

West Bengal State Council of Technical &  
Vocational Education and Skill  
Development  
(Technical Education Division)



Syllabus  
of

Diploma in Mechanical Engineering [ME]

Part-III (6<sup>th</sup> Semester)

2023

**CURRICULUM STRUCTURE FOR PART-III (SEMESTER 6) OF THE  
FULL-TIME DIPLOMA COURSES IN MECHANICAL ENGINEERING**

BRANCH: MECHANICAL ENGINEERING				SEMESTER 6						
SL No	Category	Code No	Course Title	L	P	Total Class per week	Credit	Full marks	Internal Marks	ESE Marks
1	Program Core	MEPC302	Design of Machine Elements	3		3	3	100	40	60
2	Program Core	MEPC304	Work, Organization & Management	3		3	3	100	40	60
3	Program Elective	MEPE302	Program Elective (with Lab)	2		2	2	100	40	60
4	Humanities and Social Science	HS302	Entrepreneurship and Start-ups	3		3	3	100	40	60
5	Open Elective	MEOE302	Open Elective (Compulsory)	3		3	3	100	40	60
6	Open Elective	MEOE304	Open Elective	3		3	3	100	40	60
7	Program Elective	MEPE304	Program Elective Lab		2	2	1	100	60	40
8	Major Project	PR302	Major Project		6	6	3	100	60	40
9	Seminar	SE302	Seminar	1		1	1	100	100	0
<b>Total</b>				<b>18</b>	<b>8</b>	<b>26</b>	<b>22</b>	<b>900</b>	<b>460</b>	<b>440</b>
STUDENT CONTACT HOURS PER WEEK: 26hours (Lecture-18 hours; Practical-8 hours) Theory and Practical Period of 60 minutes each. FULL MARKS-900 (Internal Marks-460; ESE Marks-440) L-Lecture, P-Practical, ESE- End Semester Examination										

Credit Distribution	Credit
Program Core	6
Program Elective	3
Open Elective	6
Project + Seminar	4
Humanities and Social Science	3
Total	22

**Pass Criterion:** Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately in each subject.

Sl. No.	Program Elective (with Lab)	Credit
1.	Mechatronics (Sub code: MEPE302/1)	Any one 2
2.	Oil Hydraulics & Pneumatics (Sub code: MEPE302/2)	

Sl. No.	Open Elective	Credit
1.	Engineering Economics & Project Management ( <i>Compulsory for all Branches</i> ) [Sub code: MEOE302]	3
2.	Electrical Machines & Controls (Sub code: MEOE304/1)	Any one 3
3.	Environment Engineering & Science (Sub code: MEOE304/2)	



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“Karigori Bhavan”, 4<sup>th</sup> Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	Semester : Sixth
Code No. : MEPC302	Full Marks : 100
Course Title : Design of Machine Elements	<b>Examination Scheme :</b> (i) <b>External Assessment : 60</b> marks (End Semester Examination) (ii) <b>Internal Assessment: 40</b> marks [Class test : 20 marks Assignment / viva voce : 10 marks Class attendance : 10 marks]
Duration : 17 weeks (total hours per week = 3)	
Total lecture class/week : 3	
Credit : 3	
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

**1. Course outcomes (COs):**

After completion of this course, the student will be able to -

- Analyze the various modes of failure of simple machine parts under different load patterns.
- Design simple machine parts and prepare part and assembly drawings as per the designed dimensions.
- Use design data books and different IS codes of design for the selection of materials for given applications.
- Calculate weight and various costs of different items such as pattern, casted parts, machined parts, forged parts etc.

**2. Theory Components:**

The following topics/subtopics should be taught and assessed in order for achieving the course outcomes to attain the identified competency.

Unit	Topics & Sub-topics	Teaching Hour
UNIT 1: <b>Introduction to Machine Design</b>	1.1. General considerations in machine design, Aesthetic considerations regarding shape, size, colour & surface finish. 1.2. Fatigue, Endurance Limit, Creep and creep curve. 1.3. Factor of safety and its selection criteria. 1.4. Stress concentration, its causes and remedies. 1.5. Use of design data books, Use of standards in design. 1.6. Types of failures.	<b>06</b>
UNIT 2: <b>Design of Simple Machine Parts</b>	2.1. Socket & Spigot type Cotter joint. 2.2. Knuckle Joint. Design of Bolt: 2.3. Basic types of screw fastening. 2.4. Stresses in screwed fasteners.	<b>08</b>

	2.5. Bolts of Uniform Strength. 2.6. Design of Eyebolt.	
<b>UNIT 3: Design of Shafts, Keys, Couplings &amp; Flat Belt Pulleys</b>	<p><i>Design Of Shafts:</i> 3.1 Types of shafts, Shaft materials, Standard sizes. 3.2 Design of solid shaft and hollow shaft on strength basis and torsional rigidity basis.</p> <p><i>Design of Keys:</i> 3.3 Types of keys &amp; Applications, design of Saddle key and Sunk key. 3.4 Effect of keyways on strength of shaft.</p> <p><i>Design of Couplings:</i> 3.5 Types of coupling and applications, design of rigid type flange coupling.</p> <p>Design of Pulley: 3.6 Types of pulleys and applications, design of Flat belt C.I. pulley.</p>	<b>10</b>
<b>UNIT 4: Design of Welded Joints</b>	<p><i>Design of Welded Joints:</i> 4.1. Types of fillet joints. 4.2. Strength of parallel fillet welds. 4.3. Strength of transverse fillet welds. 4.4. Axially loaded symmetrical section welded joints. 4.5. Merits and demerits of threaded joints, riveted joints and welded joints.</p>	<b>06</b>
<b>UNIT 5: Antifriction Bearings</b>	<p>5.1 Classification and applications of bearings, comparison of sliding contact &amp; rolling contact bearings, bearing materials. 5.2 Terminology of ball bearings-Load-Life relationship, Static load carrying capacity and Dynamic load carrying capacity, Equivalent-limiting load, limiting speed. 5.3 Selection of ball bearings using manufacturer's catalogue. 5.4 Bearing failure –causes &amp; remedies.</p>	<b>06</b>
<b>UNIT 6: Estimating &amp; Costing</b>	<p>6.1 Introduction to estimating&amp; costing, Elements of costing. 6.2 Determination of weight of various parts such as simple bush, flanged pipe, lathe centre, rivet, bolt head, ring, cotter and knuckle pin. 6.3 Estimation of selling price of simple engineering parts. 6.4 Estimation of fabricated jobs such as simple cylindrical tank &amp; cuboidal tank.</p>	<b>09</b>
<b>Sub Total : Total Lecture Classes</b>		<b>45</b>
<b>No. of classes required for conducting Internal Assessment examination</b>		<b>6</b>
<b>Grand Total:</b>		<b>51</b>

### 3. Suggested Home Assignments/Students' Activities: (any four)

- Assignment on the selection of materials for given applications using design data book. Also, list the mechanical properties of material selected.
- Problems on design of simple machine parts like Cotter Joint / Knuckle Joint with free hand sketches of all types of failure of each component.
- Problems on design Flange Coupling / Flat belt C.I. pulley with free hand sketches of all types of failure of each component.

- d) ASME Code for shaft design (in case of line shaft carrying a pulley supported between bearings or one overhung pulley).
- e) Problems on design of welded joints with parallel fillet welds /transverse fillet welds / combination of them, axially loaded symmetrical section welded joints.
- f) Prepare a chart for various types of antifriction bearings along with their materials & applications, causes of failure of bearing and their remedies.
- g) Problems on weight and cost calculation of different parts such as flanged pipe, lathe centre, rivets, bolts & nuts, wooden pattern of flange etc.
- h) Problems on overhead cost calculation, selling price calculation.

**4. Suggested scheme for question paper design for conducting internal assessment examination:** (Duration: 45 minutes)

<b>Questions to be set as per Bloom's Taxonomy</b>				
	<b>Distribution of Theory Marks</b>			
	<b>Level 1 (Remember)</b>	<b>Level 2 (Understand)</b>	<b>Level 3 ( Apply &amp; above)</b>	<b>Total</b>
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

**Suggested scheme for End Semester Examination:** [Duration 2.5 hours]

<b>Multiple Choice Type Questions (Carrying 1 mark each)</b>				
Group	Unit	To be Set	To be Answered	Total Marks
<b>A</b>	1 & 2	09	20	20 x 01 = 20
	3 & 4	09		
	5 & 6	07		
<b>Total:</b>		<b>25</b>	<b>20</b>	<b>20</b>
<b>Subjective Type Questions (Carrying 8 marks each)</b>				
Group	Unit	To be Set	To be Answered	Total Marks
<b>B</b>	1, 2, 3	04	05 (At least two from each group))	05 x 08 = 40
<b>C</b>	4, 5 & 6	05		
<b>Sub Total: (B + C):</b>		<b>09</b>	<b>05</b>	<b>40</b>
<b>Total [A+B+C]:</b>				<b>60</b>

**6. Rubrics for the Assessment of Students Activity:** (20 marks)

<b>Sl. No.</b>	<b>Performance Indicators</b>	<b>Weightage in %</b>	
1	In time submission of home assignment/micro-project/internet search on specific topic, preparation of chart, creation of innovative model etc.		40
2	Viva voce		60
2a	Communication skill	10	
2b	Technical interpretation skill	10	
2c	Answering / Conclusion with justification	40	
<b>Total:</b>			<b>100</b>

**7. Suggested Learning Resources:**

<b>Sl. No.</b>	<b>Title of Book</b>	<b>Author</b>	<b>Publication</b>
1	Introduction to Machine Design	V.B. Bhandari	Tata Mc-Graw Hill
2	Machine Design	Sharma & Agarwal	S.K. Kataria& Sons
3	Machine Design	R. S. Khurmi	S. Chand & Co.
4	Machine Design	R. K. Jain	Khanna Publication
5	Machine Design, Drawing, Estimating & Costing	A.R. Basu	Dhanpat Rai
6	Design Data Book	V.B. Bhandari	Tata Mc-Graw Hill
7	Hand Book of Properties of Engineering Materials & Design Data for Machine Elements	Abdulla Shariff	Dhanpat Rai & Sons



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Name of the Course: Diploma in Mechanical Engineering						
<b>Course Title : Work, Organization &amp; Management</b>				<b>Semester : Sixth</b>		
<b>Category: Programme Core</b>				<b>Full Marks: 100</b>		
<b>Code No. : MEPC304</b>				<b>Examination Scheme:</b>		
<b>Duration : 17 weeks</b>				<b>External Assessment</b>		
				End Semester Examination		<b>60</b>
				<b>Internal Assessment</b>		
<b>Teaching Scheme</b>				Class Test :	<b>20</b>	<b>40</b>
<b>L</b>	<b>T</b>	<b>Total</b>	<b>Credit</b>	Assignment/Student activity	<b>10</b>	
<b>3</b>		<b>3</b>	<b>3</b>	Class attendance	<b>10</b>	
				<b>Total</b>	<b>100</b>	
<p><b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.</p> <p><b>Assignment / Student Activity:</b> Submission of Home assignment, submission of report after conducting site visit/ industry visit/ micro-project / market survey / internet search on specific topic, preparation of chart, creation of innovative model or present seminar on specific topic which is suitable for the given subject as per instruction of subject teacher.</p>						

**1. Course Outcomes:**

Students will be able to:

- a. Understand the concept of management and organizational structure.
- b. Gain knowledge on work-study and workplace designs and evaluate standard time.
- c. Analyze the strategic issues and strategies required to select, develop and train work force.
- d. Understand the importance of Production planning & control and what is required for quality inspection.
- e. Apply various purchasing method, inventory control techniques in practice.

