



## West Bengal State Council of Technical Education

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

<b>Name of the Course :</b> Diploma in Mechanical Engineering		
<b>Subject Title: Fluid Mechanics &amp; Machinery</b>		
<b>Course code: ME/</b>	<b>Semester : Fifth</b>	
<b>Duration : 17 weeks</b>	<b>Maximum Marks : 150</b>	
<b>Teaching Scheme:</b>	<b>Examination Scheme:</b>	
Theory : 3 hrs/week	<b>Internal Assessment:</b> 20 Marks	
Tutorial: hrs/week	<b>Teacher's assessment (Assignment &amp; Quiz):</b> 10 Marks	
Practical : 2 hrs/week	<b>End Semester Exam:</b> 70 Marks	
Credit: 4	<b>Practical: Internal Sessional continuous evaluation:</b> 25 Marks	
	<b>Practical: External Sessional Examination:</b> 25 Marks	
<b>Aim :-</b>		
<b>S.No</b>		
1	To develop and apply the concepts introduced in Fluid Mechanics to engineering applications in turbo machinery and flow measurement.	
2	To introduce and apply to concepts of similarity and scaling within fluid mechanics.	
3	To review flow measurement devices / techniques, from industrial machines to modern, laser-based methods.	
<b>Objective :-</b>		
<b>S No</b>	The student will able to	
1	Know different machine elements and mechanisms.	
2	Understand Kinematics and Dynamics of different machines and mechanisms.	
3	Select Suitable Drives and Mechanisms for a particular application.	
	Appreciate concept of balancing and Vibration.	
	Develop ability to come up with innovative ideas	
<b>Pre-Requisite:-</b>		
<b>S.No</b>		
1	Measure various properties such as pressure, velocity, flow rate using various instruments. Systems.	
2	Calculate different parameters such as co-efficient of friction, power, efficiency etc of various.	
3	Describe the construction and working of turbines and pumps.	
4	Test the performance of turbines and pumps.	
5	Plot characteristics curves of turbines and pumps.	
<b>Contents</b>		<b>Hrs/week</b>
<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>
<b>GROUP:A</b>		
01	<b>Properties of fluid</b> 1.1 Density, Specific gravity, Specific Weight, Specific Volume 1.2 Dynamic Viscosity, Kinematics Viscosity, Surface tension, Capillarity 1.3 Vapour Pressure, Compressibility	<b>04</b>
02	<b>Fluid Pressure &amp; Pressure Measurement</b> 2.1 Fluid pressure, Pressure head, Pressure intensity. 2.2 Concept of absolute vacuum, gauge pressure, atmospheric pressure, absolute pressure.	<b>08</b>

	2.3 Simple and differential manometers, Bourden pressure gauge. 2.4 Concept of Total pressure on immersed bodies(flat vertical, flat inclined), center of Pressure, Pr. Distribution diagram. <b>Note:</b> Numericals on Manometers, Total Pressure & Centre of pressure.	
<b>GROUP:B</b>		
03	<b>Fluid Flow</b> 3.1 Types of fluid flows: steady-unsteady, uniform-non-uniform, laminar-turbulent. 3.2 Continuity equation 3.3 Bernoulli's theorem 3.4 Venturimeter – Construction, principle of working, Coefficient of discharge, Derivation for discharge through venturimeter. 3.5 Orifice meter – Construction, Principle of working, hydraulic coefficients, Derivation for discharge through Orifice meter 3.6 Pitot tube – Construction, Principle of Working <b>Note :-</b> Numericals on Venturimeter, orifice meter, pitot tube.	08
04	<b>Flow Through Pipes</b> 4.1 Laws of fluid friction ( Laminar and turbulent) 4.2 Darcy's equation and Chezy's equation for frictional losses. 4.3 Minor losses in pipes 4.4 Hydraulic gradient and total gradient line. 4.5 Hydraulic power transmission through pipe <b>Note:</b> Numericals to estimate major and minor losses.	05
<b>GROUP:C</b>		
05	<b>Impact of jet</b> 5.1 Impact of jet on fixed vertical, moving vertical flat plates. 5.2 Impact of jet on curved vanes with special reference to turbines & pumps <b>Note -</b> Simple Numericals on work done and efficiency.	06
06	<b>A] Centrifugal Pumps</b> 6.1 Construction , principle of working and applications 6.2 Types of casings and impellers. 6.3 Concept of multistage 6.4 Priming and its methods, Cavitation 6.5 Manometric head, Work done, Manometric efficiency, Overall efficiency, NPSH Note :- Numericals on calculations of overall efficiency and power required to drive pumps. <b>B] Reciprocating Pump</b> 6.6 Construction ,working principle and applications of single and double acting reciprocating pumps. 6.7 Concept of Slip, Negative slip, Cavitation and separation 6.8 Use of Air Vessel. 6.9 Indicator diagram with effect of acceleration head & frictional head. Note:- No Derivations and Numericals on reciprocating pumps.	14
	<b>Total</b>	<b>45</b>
<b>Practical:</b> Skills to be developed: Intellectual Skills: 1) Select and use appropriate flow measuring device. 2) Select and use appropriate pressure measuring device. 3) Analyze the performance of pumps.		

**Motor Skills:**

- 1) Use flow measuring device.
- 2) Use pressure measuring device.
- 3) Operate pumps.

**List of Practical: (Any Five)**

01. Calibration of Bourden pressure gauge with the help of Dead Weight Pressure gauge.
02. Verification of Bernoulli's Theorem.
03. Determination of Coefficient of Discharge of Venturimeter.
04. Determination of Coefficient of Discharge, coefficient of contraction and coefficient of velocity of orifice meter.
05. Measurement of velocity of flow through pipe with the help of Pitot tube.
05. Determination of coefficient of friction of flow through pipes.
06. Trial on centrifugal pump to determine overall efficiency.
07. Trial on reciprocating pump to determine overall efficiency.

