road- roller. i) Automated Guided Vehicles (AGV) j) Career opportunities in Service stations, Marketing, Surveyor, Insurance, R&amp;D, call centers, CAD, NDT, Railways, Defense, Aeronautics, Marine, Software development, Information Technology k) Continuing education / Open university Programs, l) Air compressor technology 2) Tribological Aspects in automobiles / machine tools</p>	<b>15</b>
<b>Unit-03</b>	<p><b>Group Discussion : (Two topics)</b> 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</p> <p>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</p>	<b>10</b>

<b>Unit-04</b>	<p><b>Student Activities :</b>  <b>The students in a group of 3 to 4 will perform ANY THREE of the following activities (other similar activities to be considered), and write a report as a part of term work.</b></p> <p><b>Activity :</b></p> <p>i) Collecting internal communication forms.  ii) Collecting Failure data for automobile / machines / equipments.  iii) Study of Hydraulic system for any one application like – dumpers, Earth moving equipment, Auto service station.</p>	<b>16</b>
	<p>iv) Survey of oils used for hydraulic circuits – specifications, properties, costs, manufacturers names etc.  v) Study any one type of CNC machining center and prepare report on tooling and tool holding devices  vi) Using finite element method analyse stresses in a cantilever beam. Write all the steps involved with brief description.  vii) For a given job write a sequence of operations performed by automated manufacturing system. Draw a block diagram of control system to perform above operations  viii) Survey of types of bearings involving information about construction working principles, mounting, lubrication, materials, advantages, limitations and cost.  ix) Prepare a trouble shooting chart for any refrigeration system and suggest remedial measures to avoid failures  x) For a drilling or milling operations on a simple machine component, draw a jig or fixtures showing various features like locating clamping, fool proofing etc.  xi) Compare non traditional methods on the basis of working principles, accuracy , MRR, Applications and limitations  a) EBM b) PAM C)AJM d)WJM  Xii) For a given job involving 3 to 4 operations suggest to prepare a report</p>	
<b>Unit-05</b>	<p><b>Seminar :-</b>  Seminar on any advanced technical topic to be presented by individual student in a batch of 20 students. A separate topic be selected by an individual student</p>	<b>12</b>
	<b>Total</b>	<b>70</b>