**2. Theory Components:**

Unit	Topics	Teaching Hours
<b>Unit: 1 Management Process</b>	-Concept of Business and management - Introduction to types of business – Service, Manufacturing , Trading - Introduction to types of Industry – Engineering Industry (Heavy & Light Engineering Industries), Process Industry , - Resources of management, primary and Secondary objectives of management -Introduction to types of management according to nature of Organization -	08

	<p>Industrial Management, Hotel management , Sports management, Transport management , Event management etc. ( types only )</p> <p>-Introduction to types functional areas of management -- Human resources management , Materials management, Financial management, Production management</p> <p>- Principles of Scientific management by F.W.Taylor</p> <p>- Principles of Management (14 principles of Henry Fayol)</p> <p>- Functions of Management -Planning, Organizing, Directing, Controlling</p>	
<b>Unit: 2 Organizational Management</b>	<p>-Definition</p> <p>- Types of organization – Line, Line &amp; staff, Functional, Project</p> <p>-Authority &amp; Responsibility, Span of Control</p>	03
<b>Unit: 3 Human Resource Management</b>	<p>-Objectives &amp; Functions of Human resource Management</p> <p>-Recruitment &amp; selection - process; Training &amp; Development - Types of training – Induction, Skill Enhancement; Performance appraisal, Merit rating.</p> <p>Leadership &amp; Motivation - Styles of Leadership; Qualities of a good leader; Motivation; Maslow’s Theory of Motivation, Factors for motivation;</p> <p>Safety Management- Causes of accident, Safety precautions;</p> <p>Fire Safety - Fire triangle, classification of fire, Different extinguishing Modes;</p>	06
<b>Unit: 4 Materials Management and inventory control</b>	<p>-Objectives &amp; Functions of materials Management</p> <p>Purchase procedure – steps involved in purchasing</p> <p>Stores Management – Functions, BIN card</p> <p>- objectives of inventory control</p> <p>Maximum &amp; Minimum Stock, Lead Time, Reorder Level- Economic Order Quantity</p> <p>ABC analysis and VED analysis of Inventory,</p> <p>Break Even analysis,</p>	06
<b>Unit: 5 Work Study</b>	<p>Work Study-</p> <p>Method Study- Objectives, Selection of work ; Basic procedure for conduct of Method study, Flow process chart( Names only) Flow Process chart symbols, Work Measurement -</p> <p>Objectives, steps involved in work measurement, Time study, procedure of Time Study, Time Study Equipment. Standard Time, Allowances, PMTS.</p>	05
<b>Unit: 6 Plant location, Plant layout</b>	<p>Plant Location - Factors affecting Site Selection,</p> <p>Plant Layout – Objectives &amp; principles of good plant lay out,</p> <p>Types of plant lay out based on types of production - Job production, Batch Production, Mass production,</p> <p>Productivity and types.</p> <p>Material handling – Need and Types of material handling devices.</p>	05
<b>Unit: 7 Introduction to Production Planning and Control</b>	<p>Production planning – Definition of planning, sequencing, Routing, Scheduling, loading, dispatching, follow up, Inspection, corrective action.</p>	04
<b>Unit:8 Introduction to Plant Maintenance</b>	<p>Importance of plant and machinery maintenance, Types of maintenance-breakdown, scheduled, Preventive &amp; Predictive maintenance</p>	04



<b>Unit : 9 Inspection and Introduction to Quality Control</b>	Purpose of inspection, Inspection of – incoming materials- in-process – Finished goods Concept Quality, quality Control, Brief introduction of Total quality Management (TQM), Quality circle, Concept of ISO series, Benefits of ISO	04
<b>Sub Total :</b>		<b>Total Lecture Classes</b>
		45
<b>No. of classes required for conducting Internal Assessment</b>		06
<b>Grand Total :</b>		51

### 3. Suggested Home Assignments/Students' Activities: (any four)

- i. Preparation of chart to show the different types of organization.
- ii. Preparation of chart for fire safety.
- iii. Preparation of chart for personal, Tools & Equipment and products safety.
- iv. Preparation of chart showing layout of material handling system for a given application (coal handling system in power plant / Ash handling system / manufacturing industry / foundry shop / etc.)
- v. Preparation of a flow process chart and operation process chart.
- vi. Preparation of EOQ model
- vii. Prepare charts for showing steps of recruitment, types of training and performance appraisal & merit rating
- viii. Preparation of chart of maintenance of machinery used in an engineering industry
- ix. Prepare a report on types of inspection and Total Quality Management.

### 4. Suggested scheme for question paper design for conducting internal assessment examination:

(Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1(Remember)	Level 2(understand)	Level3 (Apply &above)	Total
Class Test -1	4	8	8	20
Class Test -2	4	8	8	20

### f. Suggested Scheme for End Semester Examination [Duration3 hours]

A: Multiple Choice Type Questions(Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1, 2 & 3	08	20	20x01=20
	4, 5 & 6	10		
	7, 8 & 9	07		
Total:		25	20	<b>20</b>
B: Subjective Type Questions (Carrying 08 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1, 2, 3 & 4	04	05 (taking at least one from each group)	05 x 08=40
C	5, 6, 7, 8 & 9	05		
Total:(B + C)		09	05	<b>40</b>
Total[A+B + C]:				<b>60</b>

## 6. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1.	Industrial Engineering and Management	O.P. Khanna	Dhanpat Rai & Sons
2	Production & Operations Management	Kanishka Bedi	Oxford University Press
3	Essentials of Management	Joseph L. Massie,	Prentice-Hall of India, New Delhi 2004.
4	Industrial Engineering & Management	S. C. Sharma,	Khanna Book Publishing Co. (P) Ltd., Delhi
5	Management Principles, Processes & Practices	A.Bhattacharya & A.Kumar	Oxford University Press
6	Production & Operation Management	M.T.Telsang	S.Chand



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Name of the Course: <b>Diploma in Mechanical Engineering</b>	
<b>Category: Program Elective</b>	<b>Semester : Sixth</b>
<b>Code No.: MEPE 302/1</b>	<b>Full Marks : 100</b>
<b>Course Title: Mechatronics</b>	<b>Examination Scheme:</b> (i) <b>External Assessment: 60</b> marks (End Semester Examination)  (ii) <b>Internal Assessment: 40</b> marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
<b>Duration : 17 weeks</b> (Total class hour/week = 2)	
<b>Total lecture class/week: 2</b>	
<b>Credit : 2</b>	
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

**1. Course Outcomes (COs):**

After completion of this course, the students should be able to:

- Understand and demonstrate the basic concept of Mechatronics.
- Demonstrate the application of Mechatronics in Manufacturing.
- Identify different components, interpret their function and demonstrate the working of a given Mechatronics System.
- Understand the basic concept and application of CNC machines, Part Programming and Industrial Robotics.

**2. Theory Components:**

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics and Sub-topics	Teaching Hours
<b>Unit: 1</b> <b>Introduction to Mechatronics</b>	1.1. Definition of mechatronics. 1.2. Mechatronics in manufacturing, products and design.	<b>2</b>
<b>Unit 2</b> <b>Elements in Mechatronics</b>	2.1. Basic working principle and applications of data conversion devices, sensors (Displacement, Position and Proximity Sensors, Velocity and Motion Sensors, Force Sensors, Fluid Pressure Sensors, Flow Sensors, Liquid Level Sensors, Temperature Sensors and Light Sensors), micro-sensors, transducers, signal processing devices and timers.	<b>6</b>
<b>Unit: 3</b> <b>Processors and Controllers</b>	3.1. Basic working principle and applications of Microprocessors and Microcontrollers. 3.2. Basic working principle and applications of PID Controllers and PLCs.	<b>4</b>
<b>Unit: 4</b>	4.1. Basic working principle and applications of stepper motors and servo	<b>6</b>

<b>Drives and Mechanisms of an Automated System</b>	drives. 4.2. Basic working principle and applications of ball screws, linear motion bearings and cams. 4.3. Basic concept and application of systems controlled by camshafts and electronic cams. 4.4. Basic concept and application of tool magazines and indexing mechanisms.	
<b>Unit: 5 Hydraulic Systems</b>	5.1. Components, their symbol and functions of Hydraulic Systems: Pumps, Control Valves (Pressure Control Valves, Flow Control Valves and Direction Control Valves) and Actuators (Linear Actuators and Rotary Actuators). 5.2. Design of hydraulic circuits (Meter in, Meter out circuits and Sequencing circuit) 5.3. Application of hydraulic systems.	<b>5</b>
<b>Unit: 6 Pneumatic System:</b>	6.1. Components, their symbol and functions of Pneumatic Systems: Compressors, Control Valves (Pressure Control Valves, Flow Control Valves and Direction Control Valves), Actuators (Linear Actuators and Rotary Actuators), FRL Unit and Silencers. 6.2. Production, distribution and conditioning of compressed air. 6.3. Design of pneumatic circuits (Meter in, Meter out circuits and Sequencing circuit). 6.4. Application of pneumatic systems.	<b>5</b>
<b>Unit: 7 CNC Technology and Robotics:</b>	7.1. Basic concept and application of CNC machines and part programming. 7.2. Basic concept and application of Industrial Robotics.	<b>2</b>
<b>Total Lecture Classes ( Sub Total):</b>		<b>30</b>
<b>No. of classes required for conducting Internal Assessment:</b>		<b>04</b>
<b>Grand Total :</b>		<b>34</b>

### 3. Suggested Home Assignments / Student Activities: (Any Four)

Other than classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in the course:

Note:

A suggested list of home assignments / student activities is given here. Similar home assignments / student activities could be added by the concerned faculty member also. **Four (04)** home assignments / student activities are to be undertaken by an individual student that needs to be assigned to him / her by the concern faculty member during the course. Students should prepare and submit report for each of their assignment / activity.