**List of Books:**

Author	Title	Publication
Ramamrutham S.	Hydraulic, fluid mechanics & fluid machines	Dhanpat Rai and Sons ,New Delhi
C.S.P.Ojha	Fluid Mechanics & Machinery	Oxford University Press
Modi P. N. and Seth S. M.	Hydraulics and fluid mechanics including Hydraulic machines	Standard Book House. New Delhi
Streeter Victor, Bedford K.W., Wylie E.B	Fluid Mechanics	McGraw Hill Int.
K. Subramanya	One Thousand Solved Problems in Fluid Mechanics	Tata McGraw Hill
Garde	Fluid Mechanics	CITECH
Pump manufactures' catalogs such as Kirloskar Brothers, KSB, Kishor pumps etc.		

**Reference books :- Nil**

Suggested List of Laboratory Experiments :- Nil							
Suggested List of Assignments/Tutorial :-							
1. Numericals on Manometers, Total Pressure & Centre of pressure							
2. Numericals on Venturimeter, orifice meter, pitot tube							
3. Numericals to estimate major and minor losses							
4. Simple Numericals on work done and efficiency on impact of jet.							
5. Numericals on calculations of overall efficiency and power required to drive pumps.							
End Semester Examination Scheme. Maximum Marks-70, Time Allotted-3 hrs							
Group	unit	Objective Questions		Subjective Questions			
		No. of questions to be set	Total marks	No. of questions to be set	To answer	Marks per question	Total marks
A	01,02	8	25	3	5, taking at least one from each group	10	50
B	03,04	8		4			
C	05,06	9		3			

### EXAMINATION SCHEME FOR PRACTICAL SESSIONAL

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



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<b>Name of the Course :</b> Diploma in Mechanical Engineering		
Subject Title: Engineering Metrology		
<b>Course code: ME/</b>		<b>Semester : Fifth</b>
<b>Duration : 17 weeks</b>		<b>Maximum Marks : 100</b>
		<b>Examination Scheme:</b>
<b>Teaching Scheme:</b>		<b>Internal Assessment:</b> 10 Marks
Theory : 2 hrs/week		<b>Teacher's assessment (Assignment &amp; Quiz):</b> 05 Marks
Tutorial: hrs/week		<b>End Semester Exam:</b> 35 Marks
Practical : 2 hrs/week		<b>Practical: Internal Sessional continuous evaluation:</b> 25 Marks
Credit: 3		<b>Practical: External Sessional Examination:</b> 25 Marks
<b>Aim :-</b>		
<b>S.No</b>		
1	<p>The mechanical Engineering technician often come across measuring different parameters of machined components and the appropriate fittment of interchangeable components in the assemblies. For the above purpose the student is also required to analyze the quantitative determination of physical magnitude.</p> <p>During previous semesters different systems of measurement and their units etc have been introduced in the different subjects. The different methods and instruments which can be used for linear and angular measurements, geometrical parameters (like surface finish, Squareness, Parallelism, Roundness etc ..) and the use of gauges and system of limits, Fits, Tolerances etc. are often required to be dealt in detail by diploma technician on the shop floor. The student is also required to analyze, Interpret and present the data collected for ensuring the quality.</p> <p>The knowledge of the subject also forms the basis for the design of mechanical measurements systems, design &amp; drawing of mechanical components.</p>	
S No	The student will able to	
	<div>1. Select appropriate instrument/s for specific measurement.</div> <div>2. Measure Physical quantity</div> <div>3. Measure &amp; adjust errors of measurement</div> <div>4. Design &amp; use of gauge system in manufacturing industry</div> <div>5. Analyze and interpret the data obtained from the different measurements processes</div>	
<b>Pre-Requisite:-</b>		
<b>S.No</b>		
1	Unit system & basic physics	
<b>Contents</b>		<b>Hrs/week</b>
<b>Chapter</b>	<i>Name of the Topic</i>	<b>Hours</b>
<b>Group A</b>		
01	<b>Limits, Fits ,Tolerances and Gauges</b> Tolerances, Selective Assembly, Interchangeability, Limits Of Size, Allowances, Clearances, Interference, IS 919- 1993 , Fits, Selection Of Fits, Numerical Problems On Limits Of Size And Tolerances, , Taylor's Principle, Gauge Design, hole and shaft basis system, Plain Plug Gauge IS: 3484 -1966, Plain Ring Gauge IS: 3485 -1972, Snap Gauge IS: 3477 -1973.	05
02	<b>Linear Measurement</b>	<b>04</b>

	Description, working principle, method of reading, least count for Vernier Calipers, Micrometers(outside micrometer, Inside Micrometer, Stick Micrometers), depth gauge & Height Gauge, Feeler gauge, Slip Gauges (category, use, Selection of Slip Gauges for setting particular dimension)	
03	<b>Angular Measurement</b> Concept, Instruments for Angular Measurements, construction, Working principle and Use of Universal Bevel Protractor, Sine Bar, Spirit Level, Principle of Working of Clinometers, Angle Gauges (With Numerical on Setting of Angle Gauges).	03
04	<b>Comparators</b> Definition, Classification, use of comparators, Working principle of different type of comparators like mechanical comparator (Dial indicator, Sigma comparator), Pneumatic comparator, Electrical Comparators, Optical Comparators, characteristics of good comparator, Relative advantages and disadvantages.	04
<b>Group B</b>		
05	<b>Screw thread Measurements</b> Terminology of thread, Pitch errors, Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch & thread angle, Working principle of floating carriage dial micrometer, Screw Thread Micrometer, pitch measuring m/c, Two wire method, thread gauge (plug gauge, ring gauge & snap gauge)	04
	<b>Gear Measurement and Testing</b> Analytical and functional inspection, Rolling test, Measurement of tooth thickness (constant chord method), gear tooth Vernier, Errors in gears such as backlash, runout, composite.	03
	<b>Measurement of surface finish</b> Primary and secondary texture, Sampling length, Lay, terminology as per IS 3073- 1967, direction of lay, Sources of lay and its significance, CLA, Ra, RMS, Rz values and their interpretation, Symbol for designating surface finish on drawing, Various techniques of qualitative analysis, Working principle of stylus probe type instruments.	03
	<b>Machine tool testing</b> Parallelism by dial indicator, Straightness testing by straight edge, spirit level & Autocollimators, flatness testing by dial gauge, level or Autocollimators, optical flats Squareness Testing - by dial indicator, optical square, indicating method., alignment testing of lathe machine tool as per IS standard procedure.	04
	<b>Total</b>	<b>30</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. To understand principle, working of various measuring instruments.
2. Selection of proper instruments for measurement.
3. Calculation of least count of instrument.
4. Take reading using the instrument
5. Interpret the observation and results

**Motor Skills:**

1. Setting the instruments for zero error adjustment.
2. Proper alignment of the instrument with work piece
3. Handling of instruments

4. Care and maintenance of instruments.
5. Measure the dimensions form the instruments.
6. Calibration and traceability of the instruments
7. Graphical representation of data.