- a) Prepare a chart of sensors and transducers showing their functions and applications.
- b) Prepare a comparative study on Microprocessors and Microcontrollers for demonstration purpose.
- c) Prepare a comparative study on of PID Controllers and PLCs for demonstration purpose.
- d) With a flow diagram show the basic components, state their functions and overall working of a mechatronics system.
- e) Prepare a report on application of mechatronics in manufacturing.
- f) With a suitable diagram explain the working of a re-circulating ball screw nut mechanism.
- g) Prepare a chart showing the symbols and stating the function of different components of a hydraulic system.
- h) Prepare a chart showing the symbols and stating the function of different components of a pneumatic system.
- i) Prepare a comparative study on hydraulic & pneumatic systems for demonstration purpose.

- j) Identify different components, interpret their function and demonstrate the working of a given sequencing hydraulic circuit as assigned by the concern teacher.
- k) Develop, draw and explain a suitable hydraulic / pneumatic circuit which may be used for speed controlling a hydraulic / pneumatic actuator.
- l) Prepare a chart containing the labelled diagram of a CNC Machine showing all of its components and their functions.
- m) Prepare a Part Programming for CNC Turning Centre (CNC Lathe) using different codes for a specific job as assigned by the subject teacher.
- n) Prepare a Part Programming for CNC Machining Centre (CNC Milling) using different codes for a specific job as assigned by the subject teacher.

**4. Suggested Scheme for Question Paper Design for Conducting Internal Assessment:  
(Duration: 45 Minutes)**

<b>Questions to be set as per following Bloom's Taxonomy</b>				
Internal Assessment	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test: 1	4	8	8	20
Class Test: 2	4	8	8	20

**5. Suggested Scheme for End Semester Examination: (Duration: 2.5 hours)**

<b>Multiple Choice Type Questions (Carrying 1 mark each)</b>				
Group	Unit	To be Set	To be Answered	Total Marks
<b>A</b>	1, 2, 3 & 4	15	20	20 x 01 = 20
	5, 6 & 7	10		
<b>Sub-Total [A]:</b>		<b>25</b>	<b>20</b>	<b>20</b>
<b>Subjective Type Questions (Carrying 8 marks each)</b>				
Group	Unit	To be Set	To be Answered	Total Marks
<b>B</b>	1, 2, 3 & 4	05	05 (At least two from each group)	05 x 08 = 40
<b>C</b>	5, 6 & 7	04		
<b>Sub-Total [B+C]:</b>		<b>09</b>	<b>05</b>	<b>40</b>
<b>Total [A+B+C]:</b>				<b>60</b>

**6. Rubrics for the assessment of students' activity:**

Sl. No.	Performance Indicators
1	Originality of completing the Assigned task / micro-project work
2	Presentation Skill
3	In time submission of assignment work / micro-project work
4	Viva voce

**7. Suggested Learning Resources:**

<b>Sl. No.</b>	<b>Title of Book</b>	<b>Author</b>	<b>Publication</b>
01	Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering	Bolton W.	Pearson Education Ltd.
02	Introduction to Mechatronics and Measurement Systems	Histand B.H. and Alciatore D.G.	Tata McGraw Hill
03	Programmable Logic Controllers	John W. Webb and Ronald Reis	Prentice Hall of India
04	Programmable Logic Control – Principles and Applications	NIIT	Prentice Hall of India
05	Programmable Logic Controller & Industrial Automation	Mitra & Sengupta	Penram International Publishing (India) Pvt. Ltd.
06	Sensors for Mechatronics	Paul P.L. Regtien	Elsevier
07	Introduction to Mechatronics	Appu Kuttan K.K.	Oxford
08	Process Control Principles & Applications	Surekha Bhanot	Oxford
09	Mechatronics Systems Design	Kolk R.A. and Shetty D.	Vikas Publishing, New Delhi
10	Mechatronics Principles, Concepts and Applications	Mahalik N.P.	Tata McGraw Hill
11	A Text book of Mechatronics	R.K.Rajput	S. Chand
12	Mechatronics	H.M.T.	Tata McGraw Hill
13	Mechatronics	Ramachandran	Wiley



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Name of the Course: <b>Diploma in Mechanical Engineering</b>	
<b>Category: Program Elective</b>	<b>Semester : Sixth</b>
<b>Code No.: MEPE 302/2</b>	<b>Full Marks : 100</b>
<b>Course Title: Oil Hydraulics and Pneumatics</b>	<b>Examination Scheme:</b> (iii) <b>External Assessment: 60</b> marks (End Semester Examination) (iv) <b>Internal Assessment:40</b> marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
<b>Duration : 17 weeks</b> (Total class hour/week = 2)	
<b>Total lecture class/week: 2</b>	
<b>Credit : 2</b>	
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

**1. Course Outcomes (COs):**

After completion of this course, the Students should be able to:

- e) Understand the basic concept, advantages, limitations and applications of Fluid Power Systems (Oil Hydraulic and Pneumatic Systems).
- f) Identify and understand the function of various components of Oil Hydraulic & Pneumatic Systems.
- g) Understand and demonstrate the working principle of various components used for Oil Hydraulic & Pneumatic Systems.
- h) Develop simple Oil Hydraulic and Pneumatic Circuits for specific requirement.

**2. Theory Components:**

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics and Sub-topics	Teaching Hours
<b>Unit: 1 Introduction to Oil Hydraulic and Pneumatic Systems</b>	1.1. Basic concept of fluid power systems. 1.2. Practical applications, advantages and limitations of fluid power systems. 1.3. Classification of fluid power system. 1.4. General layout, basic components, their functions and applications of oil hydraulic system. 1.5. General layout, basic components, their functions and applications of pneumatic system. 1.6. Comparison of oil hydraulic & pneumatic systems.	<b>05</b>
<b>Unit: 2 Components of Oil Hydraulic Systems</b>	2.1. Classification, function and symbols of oil hydraulic pumps. 2.2. Working principle and construction of vane pumps, gear pumps and piston pumps. 2.3. Types, symbols and working of pressure control valves (pressure relief valve, pressure-reducing valve, unloading valve and sequence valve).	<b>10</b>

	<p>2.4. Types, symbols and working of direction control valves—check valve, poppet type DCV and spool type DCV (spool positions of 3/2, 4/2, &amp; 4/3). Method of actuation of DCV.</p> <p>2.5. Types, symbols and working of flow control valves - pressure compensated and non-pressure compensated flow control valve.</p> <p>2.6. Types, symbols and working of oil hydraulic actuators (rotary and linear actuators).</p> <p>2.7. Function and symbols of oil hydraulic accessories (oil filter, intensifier and accumulator).</p>	
<b>Unit: 3 Oil Hydraulic Circuits</b>	<p>3.1. Control circuits of single acting / double acting linear hydraulic actuators / hydraulic motor.</p> <p>3.2. Meter in, Meter out circuits, bleed off circuit.</p> <p>3.3. Pump unloading circuit.</p> <p>3.4. Motion synchronization circuit.</p> <p>3.5. Sequencing circuit.</p> <p>3.6. Accumulator Circuits.</p>	<b>07</b>
<b>Unit: 4 Components of Pneumatic System</b>	<p>4.1. Types, function and symbols of compressors and air receiver.</p> <p>4.2. Working principle and construction of reciprocating compressors and rotary compressors (Screw compressor and vane compressor only).</p> <p>4.3. Types, symbols and working of pneumatic pressure control valves, flow control valves and direction control valves (3/2, 4/3, 5/2). Working principle of poppet type 3/2 DCV.</p> <p>4.4. Types, symbols and functions of pneumatic actuators (rotary and linear actuators).</p> <p>4.5. Functions and symbols of pneumatic accessories (FRL unit&amp; silencer).</p>	<b>05</b>
<b>Unit: 5 Pneumatic Circuits</b>	<p>5.1. Control circuits of single acting / double acting linear pneumatic actuators / Air motor</p> <p>5.2. Meter in&amp; Meter out circuits.</p> <p>5.3. Sequencing circuits.</p>	<b>03</b>
<b>Total Lecture Classes ( Sub Total):</b>		<b>30</b>
<b>No. of classes required for conducting Internal Assessment:</b>		<b>04</b>
<b>Grand Total :</b>		<b>34</b>

### 3. Suggested Home Assignments / Student Activities: (Any Four)

Other than classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in the course:

Note:

A suggested list of home assignments / student activities is given here. Similar home assignments / student activities could be added by the concerned faculty member also. Four (04) home assignments / student activities are to be undertaken by an individual student that needs to be assigned to him / her by the concern faculty member during the course. Students should prepare and submit report for each of their assignment / activity.

- a) Prepare a report on unique features and applications of fluid power systems for demonstration purpose.
- b) Prepare an extensive comparative study on oil hydraulic & pneumatic systems for demonstration purpose.
- c) Prepare a comparative study on positive displacement pump and non-positive displacement pump for demonstration purpose.
- d) Deduce the expression of volumetric displacement and discharge of an external gear pump and / or an unbalance vane pump and / or a bent axis type piston pump from its setting and geometry (assume all required information).
- e) Prepare a chart explaining the spool positions of 3/2 and 4/3 spool type DCV for demonstration purpose.
- f) Prepare a chart showing the symbols of different types of pumps / compressors, control valves and actuators used in oil hydraulic and pneumatic systems.
- g) Prepare a report on purpose of mandatory mountings and accessories generally installed in an air receiver.



- h) Prepare a report on conditioning of working fluid generally implemented in oil hydraulic and pneumatic systems.
- i) Prepare a comparative study on meter-in and meter-out hydraulic circuits for demonstration purpose.
- j) Develop, draw and explain a suitable speed control circuit of hydraulic motor which may be used for driving the arbor of a hydraulic horizontal milling machine.
- k) Develop, draw and explain a suitable sequencing hydraulic circuit which may be used for sequential operation of two double acting linear actuators.
- l) With suitable circuit diagrams explain the purpose of using accumulator in oil hydraulic system.
- m) Develop, draw and explain a suitable intensifier circuit which may be used for driving a hydraulic punching press.

**4. Suggested Scheme for Question Paper Design for Conducting Internal Assessment:**

(Duration: 45 Minutes)

Questions to be set as per following Bloom's Taxonomy				
Internal Assessment	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test: 1	4	8	8	20
Class Test: 2	4	8	8	20

**5. Suggested Scheme for End Semester Examination: (Duration: 2.5 hours)**

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1, 2 & 3	18	20	20 x 01 = 20
	4 & 5	07		
<b>Sub-Total [A]:</b>		<b>25</b>	<b>20</b>	<b>20</b>
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	05	05 (At least two from each group)	05 x 08 = 40
C	3, 4 & 5	04		
<b>Sub-Total [B+C]:</b>		<b>09</b>	<b>05</b>	<b>40</b>
<b>Total [A+B + C]:</b>				<b>60</b>

**6. Rubrics for the assessment of students' activity:**

Sl. No.	Performance Indicators
1	Originality of completing the Assigned task / micro-project work
2	Presentation Skill
3	In time submission of assignment work / micro-project work
4	Viva voce

**7. Suggested Learning Resources:**

Sl. No.	Title of Book	Author	Publication
01	Fluid Power with Application	A. Esposito	Pearson
02	Oil Hydraulic System- Principle and Maintenance	S.R. Majumdar	Tata McGraw Hill
03	Pneumatics Systems- Principles and Maintenance	S.R. Majumdar	Tata McGraw Hill
04	Hydraulic and Pneumatic Control	K. Shanmuga Sundaram	S. Chand
05	Hydraulics and Pneumatics, A technician's and engineer's guide	Andrew Parr	Butterworth-Heinemann
06	Fluid Power Generation, Transmission & Control	Jagadeesha T., Thammaiah Gowda	Wiley
07	Pneumatic Controls	P. Joji	Wiley
08	Introduction to Hydraulics and Pneumatics	Ilango & Soundararajan	Prentice Hall India
09	Hydraulics and Pneumatics	Stewart	Taraporewala Publication
10	Hydraulic System & Maintenance	Farel Bradbury	ILIFFE Books, London
11	Industrial Fluid Power	Charles Hedges	Womack Educational Publications
12	Industrial Hydraulic Control	Peter Rhoner	Prentice Hall India
13	Industrial Hydraulics	Hicks Pippenger	McGraw Hill International



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"Karigori Bhavan", 4<sup>th</sup> Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: <b>Diploma in Mechanical Engineering</b>	
<b>Category: HS</b>	<b>Semester : Sixth</b>
<b>Code No.: HS302</b>	<b>Full Marks : 100</b>
<b>Course Title: Entrepreneurship and Start-ups</b>	<b>Examination Scheme:</b> (v) <b>External Assessment: 60</b> marks (End Semester Examination)  (vi) <b>Internal Assessment:40</b> marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
<b>Duration : 17 weeks</b> (Total class hour/week = 3)	
<b>Total lecture class/week: 3</b>	
<b>Credit : 3</b>	
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

### 1. Course Learning Objectives

- To raise awareness, knowledge and understanding of enterprise/ entrepreneurship.
- To motivate and inspire students toward an entrepreneurial career.
- To understand venture creation process and to develop generic entrepreneurial competences.
- To introduce students to the basic steps required for planning, starting and running a business.
- To familiarise students with the different exit strategies available to entrepreneurs.

### 2. Course Outcomes (COs):

After completing the course students will able to:

CO 1	Identify qualities of entrepreneurs, develop awareness about entrepreneurial skill and mindset and express knowledge about the suitable forms of ownership for small business
CO 2	Comprehend the basics of Business idea, Business plan, Feasibility Study report, Project Report and Project Proposal
CO 3	Understand the concept of start-up business and recognise its challenges within legal framework and compliance issues related to business.
CO 4	Make a growth plan and pitch it to all stakeholders and compare the various sources of funds available for start-up businesses

### 3. Theory Components:

Unit	Name of the Topic	Hours
<b>Unit 1: Entrepreneurship: Introduction and Process</b>	<ul style="list-style-type: none"> <li>• Concept, Competencies, Functions and Risks of entrepreneurship</li> <li>• Entrepreneurial Values&amp; Attitudes and Skills</li> <li>• Mind set of an employee/manager and an entrepreneur</li> <li>• Types of Ownership for Small Businesses               <ul style="list-style-type: none"> <li>○ Sole proprietorship</li> <li>○ Partnerships</li> <li>○ Joint Stock company- public limited and private limited companies</li> </ul> </li> </ul>	10

	<ul style="list-style-type: none"> <li>• Difference between entrepreneur and Intrapreneur</li> </ul>	
<b>Unit 2: Preparation For Entrepreneurial Ventures</b>	<ul style="list-style-type: none"> <li>• Business Idea- Concept, Characteristics of a Promising Business Idea, Uniqueness of the product or service and its competitive advantage over peers.</li> <li>• Feasibility Study – Concept, Location, Economic, Technical and Environmental Feasibility. Structure and Contents of a standard Feasibility Study Report</li> <li>• Business Plan – Concept, rationale for developing a Business Plan, Structure and Contents of a typical Business Plan</li> <li>• Project Report- Concept, its features and components</li> <li>• Basic components of Financial Statements- Revenue, Expenses (Revenue &amp; capital expense), Gross Profit, Net Profit, Asset, Liability, Cash Flow, working capital, Inventory. Funding Methods-Equity or Debt.</li> </ul> <p>Students are just expected to know about the features and key inclusions under, Business Plan and Project Report.</p> <p><u><i>They <b>may not</b> be asked to prepare a Business Plan/ Project Report/ Project Feasibility Report in the End of Semester Examination.</i></u></p>	20
<b>Unit 3: Establishing Small Enterprises</b>	<ul style="list-style-type: none"> <li>• Legal Requirements and Compliances needed for establishing a New Unit- <ul style="list-style-type: none"> <li>○ NOC from Local body</li> <li>○ Registration of business in DIC</li> <li>○ Statutory license or clearance</li> <li>○ Tax compliances</li> </ul> </li> </ul>	03
<b>Unit 4: Start-Up Ventures</b>	<ul style="list-style-type: none"> <li>• Concept &amp; Features</li> <li>• Mobilisation of resources by start-ups: Financial, Human, Intellectual and Physical</li> <li>• Problems and challenges faced by start-ups.</li> <li>• Start-up ventures in India – Contemporary Success Stories and Case Studies to be discussed in the class.</li> </ul> <p>Case studies have been included in the syllabus to motivate and inspire students toward an entrepreneurial career from the success stories.</p> <p><u><i>No questions are to be set from the case studies.</i></u></p>	04
<b>Unit 5: Financing Start- Up Ventures In India</b>	<ul style="list-style-type: none"> <li>• Communication of Ideas to potential investors – Investor Pitch</li> <li>• Equity Funding, Debt funding – by Angel Investors, Venture Capital Funds, Bank loans to start-ups</li> <li>• Govt. Initiatives including incubation centre to boost start-up ventures</li> <li>• MSME Registration for Start-ups –its benefits.</li> </ul>	06
<b>Unit 6: Exit Strategies For Entrepreneurs</b>	<ul style="list-style-type: none"> <li>• Merger and acquisition exit, Initial Public Offering (IPO), Liquidation, Bankruptcy – <u><i>Basic Concept only.</i></u></li> </ul>	02
<b>Sub Total : Total Lecture Classes</b>		<b>45</b>
<b>No. of classes required for conducting Internal Assessment examination</b>		<b>6</b>
<b>Grand Total:</b>		<b>51</b>

**4. Suggested Scheme for Question Paper Design for Conducting Internal Assessment:**

(Duration: 45 Minutes)

Questions to be set as per following Bloom's Taxonomy				
Internal Assessment	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test: 1	4	8	8	20
Class Test: 2	4	8	8	20

**5. Suggested Scheme for End Semester Examination: (Duration: 2.5 hours)**

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1, 2 & 3	18	20	20 x 01 = 20
	4, 5 & 6	07		
<b>Sub-Total [A]:</b>		<b>25</b>	<b>20</b>	<b>20</b>
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	05	05 (At least two from each group)	05 x 08 = 40
C	3, 4, 5 & 6	04		
<b>Sub-Total [B+C]:</b>		<b>09</b>	<b>05</b>	<b>40</b>
<b>Total [A+B + C]:</b>				<b>60</b>

**6. Suggested Learning Resources:**

Sl. No.	Title of Book	Author	Publication
1.	Entrepreneurship Development	Sangeeta Sharma	Prentice Hall of India Learning Private Ltd
2.	Entrepreneurship Development	S. Anil Kumar	New Age International
3.	Fundamentals of Entrepreneurship	Sangram Keshari Mohanty	Prentice Hall of India Learning Private Ltd
4.	Fundamentals of Entrepreneurship	Dr. G.K. Varshney	Sahitya Bhawan Publication
5.	Managing New Ventures: Concepts and Cases on Entrepreneurship	Anjan Rai Chaudhuri	Prentice Hall of India Learning Private Ltd
6.	How to Start a Business in India	Simon Daniel	Buooks, Chennai
7.	Entrepreneurship and Small Business Management	S.S. Khanka	S. Chand & Sons, New Delhi
8.	Entrepreneurship Development and Business Ethics	Abhik Kumar Mukherjee & Shaunak Roy	Oxford University Press
9.	Entrepreneurship Development and Business Ethics	Dr B Chandra & Dr B Biswas	Tee Dee Publications
10.	Entrepreneurship Development Small Business Entrepreneurship	Poornima Charantimath	Pearson Education India



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Name of the Course: <b>Diploma in Mechanical Engineering</b>	
<b>Category: Open Elective (Compulsory)</b>	<b>Semester : Sixth</b>
<b>Code No.: OE302</b>	<b>Full Marks : 100</b>
<b>Course Title: Engineering Economics &amp; Project Management</b>	<b>Examination Scheme:</b> (i) <b>External Assessment: 60</b> marks (End Semester Examination)  (ii) <b>Internal Assessment: 40</b> marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
<b>Duration : 17 weeks</b> (Total class hour/week = 3)	
<b>Total lecture class/week: 3</b>	
<b>Credit : 3</b>	
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

**1. Course Outcomes (COs):**

After completing the course students will able to:

CO 1	To acquire knowledge of basic economics to facilitate the process of economic decision making.
CO 2	To acquire knowledge on basic financial management aspects
CO 3	To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved
CO 4	To develop an understanding of key project management skills and strategies