### **LIST OF PRACTICALS**

#### **List of Practical: (Any five)**

1. Standard use of basic measuring instruments. Surface plate, v-block, sprit level, combination set, filler gauge, screw pitch gauge, radius gauge, vernier caliper, micrometer and slip gauges to measure dimension of given jobs.
2. To find unknown angle of component using sine bar and slip gauges.
3. Study and use of optical flat for flatness testing.
4. Measurement of screw thread elements by using screw thread micrometer, screw pitch gauge.
5. Study and use of dial indicator as a mechanical comparator for run out measurement, and roundness comparison.
6. Measurement of gear tooth elements by using gear tooth vernier caliper and verification of gear tooth profile using profile projector,
7. Alignment Testing of lathe machine tool.

#### **Examination Schedule Internal practical Sessional:**

Attending classes, practicing programs & submitting respective assignment in time		5 x 4 = 20	
Viva - voce		5	
Total:		25	

#### **Examination Schedule: External practical Sessional examination**

Examiner: **Lecturer**

For submission of assignment in scheduled time		5 x 2 = 10	
On spot program		10	
viva voce		05	
Total		25	

#### **Reference books :- Nil**

#### **Suggested List of Laboratory Experiments :- Nil**

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

Examination Scheme:

G R O U P	Chapter	ONE OR TWO SENTENCE ANSWER QUESTIONS				G R O U P	Chapter	SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS			TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A		5	10	1	1 X 10 = 100	A		5	FIVE, TAKING AT LEAST TWO FROM EACH GROUP	5	5 X 5 = 25
B		5				B		5			

List of Books:

Author	Title	Publication
N V Raghavendra L Krishnamurthy	Engineering Metrology & Measurements	Oxford
R.K.Rajput	Mechanical Measurement & Instrumentation	S.K. Kataria & Sons
R. K. Jain.	Engineering metrology	Khanna Publisher, Delhi
M. Mahajan	A text book of metrology	Dhanpat Rai and Sons,
I.C. Gupta	A text book of Engineering metrology	Dhanpat Rai and Sons,
M. Adithan and R.Bahl	Metrology Lab. Manual	T.T.T.I. Chandigarh.
K. J. Hume	A text book of Engineering metrology	Kalyani publishers
J.F.W. Galyer and C. R. Shotbolt	Metrology for Engineers	ELBS

2. IS/ International Codes:

IS 919 – 1993 Recommendation for limits, fits and tolerances  
 IS 2029 – 1962 Dial gauges.  
 IS 2103 – 1972 Engineering Square  
 IS 2909 – 1964 Guide for selection of fits.  
 IS 2921 – 1964 Vernier height gauges  
 IS 2949 – 1964 V Block.  
 IS 2984 – 1966 Slip gauges.  
 IS 3139 – 1966 Dimensions for screw threads.  
 IS 3179 – 1965 Feeler gauges.  
 IS 3455 – 1966 Tolerances for plain limit gauges.  
 IS 3477 – 1973 Snap gauges.  
 IS 6137 – 1971 Plain plug gauges.  
 IS 3651 – 1976 Vernier Caliper  
 IS 4218 - Isometric screw threads



IS 4440 – 1967 Slip gauges accessories  
IS 5359 – 1969 Sine bars  
IS 5402 – 1970 Principle and applications of sine bars  
IS 5939 – 1970 Sine angles, sine tables.

Name of the Course : MECHANICAL AND PRODUCTION ENGINEERING / PRODUCTION TECHNOLOGY (ADVANCED MANUFACTURING PROCESSES)			
Course code:		Semester : Fifth	
Duration : 17 weeks		Maximum Marks : 200	
Teaching Scheme		Examination Scheme	
Theory : 2 hrs/week		Semester Exam: 70 Marks	
Tutorial: hrs/week		Teacher's Assessment (Assignment & Quiz): 10 Marks	
Practical : 3 hrs/week		Internal Assessment: 20 Marks	
Credit:4		Practical Sessional internal continuous evaluation: 50 Marks	
		Practical Sessional external examination: 50 marks	
Aim :-			
S.No			
1	To know about the advancements in the area of manufacturing and production processes. To impart knowledge & skills necessary for working in modern manufacturing environment. To get familiarized with working principles and operations performed on non traditional machines, machining center, SPM, automated machines and maintenance of machine tools.		
Objective :-			
S No	The student will able to		
1	• Know different non traditional machining processes, CNC milling machines.		
2	• Understand the working of Special Purpose Machines.		
3	• Work as maintenance engineer.		
4	• Know the Operation and control of different advanced machine tools and equipments.		
5	• Produce jobs as per specified requirements by selecting the specific machining process.		
6	• Adopt safety practices while working on various machines.		
7	• Develop the mindset for modern trends in manufacturing and automation.		
Pre-Requisite:-			
S.No			
1	Knowledge of basic manufacturing processes.		
Contents			Hrs/week
Chapter	Name of the Topic	Hours	Marks
01	Non traditional machining processes 1.1 Electrical discharge Machining. Principle of working, Setup of EDM, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, Applications e.g. microhole drilling, curve hole drilling. 1.2 Wire cut EDM - Principle of working, Setup of WEDM, controlling Parameters, Applications. 1.3 Laser Beam Machining. Physical principle of Laser, Laser action in ruby rod, Types of Lasers. Set-up for LBM. Characteristics, controlling Parameters, Applications, Application Of Laser Beam for Welding (LBW) 1.4 Other non traditional machines such as ECM Principle of working, Applications.	10	
	Jigs and Fixtures Introduction. Difference between jig and fixture Different components of Jig/ fixture 3-2-1 principle of location. Types of locators and clamping devices.	4	