**2. Theory Components:**

Unit	Name of the Topic	Hours
<b>Unit 1: Introduction, Theory of Demand &amp; Supply</b>	1.1 Introduction to Engineering Economics, the relationship between Engineering and Economics. 1.2 Resources, scarcity of resources, and efficient utilization of resources. 1.3 Opportunity cost, rationality costs, and benefits. 1.4 Theory of Demand: the law of demand, different types of demand, determinants of demand, demand function, price elasticity of demand. 1.5 Theory of Supply: determinants of supply, supply function. 1.6 Market mechanism: Equilibrium, basic comparative static analysis (Numerical problems)	<b>9</b>
<b>Unit 2: Theory of Production &amp; Costs</b>	2.1 Concept of production (goods & services), Different factors of production (fixed and variable factors), Short-run Production function (Graphical illustration), and Long run production function (returns to scale). 2.2 Theory of Cost: Short-run and long-run cost curves with graphical illustration, basic concept on total cost, fixed cost, variable cost, marginal cost, average cost etc.	<b>10</b>

	2.3 Economic concept of profit, profit maximization (numerical problems)	
<b>Unit 3: Different Types of Market and Role of Government</b>	3.1 Perfect Competition: Features of Perfectly Competitive Market. 3.2 Imperfect Competition: Monopoly, Monopolistic Competition, and Oligopoly. 3.3 Role of government in Socialist, Capitalist and Mixed Economy structure with example.	<b>04</b>
<b>Unit 4: Concept of Project</b>	2.1 Definition and classification of projects). 2.2 Importance of Project Management. 2.3 Project life Cycle -[Conceptualization → Planning → Execution → Termination]	<b>04</b>
<b>Unit 5: Feasibility Analysis of a Project</b>	5.1 Economic and Market analysis. 5.2 Financial analysis: Basic techniques in capital budgeting– Payback period method, Net Present Value method, Internal Rate of Return method. 5.3 Environmental Impact study–adverse impact of the project on the environment. 5.4 Project risk and uncertainty: Technical, economical, socio-political, and environmental risks. 5.5 Evaluation of the financial health of a project–Understanding the basic concept of Fixed & Working Capital, Debt & Equity, Shares, Debentures etc., and different financial ratios like Liquidity Ratios, Activity Ratios, Debt-equity ratio & Profitability Ratio (Basic concept only). <i><u>N.B: Knowledge of financial statements is not required; for the estimation of ratios the values of the relevant variables will be provided.</u></i>	<b>10</b>
<b>Unit 6: Project Administration</b>	6.1 Gantt Chart– a system of bar charts for scheduling and reporting the progress of a project (basic concept only). 6.2 Concept of Project Evaluation and Review Technique (PERT) and Critical Path method (CPM): basic concept and application with real-life examples.	<b>08</b>
<b>Sub Total : Total Lecture Classes</b>		<b>45</b>
<b>No. of classes required for conducting Internal Assessment examination</b>		<b>6</b>
<b>Grand Total:</b>		<b>51</b>

### 3. Suggested Home Assignments / Student Activities:

#### Guideline for Assignment -

Students should be instructed to prepare a report on a project (preferably the Major Project they prepare in 6th Semester), using a popular project management software in IT/ Computer Laboratory, under the guidance of the Lecturer in Computer Science & Technology and Lecturer in Humanities.

#### 4. Suggested Scheme for Question Paper Design for Conducting Internal Assessment:

(Duration: 45 Minutes)

Questions to be set as per following Bloom's Taxonomy				
Internal Assessment	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test: 1	4	8	8	20
Class Test: 2	4	8	8	20

#### 3. Suggested Scheme for End Semester Examination: (Duration: 2.5 hours)

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
<b>A</b>	1, 2 & 3	13	20	20 x 01 = <b>20</b>
	4, 5 & 6	12		
<b>Sub-Total [A]:</b>		<b>25</b>	<b>20</b>	<b>20</b>
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
<b>B</b>	1, 2 & 3	05	05 (At least two from each group)	05 x 08 = <b>40</b>
<b>C</b>	4, 5 & 6	04		
<b>Sub-Total [B+C]:</b>		<b>09</b>	<b>05</b>	<b>40</b>
<b>Total [A+B +C]:</b>				<b>60</b>

#### 6. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1.	Principles of Economics	Case and Fair	Pearson Education Publication
2.	Principles of Economics	Mankiw	Cengage Learning
3.	Project planning, analysis, selection, implementation and review	Prasanna chandra	Tata McGraw Hill.
4.	Project Management	Gopala Krishnan	McMillan India Ltd





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Name of the Course: <b>Diploma in Mechanical Engineering</b>	
<b>Category: Open Elective</b>	<b>Semester : Sixth</b>
<b>Code No.: OE304/1</b>	<b>Full Marks : 100</b>
<b>Course Title: Electrical Machines &amp; Controls</b>	<b>Examination Scheme:</b> (i) <b>External Assessment: 60</b> marks (End Semester Examination) (ii) <b>Internal Assessment: 40</b> marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
<b>Duration : 17 weeks</b> (Total class hour/week = 3)	
<b>Total lecture class/week: 3</b>	
<b>Credit : 3</b>	
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

**1. Course Outcomes (COs):**

After completing the course students will able to:

<b>CO 1</b>	Identify suitable transformer & DC motors for an intended application.
<b>CO 2</b>	Analyze the input and output characteristics curves of a motor to determine its aptness for an application.
<b>CO 3</b>	Recommend suitable fractional kW motor for a planned project.
<b>CO 4</b>	Obtain an accurate yet compact mathematical model of a dynamical system.
<b>CO 5</b>	Determine a suitable control algorithm for an intended application.

**2. Theory Components:**

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcome.

Unit	Topics and Sub-topics		Hours
<b>Unit 1: DC Machines &amp; Transformers</b>	1.1	Mechanism of Electro – Mechanical Energy Conversion	<b>11</b>
	1.2	Basics of DC Machines: <ul style="list-style-type: none"> <li>Identify the different parts with functions</li> <li>Working / Operating principles of Motor &amp; Generator</li> <li>Types of DCMachines</li> <li>General circuit diagram / representation of DC Motor</li> <li>Applications of different types of DC Motors in industrial sector</li> </ul>	

	1.2	<p>Brief concept of DC Motors:</p> <ul style="list-style-type: none"> <li>• Back – EMF – concept and necessity for starting</li> <li>• DC starter – necessity and types (only names)</li> <li>• Speed &amp; Torque equation. (only expression)</li> <li>• Numerical on torque – speed equation</li> </ul>	
	1.3	<p>. Basic concept of Transformers:</p> <ul style="list-style-type: none"> <li>• Identify main constructional parts with their functions</li> <li>• Types of transformers</li> <li>• Operating principle of Transformer</li> <li>• EMF equation and Transformation Ratio (expressions only)</li> <li>• Simple numerical on EMF equation &amp; Transformation ratio</li> </ul>	
	1.4	Various losses in transformer, OC and SC Test of transformer for finding the parameters.	
	1.5	<p>Basic concept of Auto – transformer:</p> <ul style="list-style-type: none"> <li>• Working concept</li> <li>• Volt – Ampererelationship</li> <li>• Application in industrial sector</li> </ul>	
<b>Unit 2: A C Machines</b>	<b>A: Induction Motor</b>		<b>11</b>
	2.A.1	<p>Basics of Induction Motor:</p> <ul style="list-style-type: none"> <li>• Identify the constructional parts with their functions</li> <li>• Outline the constructional differences between SQIM &amp; Wound rotor</li> </ul>	
	2.A.2	<p>Terminology and expressions related to Induction Motor:</p> <ul style="list-style-type: none"> <li>• Synchronous Speed &amp; Rotor Speed</li> <li>• Slip</li> <li>• Stator &amp; Rotor frequency</li> </ul>	
	2.A.3	Working principle of an Induction Motor (Brief idea).	
	2.A.4	Expression of Torque developed in an Induction Motor (only equation). Simple numerical on torque equation.	
	2.A.5	<p>Characteristics of Induction Motor:</p> <ul style="list-style-type: none"> <li>• Speed – Torque Characteristics</li> <li>• Slip – Torque Characteristics</li> </ul>	
	2.A.6	<p>Control of Induction Motor:</p> <ul style="list-style-type: none"> <li>• Reversal of rotation</li> <li>• Voltage &amp; frequency control method (comprehensive)</li> <li>• Stator &amp; Rotor resistance control method (brief idea)</li> <li>• Pole changing control method (brief idea)</li> </ul>	
	2.A.7	Concept of different types of Braking method of Induction Motor.	
	2.A.8	Industrial applications of Squirrel Cage & Wound – Rotor type Induction Motors.	

		<b>B: Synchronous Machines</b>		
	2.B.1	Basics of Synchronous Machines: <ul style="list-style-type: none"> <li>Identify main constructional parts with their functions</li> <li>Operating principle of Synchronous Motor</li> </ul>		
	2.B.2	Terminology related to Synchronous Motor: <ul style="list-style-type: none"> <li>Concept of starting</li> <li>Hunting</li> <li>Damper winding</li> </ul>		
	2.B.3	Applications of Synchronous Motor.		
<b>Unit 3: Fractional kW Motors</b>	3.1	Basics of Permanent Magnet Synchronous Motor (PMSM) <ul style="list-style-type: none"> <li>Identify different constructional parts</li> <li>Describe operating principle</li> <li>Control of PMSM</li> <li>Applications</li> </ul>	<b>07</b>	
	3.2	Basics of Brushless DC Motor (BLDC) <ul style="list-style-type: none"> <li>Define the constructional parts</li> <li>Describe operating principle</li> <li>Closed loop Control of BLDC</li> <li>Applications</li> </ul>		
	3.3	Brief concept and applications: <ul style="list-style-type: none"> <li>Stepper Motor</li> <li>Universal Motor</li> <li>Single phase Induction Motors</li> </ul>		
<b>Unit 4: Introduction to Control System</b>	4.1	Introduction to control system, Classification of control system.	<b>09</b>	
	4.2	Control system components: Synchro, D.C Servomotor, A.C Servo motor, AC Tachometer (only basic operating principle & construction and diagram. (no deduction)		
	4.3	Concept of transfer function, poles and zeroes, transfer function of first & second order system. (no deduction)		
	4.4	Signals (unit step, unit ramp, unit impulse) and their mathematical representation and characteristics.		
	4.5	Modelling of mechanical systems, force-voltage and force-current analogy.		
	4.6	Block Diagram Representation of control system, Transfer function from Block diagram reduction technique, State space representation of continuous time systems, State equations, Transfer function from State Variable representation.		
<b>Unit 5:</b>	5.1	Time response characteristics of first and second order system to unit step excitation (no deduction).	<b>07</b>	