	General principles of jig/fixture design. Types of jigs and fixtures.		
	<b>CNC Machine Tools:</b> Concept of NC & CNC, CNC Turning Centre, Advantages & Disadvantages of CNC machine tools, Applications of NC/CNC Machine, Classification of CNC M/C Tools (Based on motion type, based on control loops, based on axis, based on power supply), Different components of CNC machine tools & their functions, Components of CNC System (function & application): Stepper motor, Servo motor, Encoders (rotary & linear encoder), Recirculating ball screw, Automatic tool changer, Tool magazine. work holding methods for turning centre(name & relative advantage & disadvantage), work holding methods for machining centre(name & relative advantage & disadvantage), steps in CNC process. Part Programming: concept of part programming, reference point (Machine Zero, Program Zero, Part Origin), Axis identification of Turning Centre & Machining Centre, CNC Codes for manual part programming G – codes, M- Codes, Spindle speed control, feed rate control, Tool selection) part programming for turning centre using different codes & fixed cycles (canned cycle, do-loop & Subroutine) to get step, taper, plain & circular turning, facing, external threading & parting off operation. part programming for machining centre considering Cutter radius compensation, ramp on/off motion, tool offset and using different codes, canned cycles & subroutine for generating different milled surface. CNC part program verification. Principles of computer aided part programming.	12	
4	<b>FMS:</b> Concept, Basic components of FMS (Different workstations, Automated material handling & storage system, computer control system), types of FMS layout, objectives of FMS, advantages & disadvantages of FMS.	4	
	<b>Total</b>	30	

### Practical:

Skills to be developed:

Intellectual skills:

- 1) To select an appropriate non conventional machining process for required component.
- 2) To write programs for CNC milling machine.
- 3) To specify the requirement for special purpose machines and automation.
- 4) To select the maintenance procedure for given machine tool.

Motor Skills:

- 1) To execute part programs on CNC milling machine / machining center.
- 2) To repair and maintain machine tools and sub systems.
- 3) To use and operate different hand tools required for repair and maintenance.
- 4) To identify and rectify the faults in the given sub assembly.

**Notes:** 1. The workshop instructors should prepare specimen job in each shop as demonstration practice before the student (as per the drawing given by subject teacher / workshop superintendent)  
 2. Theory behind practical is to be covered by the concerned subject teacher / workshop superintendent.

3. Workshop diary should be maintained by each student duly signed by respective shop instructors

### List of Practical:(Any five):

- 1) Study of Non traditional machining process like EDM, Wire EDM , ECM ,USM & also one assignment on the processes.
- 2) Study of CNC lathe & CNC Milling machine & identify of different parts, drives , automatic tool changer and also tool magazine
- 3) Practice on making Eccentric turning in a round job
- 4) One assignment on part programming of straight turning , taper turning , radius forming operation in a

turning centre

- 5) Practice on making simple job like straight turning , taper turning ,radius forming by CNC lathe machine
- 6) One assignment on part programming on machining centre
- 7) Practice on making simple job by CNC machining centre
- 8) Practice on making face milling, slotting, contour machining on a machining centre
- 9) One assignment on machine tool installation process

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Amitabh Ghosh , Mallik	Manufacturing Science		East-West Press Pvt. Ltd.
HMT Bangalore	Production Technology		Tata McGraw-Hill
H.P.Garg	Industrial maintenance		S. Chand & Co. Ltd.
S. K. Hajra Chaudary, Bose, Roy	Elements of workshop Technology – Volume I & II		Media Promoters and Publishers limited
P. K. Mistra	Non conventional Machining		Narvasa Publishining House
Lindley R. Higgins	Maintenance Engg. Handbook		Mc-Graw Hill
B. L. Juneja	Fundamental of metal cutting and machine tools		New age international limited.
Steve Krar, Albert Check	Technology of Machine Tools.		Mc-Graw-Hill International
O. P. Khanna and Lal	Production Technology - Volume I & II		Dhanpat Rai Publications.
W.A.J. Chapman, S.J.Martin	Workshop Technology - Volume I , II & III		Viva Books (p) Ltd.
O.P. Khanna	A text book of Foundry Tech.		Dhanpat Rai Publications.
R.B. Gupta	Production Technology		Satya Prakashan New Delhi
H.S.Bawa	Workshop Technology Volume-I& II		Tata McGraw-Hill
John A. Schey	Introduction to Manufacturing Processes		McGraw-Hill
M. Adithan A. B. Gupta	Manufacturing Technology		New age International
Pabla B. S. M. Adithan	CNC machines		New age international limited.
B. L. Juneja	Fundamental of metal cutting and machine tools		New age international limited.
Steve Krar, Albert Check	Technology of Machine Tools.		McGraw-Hill International
P. N. Rao	CAD/CAM Principals and Applications		Tata McGraw-Hill
P. N. Rao	Manufacrating Technology Metal Cutting & Machne tools		Tata McGraw-Hill

<b>Reference books :- Nil</b>	
<b>Suggested List of Laboratory Experiments :- Nil</b>	
<b>Suggested List of Assignments/Tutorial :- Nil</b>	

**Examination Schedule Internal practical Sessional:**

Making job (4 task) & submitting job sheet in scheduled time		4X5 = 20	
Viva - voce		4X2.5 = 10	
Attending classes for studying different machines and submitting respective assignment		3X4 = 12	
Viva voce & skill in operating machine		8	
Total:		50	

**Examination Schedule: External practical Sessional examination**  
**Examiner : Lecturer in Mechanical Engineering & Foreman (Work Shop).**

For Making job (4 task) & submitting signed job sheet in scheduled time		4X2.5 = 10	
On spot job		20	
viva voce on study		20	
		50	

**End Semester EXAMINATION SCHEME**

GROUP	MODULE	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2	10	20	1	20	5	FIVE (AT LEAST TWO FROM EACH GROUP)	10	50
B	3,4	10				5			



## West Bengal State Council of Technical Education

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

<b>Name of the Course :</b> Diploma in Mechanical Engineering		
<b>Subject Title:</b> Measurement & Control		
<b>Course code: ME/</b>		<b>Semester :</b> Fifth
<b>Duration : 17 weeks</b>		<b>Maximum Marks : 100</b>
<b>Teaching Scheme:</b>		<b>Examination Scheme:</b>
		<b>Internal Assessment:</b> 10 Marks
Theory : 2 hrs/week		<b>Teacher's assessment (Assignment &amp; Quiz):</b> 05 Marks
Tutorial: hrs/week		<b>End Semester Exam:</b> 35 Marks
Practical : 2 hrs/week		<b>Practical: Internal Sessional continuous evaluation:</b> 25 Marks
Credit: 3		<b>Practical: External Sessional Examination:</b> 25 Marks
<b>Aim :-</b>		
	The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid changes, with many types of instrumentation devices, innovations, refinements. The course aims at making a Mechanical Engineering student familiar with the principles of instrumentation, transducers & measurement of non electrical parameters like temperature, pressure, flow, speed, force and stress.	
S No	The student will able to	
	<div>1. Understand the principle of operation of an instrument.</div> <div>2. Identify different functional elements of measuring system</div> <div>3. Appreciate the concept of calibration of an instrument.</div> <div>4. Select Suitable measuring device for a particular application.</div> <div>5. Measure different mechanical measuring quantity</div> <div>6. Know the working principle of transducers.</div>	
<b>Pre-Requisite:-</b>		
<b>S.No</b>		
<b>Contents</b>		<b>Hrs/week</b>
<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>
<b>Group A</b>		
01	<b>Introduction to measuring system:</b> Significance Of Measurement, block diagram of a measuring system, Functional Elements Of measurement System, Classification Of Instrument. <b>Introduction to Control system:</b> Function of control system, Block diagram of open loop & closed loop system. Basic elements of closed loop system.	05

	<b>Example</b> of measurement & control system for Heating a room at specific temperature, Maintain a particular shaft speed.	
02	<b>Displacement measurement:</b> Working principle & use of Potentiometer, Differential transformer (LVDT & RVDT), Capacitive element & Optical encoders.	<b>04</b>
03	<b>Speed Measurement:</b> Mechanical tachometer, Electrical Tachometer, incremental optical encoder, Eddy current drag cup tachometer, Magnetic pickup tachometer, Stroboscopic tachometer, Photoelectric tachometer, non contacting electrical tachometer (inductive pick up & capacitive pick up)	<b>06</b>
<b>Group B</b>		
04	<b>Temperature measurement:</b> Pressure thermometer, Resistance Temperature Detector, Platinum resistance thermometer, Thermistors, Thermocouple, Quartz thermometer, radiation pyrometer, optical pyrometer.	<b>03</b>
05	<b>Flow Measurement:</b> Variable area meter – Rotameter, Variable velocity meter – Anemometer, Special methods – ultrasonic flow meter, hot wire anemometer, electromagnetic flow meter.	<b>03</b>
06	<b>Miscellaneous Measurement:</b> <b>Acoustic Measurement:</b> Characteristics of Sound, sound measuring system Sound level meter (using Piezo – electric crystal type microphone). <b>Force measurement:</b> Electromechanical method, strain gauge load cell. <b>Shaft power measurement:</b> Eddy current dynamometer, Strain gauge transmission dynamometer <b>Strain measurement:</b> strain gauge materials, resistance strain gauge – unbounded & bonded, wire gauge, foil gauge & semiconductor gauge, strain gauge rosettes. <b>Humidity measurement:</b> Hair hygrometer, humistor hygrometer. <b>Liquid level:</b> floats, differential pressure cell	<b>06</b>
07	<b>Control systems:</b> Servomotor, mechanism & comparison of hydraulic, pneumatic, electronic control systems, proportional control action.	<b>03</b>
<b>Total</b>		<b>30</b>

### Practical:

Skills to be developed:

Intellectual skills:

1. Analyse the result of calibration of thermister.
2. Interpret calibration curve of a rotameter.
3. Evaluate the stress induces in a strain gauge.

4. Verify the characteristics of photo transistor and photo diode.

Motor skills:

1. Test and calibration of a thermocouple.
2. Handle various instruments.
3. Draw the calibration curves of rotameter and thermister.
4. Measure various parameters using instruments.

**List of Practical: (Any five)**

1. Measurement of strain by using a basic strain gauge and hence verify the stress induced.
2. Speed Measurement by using Stroboscope / Magnetic / Inductive Pick Up.
3. Measurement of flow by using Rotameter.
4. Calibration of given LVDT.
5. Temperature control using Thermal Reed switch & Bimetal switch.
6. Temperature calibration by using Thermocouple.
7. Determination of negative temperature coefficient and calibration of a Thermister.
8. Measurement of force & weight by using a load cell.
9. Liquid Level Measurement by using floats/ differential pressure cell system.
10. Verify characteristics of photo transducer & photo diode.

**Examination Schedule Internal practical Sessional:**

Attending classes, practicing programs & submitting respective assignment in time		5 x 4 =20	
Viva - voce		5	
Total:		25	

**Examination Schedule: External practical Sessional examination**

Examiner: **Lecturer**

For submission of assignment in scheduled time		5 x 2 = 10	
On spot experiment		10	
viva voce		05	
Total		25	

**Reference books :- Nil**

**Suggested List of Laboratory Experiments :- Nil**

**Suggested List of Assignments/Tutorial :-**



G R O U P	Chapter	ONE OR TWO SENTENCE ANSWER QUESTIONS				G R O U P	Chapter	SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS			TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A		5	10	1	1 X 10 = 100	A		5	FIVE, TAKING AT LEAST TWO FROM EACH GROUP	5	5 X 5 = 25
B		5				B		5			