<b>Time response analysis, Stability and Process control</b>	5.2	Stability concept: characteristic equation, Deciding stability from pole zero concept, Routh Hurwitz criteria (Numerical), Applications and limitations.	
	5.3	Control action of a system with ON/OFF, P, PI, PD, PID controller, Practical application of these controllers (with block diagram only).	
<b>Total Lecture Classes (Sub Total):</b>			<b>45</b>
<b>No. of classes required for conducting Internal Assessment:</b>			<b>06</b>
<b>Grand Total :</b>			<b>51</b>

### 3. Suggested Home Assignments/ Student Activities: (Any Four)

- i) Visit a small motor manufacturing industry and make a report based on their observation.
- ii) Prepare a Power – Point Presentation on the working of DC Motors, Induction Motors, Transformers, Synchronous Motor, PMSM and BLDC.
- iii) Prepare a Power – Point Presentation on the parts of DC Motors, Induction Motors, Transformers, Synchronous Motor, PMSM and BLDC.
- iv) Make a market survey and submit a report on the basis of the following:
  - a. Types of Machines, b. Manufacturer, c. Name Plate details, d. Applications.
- v) Visit a Transformer manufacturing factory and observe the various routine tests on Transformers and submit a report.
- vi) Make a model or simulation type project using BLDC and PMSM.
- vii) Deduce mathematical modelling of different mechanical and electrical systems.
- viii) Make a power point presentation on block diagram reduction technique.
- ix) Make a power point presentation on different controllers.
- x) Prepare a power point presentation on Programmable Logic Controllers.

### 4. Suggested Scheme for Question Paper Design for Conducting Internal Assessment: (Duration:45 Minutes)

<b>Questions to be set as per Bloom's Taxonomy</b>				
<b>Internal Assessment</b>	<b>Distribution of Theory Marks</b>			
	<b>Level 1 (Remember)</b>	<b>Level 2 (Understand)</b>	<b>Level 3 ( Apply &amp; above)</b>	<b>Total</b>
<b>Class Test – 1</b>	4	4	12	20
<b>Class Test – 2</b>	4	4	12	20

**5. Suggested Scheme for End Semester Examination: (Duration: 2 hrs. 30 minutes.)**

<b>Multiple Choice Type Questions (Carrying 1 mark each)</b>				
Group	Unit	To be set	To be Answered	Total Marks
A	1 & 2	12	20	20 X 1 = 20
	3	03		
	4 & 5	10		
Total:		25	20	20
<b>Long Answer Type Questions (Carrying 5 mark each)</b>				
Group	Unit	To be set	To be Answered	Total Marks
B	1 & 2	04	05 (At least two from each group)	05 X 08 = 40
C	3, 4 & 5	05		
Total: ( B + C )		<b>09</b>	<b>05</b>	<b>40</b>
<b>Sub – Total (A) Marks:</b>				<b>20</b>
<b>Sub – Total (B+C) Marks:</b>				<b>40</b>
<b>Total (A+B+C) Marks for End Semester:</b>				<b>60</b>

**6. Rubrics for the Assessment of Student’s Activity:**

Sl. No.	Performance Indicators	Weightage in %
01.	Originality of completing the Assigned task / micro-project work.	50
02.	Presentation Skill.	30
03.	In time submission of assignment work / micro- project work.	10
04.	Viva voce	10
Total:		100

**7. Suggested Learning Resources:**

<b>Sl. No.</b>	<b>Title of Book</b>	<b>Author</b>	<b>Publication</b>
01.	Principle of Electrical Machines	V. K. Mehta Rohit Mehta	S. Chand & Co. Pvt. Ltd., New Delhi
02.	Electrical Technology Vol – II	B. L. Thereja A. K. Thereja	BPB Publication, New Delhi
03.	Electrical Machinery	P. S. Bimbhara	Khanna Publishers, New Delhi



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"Karigori Bhavan", 4<sup>th</sup> Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: <b>Diploma in Mechanical Engineering</b>	
<b>Category: Open Elective</b>	<b>Semester : Sixth</b>
<b>Code No.: OE304/2</b>	<b>Full Marks : 100</b>
<b>Course Title: Environment Engineering &amp; Science</b>	<b>Examination Scheme:</b> (iii) <b>External Assessment: 60</b> marks (End Semester Examination)  (iv) <b>Internal Assessment: 40</b> marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
<b>Duration : 17 weeks</b> (Total class hour/week = 3)	
<b>Total lecture class/week: 3</b>	
<b>Credit : 3</b>	
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

**1. Course Outcomes (COs):**

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

<b>CO 1</b>	Recognize the relevance and the concept of Environmental Science and Engineering and different world-wide activities on this area.
<b>CO 2</b>	Illuminate the different types of environmental pollutant, their effects and their sustainable solutions.
<b>CO 3</b>	Discuss the environmental regulations act. and standards.
<b>CO 4</b>	Gather basic idea about conventional and non-conventional energy resources.
<b>CO 5</b>	Demonstrate the broad perspective of Environmental Science practices by utilizing engineering knowledge and principles

**2. Theory Components:**

Unit	Name of the Topic	Hours
<b>Unit 1: Environment and Ecology</b>	1.1 Classification of Environment 1.2 Environmental descriptors 1.3 Environmental quality and descriptive parameters 1.4 Ecology: Definition and classification 1.5 Environmental impact on ecology	<b>08</b>
<b>Unit 2: Water pollution and pollutants (Natural and Anthropogenic)</b>	2.1 Ground water: Sources and quality analysis 2.2 Surface water: Sources and quality analysis 2.3 Quality parameters in water treatment along with flow-sheets 2.4 Basic processes for potable water supply (Detailed technology not necessary) 2.5 Water pollution: Surface and ground water pollution, types of pollutants 2.6 Mode of water pollution 2.7 Parameters to be assessed for water pollution (Turbidity, pH, total suspended solids, total solids, BOD and COD: Definition, calculation) 2.8 Chemistry aspect for water pollution	<b>11</b>

	2.9 Control of water pollution (Description only) 2.10 Fundamental of water treatment techniques.	
<b>Unit 3: Air quality, Air Pollution and Control, Noise Pollution</b>	3.1 Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler) 3.2 Air Pollutants: Types, Units of air pollutants 3.3 Atmospheric physics for air pollution 3.4 Particulate Pollutants: Effects and control strategies (Bag filter, Cyclone separator, Electrostatic Precipitator) 3.5 Advanced air pollution control methods 3.6 Noise pollution: sources of pollution, measurement of noise pollution 3.7 Noise measuring devices and their demonstration.	<b>10</b>
<b>Unit 4: Solid waste and Soil pollution</b>	4.1 Definition of solid waste 4.2 Classification of solid waste 4.3 Overview on municipal, industrial, hazardous, hospital, plastic, E-waste. etc. 4.4 Solid waste management and disposal process. 4.5 Soil pollution, Poor Fertility, Septicity, Concentration of Infecting Agents in Soil 4.6 Leaching and its impact on soil pollution.	<b>06</b>
<b>Unit 5: Renewable sources of Energy</b>	5.1 Energy Resources: Energy scenario, national and international status. 5.2 Solar Photovoltaic: Solar radiation and types, basic working principle of solar PV, solar cells and types, water pumping and applications of solar PV. 5.3 Solar Thermal system: basic working principle and applications of solar thermal energy, solar water heater and types, solar cooking, solar pond, Solar still etc. 5.4 Wind energy systems: basic principle, types of wind turbines, application of wind energy, 5.5 Bio-energy systems: bio thermal and chemical basic principle, gasifier and digesters. 5.6 Hydro energy systems: small and micro hydro systems and its basic working. 5.7 Geothermal energy: Basic working principle, types and application of geothermal energy. 5.8 Ocean & Tidal Energy: Basic working principle, applications and types of different types of energy generation through ocean and tidal systems.	<b>08</b>
<b>Unit 6: Environment Legislation system and Rules</b>	6.1 Environmental protection rules 6.2 Sustainable environmental management.	<b>02</b>
<b>Sub Total : Total Lecture Classes</b>		<b>45</b>
<b>No. of classes required for conducting Internal Assessment examination</b>		<b>6</b>
<b>Grand Total:</b>		<b>51</b>



### 3. Suggested Scheme for Question Paper Design for Conducting Internal Assessment:

(Duration: 45 Minutes)

Questions to be set as per following Bloom's Taxonomy				
Internal Assessment	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test: 1	4	8	8	20
Class Test: 2	4	8	8	20

### 4. Suggested Scheme for End Semester Examination: (Duration: 2.5 hours)

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
<b>A</b>	1, 2 & 3	17	20	20 x 01 = <b>20</b>
	4, 5 & 6	8		
<b>Sub-Total [A]:</b>		<b>25</b>	<b>20</b>	<b>20</b>
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
<b>B</b>	1, 2 & 3	06	05 (At least two from each group)	05 x 08 = <b>40</b>
<b>C</b>	4, 5 & 6	03		
<b>Sub-Total [B+C]:</b>		<b>09</b>	<b>05</b>	<b>40</b>
<b>Total [A+B+C]:</b>			<b>60</b>	<b>60</b>

### 5. Suggested Learning Resources:

#### Text Books:

1. Environmental Studies- By N.N. Basak
2. Environmental Studies-By D .Srivastava
3. Introduction to Environmental Engineering— By Dr. Manindra Nath Patra.
4. Environmental Engineering- By A.K. Jain

#### Reference Books:

1. Environmental Engineering---By G.Killy
2. Environmental Engineering--- By Peavy, Rowe
3. Water and Waste Water Engineering— By S.Garg
4. Waste Water Engineering--By -Panmia
5. Non-conventional Energy Sources-4<sup>th</sup> Edition, By Prasad Rajesh K and Ojha
6. Non-conventional Energy Resources—By Chauhan and Srevastava
7. Non-conventional Energy Sources---By G.D.Rai (Khanna Publisher)
8. Ecology --By -Odum
9. Ecology---By -Das & Das
10. Environmental Law ---By -Gurdip Sing
11. Environmental Law----By Jaiswal Jaiswal Jaiswal
12. Environmental Law in India ---By -P. Leela Krishnan
13. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
14. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
15. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications- Rating System, TERI Publications - GRIHA Rating System.