### List of Books:

r. No.	Author	Title	Publication
01	N V Raghavendra L Krishnamurthy	Engineering Metrology & Measurements	Oxford
	R.K.Rajput	Mechanical Measurement & Instrumentation	S.K. Kataria & Sons
	A.K.Sawhney	Mechanical Measurements & Instrumentation	Dhanpat Rai & Sons, New Delhi.
02	R.V. Jalgaonkar	Mechanical Measurement & Control	Everest Publishing House, Pune
	Katta Narayana Reddy P.S.R. Krishnudu	Instrumentation & Control System	SCITECH
	John Turner Martyn Hill	Instrumentation for Engineers and Scientists	Oxford
03	D.S.Kumar	Mechanical Measurements & Control	Metropolitan Publications, New Delhi
04	C.S. Narang	Instrumentation Devices & Systems	Tata McGraw Hill Publications
05	R.K.Jain	Mechanical & Industrial Measurements	Khanna Publications, New Delhi
06	B.C.Nakra and K.K.Chaudhry	Instrumentation, Measurement and Analysis	Tata Mc Graw Hill Publication

<b>Name of the Course : Mechanical Engineering</b>				
<b>Subject: POWER ENGINEERING</b>				
<b>Course code: ME</b>			<b>Semester: Fifth.</b>	
<b>Duration: 17 weeks</b>			<b>Maximum Marks : 150</b>	
<b>Teaching Scheme</b>			<b>Examination Scheme:</b>	
Theory : 3 hrs/week			Internal Assessment: 20 Marks	
Tutorial: hrs/week			Teacher's Assessment (Assignment & Quiz): 10 Marks	
Practical : 2 hrs/week			End Semester Exam: 70 Marks	
Credit: 4			Practical: Internal Sessional continuous evaluation: 25 Marks	
			Practical: External Sessional examination: 25 marks	
<b>Aim :-</b>				
<b>S. No.</b>				
1	To study the Internal Combustion Engine.			
2	To understand the fundamentals of Steam Nozzle and Diffuser.			
3	To study working principle and construction of different types of Steam Turbines.			
4	To study the working principle of Gas Turbine and its industrial application.			
5	To understand the fundamentals of Jet Propulsion.			
6	To study the working principle of Hydraulic Turbines and their application in actual power generation.			
<b>Objective :-</b>				
S. No.	The Students should be able to:			
1	<ul style="list-style-type: none"><li>Describe Internal Combustion Engine and should be able to calculate various performance characteristics of IC Engines by conducting trial.</li></ul>			
2	<ul style="list-style-type: none"><li>Explain the working principle and application of Steam Nozzle and Diffuser.</li></ul>			
3	<ul style="list-style-type: none"><li>Describe construction and working of various types of Steam Turbines.</li></ul>			
4	<ul style="list-style-type: none"><li>Understand working of Gas Turbine and its application.</li></ul>			
5	<ul style="list-style-type: none"><li>Explain the basic principle of Jet Propulsion.</li></ul>			
6	<ul style="list-style-type: none"><li>Understand working of Hydraulic Turbines and their application in actual power generation.</li></ul>			
<b>Pre-Requisite:</b> Elementary knowledge on Physics, basic Mathematics, Thermal Engineering-I, Thermal Engineering-II and Fluid Mechanics.				
<b>Contents</b>			<b>Hrs/week</b>	
<b>POWER ENGINEERING</b>				
<b>Chapter</b>		<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
		<b>GROUP-A</b>		
	1.0	<b>I.C. Engine and Pollution Control:</b> Basic Principle, representation on P-V & T-S diagrams and deduction of Thermal Efficiency of Otto Cycle, Diesel Cycle and Dual Combustion Cycle. (Simple numerical) Classification of I.C. Engines. Working Principle, Construction with function of components and Comparison of Two-Stroke and Four-Stroke (Petrol and Diesel) Engines.	<b>14</b>	
	1.1			
	1.2			
	1.3			

	1.4	Hypothetical & Actual Indicator Diagram of Two-Stroke and Four-Stroke (Petrol and Diesel) Engines.		
	1.5	Valve Timing Diagram of Two-Stroke and Four-Stroke (Petrol and Diesel) Engines.		
	1.6	Brief Description of I.C. Engine Combustion (SI & CI), Firing-order of Multi-cylinder I.C. Engine, Scavenging, Preignition, Detonation, Supercharging, Turbo-charging, Simple Carburetor, M.P.F.I. and Fuel Injection Pump.		
	1.7	Basic Concept of Governing of I.C Engine, Lubrication of I.C Engine and Cooling of I.C Engine.		
	1.8	Performance of I. C Engine – Indicator Power, Brake Power, Morse Test, Mechanical Efficiency, Thermal Efficiency, Relative Efficiency (Efficiency Ratio), Volumetric Efficiency, Specific Fuel Consumption and Heat Balance Sheet. (Simple numerical)		
	1.9	Pollutants in Exhaust Gases of Petrol and Diesel Engines, their effects on environment and possible ways of reducing the Pollutants in the Exhaust Gases.		
		<b>GROUP-B</b>		
	2.0	<b>Nozzles / Diffusers and Steam Turbines:</b>	<b>10</b>	
	2.1.0	<b>Nozzles / Diffusers:</b>		
	2.1.1	Working Principle, Classification and Application of Steam Nozzles & Diffusers.		
	2.1.2	Continuity Equation, Sonic Velocity and concept of Mach Number.		
	2.1.3	Steady Flow Energy Equation for flow through Steam Nozzles. (Simple numerical)		
	2.1.4	Concept of Critical Pressure and Critical Pressure Ratio.		
	2.2.0	<b>Steam Turbines:</b>		
	2.2.1	Classification of Steam Turbines		
	2.2.2	Working Principle, Construction with function of components of Simple Impulse Turbine and Simple Impulse-Reaction Turbine.		
	2.2.3	Velocity Diagrams, Work done, Power and Efficiency of Simple Impulse Turbine. (Simple numerical by using Graphical Method only)		
	2.2.4	Concept of Compounding of Steam Turbine.		
	2.2.5	Concept of Governing of Steam Turbine.		
	3.0	<b>Gas Turbine and Jet Propulsion:</b>	<b>10</b>	
	3.1.0	<b>Gas Turbine:</b>		
	3.1.1	Basic Principle, representation on P-V & T-S diagrams and deduction of Thermal Efficiency of Brayton or Joule Cycle. (No numerical)		
	3.1.2	Classification and Applications of Gas Turbine.		
	3.1.3	Comparison, labelled schematic flow diagram and function of components of Closed Cycle & Open Cycle Gas Turbines.		
	3.1.4	Methods to improve thermal efficiency of gas turbine		