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Name of the Course: Diploma in Mechanical Engineering			
Category: Program Elective	Semester: Sixth		
Code No.: MEPE 304/1	Full Marks: 100		
Course Title: Mechatronics Lab	Sessional Examination Scheme:		
	External Assessment (End Semester Sessional Examination)		
Duration : 17 weeks (2 hours per week)	Assignment on the day of Viva Voce:	20	40 marks
	Viva Voce (before Board of Examiners):	20	
Total practical classes / week: 2	Internal Assessment		
	Continuous assessment of class performance and in time submission of Assignments:	30	60 marks
Credit: 1	Viva Voce:	20	
	Class Attendance:	10	
Total Marks:		100	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			
Pre-requisite: Knowledge of Mechatronics [Code No.: MEPE 302/1].			

**1. Course Outcomes (COs):**

The theory and practical experiences associated with this subject are to be taught and implemented, so that the student demonstrates the following industry oriented course outcomes:

- The Students should be able to identify and understand the function of various components of a Mechatronics Systems.
- The Students should be able to demonstrate the working of a given Mechatronics System.
- The Students should be able to understand the basic concept of CNC machines and Part Programming.

**2. Suggested Assignments / Practical for Continuous Assessment:**

The list of practical to be completed by the students towards attainment of the required competency:

Sl. No.	List of Practical
01	Identification, demonstration of working principle and application of different sensors and transducers.
02	Verification or calibration or measurement different mechanical quantity with suitable setup comprising of different sensor(s) and / or transducer(s): <b>(Any two of the following)</b> <ol style="list-style-type: none"> <li>Measurement of strain by using a basic strain gauge and determination of the stress induced.</li> <li>Measurement of velocity of compressible fluid across a duct using Anemometer.</li> <li>Speed Measurement by using Stroboscope / Magnetic / Inductive Pick Up.</li> <li>Measurement of flow of fluid by using Rotameter.</li> <li>Calibration of given LVDT.</li> <li>Temperature control using Thermal Reed switch &amp; Bimetal switch.</li> <li>Temperature measurement using Thermocouple.</li> <li>Measurement of force &amp; weight by using a load cell.</li> <li>Liquid Level Measurement by using floats/ differential pressure cell system.</li> </ol>

	x. Verify characteristics of photo transducer & photo diode.
03	Demonstration of basic working principle and application of various digital to analog and analog to digital converters.
04	Simulation or design and develop program using PLC / Microcontroller for the following purpose: (Any two) <ul style="list-style-type: none"> <li>i. Measurement of speed of a motor.</li> <li>ii. Motor start and stop by using two different sensors.</li> <li>iii. Simulation of a pedestrian traffic controller.</li> <li>iv. Simulation of four-road junction traffic controller.</li> <li>v. Lift / elevator control.</li> <li>vi. Washing machine control.</li> <li>vii. Tank level control.</li> <li>viii. Soft drink vending machine control.</li> <li>ix. Speed control of servo motor / DC motor</li> <li>x. Temperature &amp; humidity measurement and control</li> <li>xi. Measurement of distance using suitable sensor</li> </ul>
05	Identification of different components, interpretation of their function and demonstration of working of a given hydraulic system as assigned by the concern teacher.
06	Identification of different components, interpretation of their function and demonstration of working of a given pneumatic system as assigned by the concern teacher.
07	Design and demonstration of Meter-in and Meter-out Circuits.
08	Design and demonstrate a suitable sequencing Circuit for sequential operation two actuators.
09	Identification of different components, interpretation of their function and demonstration of working of a CNC machine as specified by concern teacher.
10	Preparation of a chart containing commonly used word address codes, G-codes, M-codes and their interpretation as used in manual part programming of CNC machine tool.
11	Prepare a Part Program by using different codes for a specific job as assigned by the concern teacher, which is to be digitally manufactured or manufactured in CNC Turning Centre (CNC Lathe).
12	Prepare a Part Program by using different codes for a specific job as assigned by the concern teacher, which is to be digitally manufactured or manufactured in CNC Machining Centre (CNC Milling).

**Note:**

A suggested list of Practical is given in the above table. The concerned faculty member may add similar Practical Assignment also. **Any five (05)** practical are needed to be performed during the course, so that the student achieves the desired level of competency as generally required by the industry.

**3. Suggested Scheme for Internal Assessment: [Total Marks: 60]**

Involvement	Total Marks
Continuous assessment of class performance and in time submission of Assignments.	30
Viva Voce on to the Laboratory Practice at the end of the semester.	20
Class attendance.	10
<b>Total Internal Assessment:</b>	<b>60</b>
<b>Pass criterion for Internal Assessment = 24 Marks [Minimum]</b>	

#### 4. Suggested Scheme for End Semester Examination: [Total Marks: 40]

Involvement	Total Marks
Assignment on the day of End Semester Exam.	20
Viva Voce on to the Laboratory Practice on the day of End Semester Exam.	20
<b>Total External Assessment:</b>	<b>40</b>
<b>Pass criterion for Internal Assessment = 16 Marks [Minimum]</b>	

During conducting such Practical (laboratory / field based) work, the following social Skills / attitudes which are to be developed through the experiences:

- Follow the safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader / team member.
- Maintain tools and equipment in good working condition.
- Follow ethical practice.

#### 5. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
01	Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering	Bolton W.	Pearson Education Ltd.
02	Introduction to Mechatronics and Measurement Systems	Histand B.H. and Alciatore D.G.	Tata McGraw Hill
03	Programmable Logic Controllers	John W. Webb and Ronald Reis	Prentice Hall of India
04	Programmable Logic Control – Principles and Applications	NIIT	Prentice Hall of India
05	Programmable Logic Controller & Industrial Automation	Mitra & Sengupta	Penram International Publishing (India) Pvt. Ltd.
06	Sensors for Mechatronics	Paul P.L. Regtien	Elsevier
07	Introduction to Mechatronics	Appu Kuttan K.K.	Oxford
08	Process Control Principles & Applications	Surekha Bhanot	Oxford
09	Mechatronics Systems Design	Kolk R.A. and Shetty D.	Vikas Publishing, New Delhi
10	Mechatronics Principles, Concepts and Applications	Mahalik N.P.	Tata McGraw Hill
11	A Text book of Mechatronics	R.K.Rajput	S. Chand
12	Mechatronics	H.M.T.	Tata McGraw Hill
13	Mechatronics	Ramachandran	Wiley



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Name of the Course: Diploma in Mechanical Engineering			
Category: Program Elective	Semester: Sixth		
Code No.: MEPE304/2	Full Marks: 100		
Course Title: Oil Hydraulics and Pneumatics Lab	Sessional Examination Scheme:		
	External Assessment (End Semester Sessional Examination)		
Duration : 17 weeks (2 hours per week)	Assignment on the day of Viva Voce:	20	40 marks
	Viva Voce (before Board of Examiners):	20	
Total practical classes/week: 2	Internal Assessment		
	Continuous assessment of class performance and in time submission of Assignments:	30	60 marks
	Viva Voce:	20	
Class Attendance:	10		
Credit: 1	Total Marks:		100
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			
Pre-requisite: Knowledge of Oil Hydraulics and Pneumatics [Code No.: MEPE 302/2].			

**1. Course Outcomes (COs):**

The theory and practical experiences associated with this subject are to be taught and implemented, so that the student demonstrates the following industry oriented course outcomes:

- The Students should be able to identify and understand the function of various components of Oil Hydraulic & Pneumatic Systems.
- The Students should be able to understand and demonstrate the working principle of various components used for Oil Hydraulic & Pneumatic Systems.
- The Students should be able to develop simple Oil Hydraulic and Pneumatic Circuits for specific requirement.

**2. Suggested Assignments / Practical for Continuous Assessment:**

The list of practical to be completed by the students towards attainment of the required competency:

Sl. No.	List of Practical	Unit No. with Subject Code
01	Study of external gear pump and / or an unbalance vane pump and / or a bent axis type piston pump generally used in oil hydraulic systems and prepare report with suitable diagrams explaining its working principle and applications.	02 [MEPE 302/2]
02	Study of receiver mounted reciprocating air compressor generally used in pneumatic systems and prepare report with suitable diagrams explaining its working principle and function of its mandatory mountings and accessories.	04 [MEPE 302/2]
03	Study of rotary compressor (screw and / or vane compressor) generally used in pneumatic systems and prepare report with suitable diagrams explaining its working principle and applications.	04 [MEPE 302/2]
04	Study of pressure control valves generally used in oil hydraulic / pneumatic system and prepare report on its type, working principle, symbol and application.	02 & 04 [MEPE 302/2]

05	Study of flow control valves generally used in oil hydraulic / pneumatic system and prepare report on its type, working principle, symbol and application.	02 & 04 [MEPE 302/2]
06	Study of direction control valves generally used in oil hydraulic / pneumatic System and prepare report on its type, working principle, types of actuation, specification, symbol and application.	02 & 04 [MEPE 302/2]
07	Examine the cut-section model of check valve and needle valve and prepare report with suitable diagrams explaining its working principle and applications.	02 [MEPE 302/2]
08	Study of rotary / linier (single /double acting) actuators generally used in oil hydraulic / pneumatic system and prepare report on its working principle, symbol and application.	02 & 04 [MEPE 302/2]
09	Study of FRL Unit used in pneumatic system and prepare a report with suitable diagrams on working principle and function of its individual components.	04 [MEPE 302/2]
10	Identify and operate different components of oil hydraulic trainer system and prepare a report comprising list of components, function with symbol of each components and overall utility of the system.	02 & 03 [MEPE 302/2]
11	Identify and operate different components of pneumatic trainer system and prepare a report comprising list of components, function with symbol of each components and overall utility of the system.	04 & 05 [MEPE 302/2]
12	Prepare and operate an oil hydraulic circuit as specified by the concern teacher in a hydraulic trainer system. Observe, record pressure gauge readings at different stages of operation and prepare a report on working and setting of safety equipment(s) of hydraulic trainer system.	02 & 03 [MEPE 302/2]
13	Design, prepare, operate and submit a report on Control circuits of single acting and double acting linear actuators.	03 & 05 [MEPE 302/2]
14	Design, prepare, operate and submit a report on Meter-in and Meter-out Circuits.	03 & 05 [MEPE 302/2]
15	Design, prepare, operate and submit a report on Sequencing Circuit.	03 & 05 [MEPE 302/2]
16	Design, prepare, operate and submit a report on a suitable oil hydraulic Circuit which may be used to drive a shaping machine.	03 [MEPE 302/2]
17	Design, prepare, operate and submit a report on a suitable pneumatic circuit for Speed Control of pneumatic motor which may be used to drive pneumatic drill machine.	05 [MEPE 302/2]

**Note:**

A suggested list of Practical is given in the above table. The concerned faculty member may add similar Practical Assignment also. Any five (05) practical are needed to be performed during the course, so that the student achieves the desired level of competency as generally required by the industry.