	3.2.0	(Regeneration, Inter- Cooling, Reheating using T-S Diagram). (No analytical treatment)		
	3.2.1	<b>Jet Propulsion:</b> Jet Propulsion – Basic Principles of Turbojet, Turbo Propeller & Ram Jet.		
	3.2.2	Rocket Propulsion- Solid Propellants and Liquid Propellants and Components & Function of Liquid Propellants Rocket Engine.		
<b>GROUP-C</b>				
	4.0	<b>Hydraulic Turbines:</b>	<b>11</b>	
	4.1	Classification of Hydraulic Turbines.		
	4.2	Construction and working principle of Pelton Wheel, Francis and Kaplan Turbine.		
	4.3	Draft Tubes – working principle and types, Concept of Cavitation in Turbines		
	4.4	Velocity Diagrams, Work done, Power and Efficiency of Pelton Wheel & Francis Turbine. (Simple numerical)		
	4.5	Basic concept of Governing of Turbine.		
	4.6	Specific Speed and Selection of turbine on the basis of head and discharge available.		
	4.7	Schematic Layout of Hydroelectric Power Plant.		
Sub Total:			<b>45</b>	
<b>Internal Assessment Examination &amp; Preparation of Semester Examination</b>			<b>6</b>	
<b>Total</b>			<b>51</b>	
<b>Practical:</b> <b>Skills to be developed:</b> <b>Intellectual Skill :</b> <ol style="list-style-type: none"> <li>Understand working principle and construction of (four-stroke / two-stroke) Petrol and Diesel Engine.</li> <li>Understand working principle and construction of Steam Turbines.</li> <li>Understand working principle of Gas Turbine.</li> <li>Understand working principle and construction of Hydraulic Turbines.</li> </ol> <b>Motor Skills :</b> <ol style="list-style-type: none"> <li>Conduct dismantling and reassembling an I.C. Engine.</li> <li>Conduct trial on I.C. Engine Test Rig to find out the Heat Balance in an I.C. Engine.</li> <li>Conduct trial on suitable Test Rig to determine I.P., B.P., Mechanical Efficiency and Thermal Efficiency of an I.C. Engine.</li> <li>Report on visit to Hydroelectric Power Plant.</li> </ol> <b>List of Practical:</b> <ol style="list-style-type: none"> <li>Study of (four-stroke / two-stroke) Petrol and Diesel Engine. (If possible conduct the study by dismantling and reassembling an I.C. Engine)</li> <li>Study of valve timing diagram of four-stroke Petrol and Diesel Engine.</li> <li>Determination of I.P., B.P., Mechanical Efficiency and Thermal Efficiency of an I.C. Engine through suitable method.</li> <li>Conduct trial on I.C. Engine Test Rig to find out the Heat Balance in an I.C. Engine.</li> <li>Conduct Morse Test on Multi-cylinder Diesel / Petrol Engine.</li> </ol>				

6. Study of Cooling System generally installed in four-stroke (single / multi-cylinder) I.C. Engine.
7. Study of Lubrication System generally installed in two-stroke I.C. Engine.
8. Study of Steam Turbines.
9. Study of Gas Turbine.
10. Study of Water Turbines.
11. Study of schematic layout of Hydroelectric Power Plant.

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

#### Text Books

Name of Authors	Titles of the Book	Edition	Name of the Publisher
V.M. Domkundwar	A Course in Thermal Engineering.		Dhanpat Rai & Co.
Dr. D.S.Kumar	Engineering Thermodynamics (Principles & Practices)		S.K. Kataria & Sons
P. L. Ballaney	A Course in Thermal Engineering.		Khanna Publishers
R. S. Khurmi	A text book of Thermal Engineering.		S. Chand & co. Ltd.
R. K. Rajput	A Course in Thermal Engineering.		Laxmi Publication, Delhi
Patel and Karmchandani	Heat Engine Vol. - I & II		Acharya Publication
P. K. Nag	Engineering Thermodynamics		Tata McGraw Hill
B. K. Sarkar	Thermal Engineering		Tata McGraw Hill
A.R. Basu	Thermal Engineering (Heat Power)		Dhanpat Rai & Co.
R. k. Jain	Automobile Engineering		Tata McGraw Hil
S. Ramamrutham	Hydraulic & Fluid Machines		Dhanpat Rai and Sons New Delhi
SAWHNEY	Thermal and Hydraulic Machines		PHI

#### Suggested List of Assignments / Tutorial :-

1. Simple numerical on Otto Cycle, Diesel Cycle, Dual Combustion Cycle and Performance of I. C Engine.
2. Simple numerical related to Velocity Diagrams, Work done, Power and Efficiency of Simple Impulse Turbine by using Graphical Method only.
3. Draw labelled schematic flow diagram and write function of components of Closed Cycle & Open Cycle Gas Turbines.
4. Simple numerical related to Velocity Diagrams, Work done, Power and Efficiency of Pelton Wheel & Francis Turbine.