**3. Suggested Scheme for Internal Assessment:** [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of class performance and in time submission of Assignments.	30
Viva Voce on to the Laboratory Practice at the end of the semester.	20
Class attendance.	10
<b>Total Internal Assessment:</b>	60
<b>Pass criterion for Internal Assessment = 24 Marks [Minimum]</b>	

**4. Suggested Scheme for End Semester Examination: [Total Marks: 40]**

Involvement	Total Marks
Assignment on the day of End Semester Exam.	20
Viva Voce on to the Laboratory Practice on the day of End Semester Exam.	20
<b>Total External Assessment:</b>	<b>40</b>
<b>Pass criterion for Internal Assessment = 16 Marks [Minimum]</b>	

During conducting such Practical (laboratory / field based) work, the following social Skills / attitudes which are to be developed through the experiences:

- f) Follow the safety practices.
- g) Practice good housekeeping.
- h) Demonstrate working as a leader / team member.
- i) Maintain tools and equipment in good working condition.
- j) Follow ethical practice.

**5. Suggested Learning Resources:**

Sl. No.	Title of Book	Author	Publication
01	Fluid Power with Application	A. Esposito	Pearson
02	Oil Hydraulic System- Principle and Maintenance	S.R. Majumdar	Tata McGraw Hill
03	Pneumatics Systems- Principles and Maintenance	S.R. Majumdar	Tata McGraw Hill
04	Hydraulic and Pneumatic Control	K. Shanmuga Sundaram	S. Chand
05	Hydraulics and Pneumatics, A technician's and engineer's guide	Andrew Parr	Butterworth-Heinemann
06	Fluid Power Generation, Transmission & Control	Jagadeesha T., Thammaiah Gowda	Wiley
07	Pneumatic Controls	P. Joji	Wiley
08	Introduction to Hydraulics and Pneumatics	Ilango & Soundararajan	Prentice Hall India
09	Hydraulics and Pneumatics	Stewart	Taraporewala Publication
10	Hydraulic System & Maintenance	Farel Bradbury	ILIFFE Books, London
11	Industrial Fluid Power	Charles Hedges	Womack Educational Publications
12	Industrial Hydraulic Control	Peter Rhoner	Prentice Hall India
13	Industrial Hydraulics	Hicks Pippenger	McGraw Hill International



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Name of the Course: Diploma in Mechanical Engineering			
Category: Major Project	Semester: Sixth		
CodeNo.:PR302	FullMarks:100		
Course Title: Major Project	Sessional Examination Scheme:		
Duration:17weeks(total hours per week=6)	<b>External Assessment</b> (End Semester Sessional Examination)		
	Evaluation of final report of the major project	20	<b>40 marks</b>
	Viva voce (before Board of Examiner(s))	20	
	<b>Internal Assessment</b>		
Total Practical class / week: 6	Continuous assessment of class Performance and in time submission of final report of the major project	30	<b>60 marks</b>
	Seminar presentation and viva voce	20	
	Credit:3	Class attendance	
<b>Total marks</b>			<b>100</b>
<b>Pass Criterion:</b> Students must obtain at least 40 % marks (pass marks) in both the internal assessment and end semester examination separately.			
<b>Note:</b> Most of the departmental faculties / teaching staff (as per availability) have to be involved to conduct number of different Major Projects by grouping the students of Semester 5 / Semester 6.			

**1. Course Outcomes (COs):**

Depending upon the nature of the projects undertaken, some of the following major course outcomes can be attained:

After completion of the project, the students will be able to:

- a) Implement the planned activity individually and / or as team.
- b) Select, collect and use required information / knowledge to solve the identified problem.
- c) Take appropriate decisions based on collected and analyzed information.
- d) Communicate effectively and confidently as a member and leader of team.
- e) Prepare project report following proper guidelines using appropriate tools (if any).

**2. Course details:**

At the end of 5<sup>th</sup> semester ‘progress report’ was submitted by the student based on the progress of project work done by him / her. The project work started in 5<sup>th</sup> semester is to be continued in 6<sup>th</sup> semester to attain the course outcomes as mentioned above. Such major project work must be completed in 6<sup>th</sup> semester and a ‘Final report’ is to be prepared based on the project work executed by the students. At the end of 6<sup>th</sup> semester, each student must present a ‘Seminar’ presentation (in ppt format) in presence of the faculties and students of the respective department.



This Seminar presentation will be entirely based on the project work done and the 'Final Report' prepared by the student. Evaluation of 'viva voce' part will be based on the question-answer part at the end of the seminar presentation. The questions may be asked by any faculty or students.

**3. Suggested contents of the project Final Report:**

- a) Title page (Containing Project Title along with Polytechnic name and Logo (if any), names of team members and guide teacher(s)).
- b) Certificate (in the format given in this document as Annexure- A).
- c) Acknowledgement
- d) Abstract (within 200 to 250 words)
- e) Content (Introduction, Objective of the project, Methodology / Procedure Followed, Results and Discussions, Conclusions, Appendix if any, and References)
- f) Abbreviations (if any)

**4. Suggested Scheme for End Semester External Assessment: [Total Marks: 40]**

Involvement	Total Marks
Evaluation of Final report on the day of End Semester External Exam.	20
Viva Voce on to the major project work (done by the student) on the Day of End Semester External Exam.	20
<b>Total External Assessment:</b>	<b>40</b>
<b>Pass criterion for Internal Assessment = 16 Marks[Minimum]</b>	

**5. Suggested Scheme for Internal Assessment: [Total Marks: 60]**

Involvement	Total Marks
Continuous assessment of performance, contribution and in time submission of Final report of the major project.	30
Seminar Presentation and Viva Voce on to the projects work at the end of the semester.	20
Class attendance	10
<b>Total Internal Assessment:</b>	<b>60</b>
<b>Pass criterion for Internal Assessment = 24 Marks [Minimum]</b>	

## **CERTIFICATE**

This is to certify that the project work entitled "***Title of the project work***" being submitted by (*Student's name*) to (*Polytechnic name*) for the award of the degree of Diploma in Mechanical Engineering is a record of his project work carried out under my supervision and guidance. The student is fully responsible for the results and discussion presented in this report.

This work, in my opinion, has reached the standard of fulfilling the requirements for the award of the degree of Diploma in Mechanical Engineering.

Name and signature of the Project Guide(s)

Name and signature of the HOD,  
Mechanical Engineering Dept.

Name and signature of the  
Principal/Principal-in-Charge



**WEST BENGAL STATE COUNCIL OF TECHNICAL  
& VOCATIONAL EDUCATION AND SKILL DEVELOPMENT**

[A Statutory Body under West Bengal Act XXVI of 2013]

(Formerly West Bengal State Council of Technical Education)

"Karigori Bhavan", 4<sup>th</sup> Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Mechanical Engineering			
Category: Seminar	Semester: Sixth		
Code No.: SE302	Full Marks: 100		
Course Title: Seminar	Sessional Examination Scheme:		
	External Assessment (End Semester Sessional Examination)		
Duration : 17 weeks (1 hour per week)	Final presentation of Seminar	30	40 marks
	Viva Voce (before Board of Examiners / fellow students):	10	
	Internal Assessment		
	Continuous assessment of class performance and in time submission of report	30	60 marks
Total classes/week: 1	Viva Voce:	20	
	Class Attendance:	10	
Credit: 1	Total Marks:		100
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			
Pre-requisite: Knowledge of project work / emerging field of Mechanical Engineering etc.			
Note: Most of the departmental faculties (as per availability) have to be involved to act as mentor / guide for presenting seminar by each student.			

### 1. Course Outcomes (COs):

- CO1 - Establish motivation for any topic of interest and develop a thought process for technical presentation.
- CO2 - Organize a detailed literature survey and build a document with respect to technical publications.
- CO3 - Analysis and comprehension of proof of concept and related data.
- CO4 - Effective presentation and improve soft skills.
- CO5 - Make use of new and recent technology for creating technical reports

### 2. Suggested activities for effective presentation:

This one credit point course is meant to make ready the students for Effective presentation in front of the scientific audience and improve soft skills and to explore topics in detail. The students will be allowed to opt a seminar topic in the beginning of the session (Semester – 6) based on their departmental subjects / Assigned major project / emergent field etc.

During practice, to prepare himself / herself as a speaker, each student will have to receive feedback from the fellow students and the mentor faculty (s).

Students will research topics and organize presentations on the topic before an internal committee constituted by the concerned department of the institute and other students. Each student will have to give 10-15 minute presentations on seminar topic.

On the final seminar date (s), attendance of all students enrolled is mandatory. It is expected that students will actively participate by asking questions to the speaker. The effort by students to meet these expectations will be considered in the determination of their final grade. Before due date of seminar, students have to submit a detailed outline of their presentation and also a brief abstract describing their

presentation to his or her mentor. Abstracts should be concise well written and free of grammatical and typographical errors. The abstract will also serve as an announcement and should include the time, date, and location of the seminar

Students may choose to use PowerPoint to present their seminar, or the chalkboard is also acceptable media for visual aids. It is the responsibility of the students to arrange for any additional equipment he or she feels required to present seminar. Visual aids should look professional and be readable in the entire room.

**Proposal Seminar Format:**

- Introduce the advisor/mentor and committee members present in the seminar hall.
- Give an introduction and background information on your topic.
- Clearly state the objectives to choose the topic.
- Describe the seminar topic thoroughly.
- Questioner session

The final grade of the students will be determined for seminar as per following criteria.

Sl. No.	Criteria for evaluation of students for seminar
1	Quality of content presented
2	Proper planning for presentation
3	Effectiveness of presentation
4	Quality of the report
5	Depth of knowledge and presentation skill
6	Viva – voce / Questioner session

**3. Suggested Scheme for Internal Assessment:** [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of class performance and in time submission of report.	30
Viva Voce	20
Class attendance	10
<b>Total Internal Assessment:</b>	60
<b>Pass criterion for Internal Assessment = 24 Marks [Minimum]</b>	

**4. Suggested Scheme for End Semester Examination:** [Total Marks: 40]

Involvement	Total Marks
Final Presentation of Seminar topic	30
Viva Voce on the day of final presentation	10
<b>Total External Assessment:</b>	40
<b>Pass criterion for Internal Assessment = 16 Marks [Minimum]</b>	