### **EXAMINATION SCHEME: END SEMESTER EXAMINATION**

GROUP	MODULE OR CHAPTER	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1	08	ANY 20	1	20	4	FIVE, ( AT LEAST	10	50

B	2,3	07				3	ONE FROM EACH GROUP)		
C	4	05				3			

### **EXAMINATION SCHEME FOR PRACTICAL SESSIONAL**

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

<b>Name of the Course : DIPLOMA IN MECHANICAL ENGINEERING (AUTOMOBILE ENGINEERING (ELECTIVE – I))</b>		
<b>Course code:</b>		<b>Semester : Third</b>
<b>Duration :</b>		<b>Maximum Marks : 100</b>
<b>Teaching Scheme</b>		<b>Examination Scheme:</b>
Theory : 3 hrs/week		<b>Internal Assessment:</b> 10 Marks
Tutorial: hrs/week		<b>Teacher’s assessment (Assignment &amp; Quiz):</b> 05 Marks
Practical : 2 hrs/week		<b>End Semester Exam:</b> 35 Marks
Credit: 4		<b>Practical: Internal Sessional continuous evaluation:</b> 25 Marks
		<b>Practical: External Sessional Examination:</b> 25 Marks
<b>Aim :-</b>		
<b>S.No</b>		
1	To understand & apply the knowledge about various system, subsystems & their inter-relationships of the automobile for the manufacturing of advanced automotive techniques.	
<b>Objective :-</b>		
S No	The student will able to	
1	Know automotive market in India.	
2	Identify various automotive systems & subsystems.	
3	Explain working & construction of various automotive systems & subsystems..	
4	Carry out preventive maintenance & performance resting of vehicle.	
<b>Pre-Requisite:-NIL</b>		
<b>Contents</b>		<b>Hrs/week</b>
<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>
<b>Group:A</b>		
01	<b>Introduction of Automobile</b> 1.1 Classification of automobiles 1.2 Vehicle layout & types 1.3 Body construction - Types & Nomenclature of car body. Introduction to aerodynamic body shapes 1.4 Automobile market in India of “on road vehicles”, major manufacturers, their products & their collaborations.	03
02	<b>Fuel supply system</b> 2.1 Fuel feed system in S.I engine, types, gravity & pump feed system, layout of S.I engine fuel pump system, function of each components 2.2 Fuel mixing & circuit control system, carburetor, types, working principle of simple carburetor, requirement of air- fuel ratio, defects of carburetor & its remedy Circuits of carburetor, float, starting, idling, low speed, high speed & accelerating circuit Petrol injection system, types, layout & working principle of multi point fuel injection system, advantages & disadvantages 2.3 Fuel supply system in C.I engine, layout, components ,function, types, working & line diagram of common rail, individual pump system, fuel injectors, single orifice, multiple orifice	05
<b>Group:B</b>		
03	<b>Automobile Transmission</b> 3.1 Clutch- necessity, construction & working of coil spring & diaphragm spring type clutch. 3.2 Gear Box- tractive effort and tractive resistance, types of G.B construction & working of constant mesh G.B., & synchromesh G.B., Epicyclic G.B., Torque converter, Overdrive, Transfer case 3.3 Final drive- necessity, construction & working of propeller shaft & differential. 3.4 Axle- Type of rear axles, front axles & their applications	10

04	<b>Control Systems</b> 4.1 Steering system- Requirement of steering system. Construction and working of steering linkage. Steering gear box- construction & working of rack and pinion & re-circulating ball type gearbox. Introduction to Power steering, Steering geometry- camber, caster, toe-in, toe-out, Kingpin inclination & their effects. 4.2 Brake system- construction & working of hydraulic & Pneumatic brakes. Comparison of disc & drum brake.	10
<b>Group:C</b>		
05	<b>Suspension systems, wheels &amp; Tyres</b> 5.1 Necessity & classification of suspension system. 5.2 Working & construction of Leaf spring, rigid axle suspension. 5.3 Introduction to air suspension 5.4 Construction & working of McPherson & wishbone, trailing link suspensions. 5.5 Construction & working of telescopic shock absorbers. 5.6 Construction & working of spoked wheel, disc wheel & light alloy cast wheel. 5.7 Types of rims, their construction & working. 5.8 Construction, working & comparison of radial, cross-ply and tubed, tubeless tyre & tyre specifications 5.9 Factors affecting tyre life 5.10 Wheel Alignment and Balancing	8
06	<b>Automobile Electrical Systems &amp; Body</b> 6.1 Battery- working, construction & rating of battery. 6.2 Ignition system- construction & working of electronic and CDI ignition system. 6.3 Starting system- construction & working of starting motor. 6.4 Charging system- construction & working of alternator 6.5 Wiring system-harnessing & colour codes. 6.6 Lighting system-head light, tail light, indicator light & their circuits. 6.7 Gauges- construction & working of Fuel level gauge, oil gauge and water temperature gauge. 6.8 Use of microprocessor in automobile control systems	8
	<b>Total</b>	44

**Practical:**

Skills to be developed:

Intellectual Skills:

1. Select tools and equipments
2. Find fault of battery and charging system
3. Identify component and system
4. Use service manual for information search
5. Compare conventional fuels with LPG and CNG fuels for automobiles
6. Observe various components and systems like transmission, braking and charging

Motor Skills:

1. Understand proper handling of tools, equipments
2. Adopt the recommended procedures of maintenance, testing – as mentioned in service manual
3. Handle components of CNG and LPG kit

**List of Practical: (Any five)**

1. Carrying out preventative maintenance of four wheeler as per manufacturers specifications.
2. Carrying out preventative maintenance of two wheeler as per manufacturers specifications.
3. Demonstration of single plate coil spring & diaphragm spring type clutch.
4. Demonstration of synchromesh gearbox.



5. Demonstration of differential.
  6. Demonstration of rack & pinion steering gearbox.
  7. Demonstration of rigid axle suspension.
  8. Demonstration of hydraulic brake system
  9. Testing of battery and charging system.
  10. Study of LPG / CNG kit retrofitting.
  11. Visit to four- wheeler service station & any automobile manufacturing unit.
  12. Mini project :- Student will prepare a project report & present a seminar  
Title:- Automotive market In India.  
Collect following information.
- a) Top 10 Car/MUV/2W/Heavy vehicle Manufacturers in India & their sale in last 2 Years.
  - b) Top 5 models of Car/MUV/2W/Heavy vehicle Manufacturers in India.
  - c) New models launched in last 3 years of Car/MUV/2W/Heavy vehicle. Survey modern features in these vehicle.
  - d) Proposed launches in next two years in Car/MUV/2W/Heavy vehicle. Survey modern features in these vehicle

### **EXAMINATION SCHEME**

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

Name of Authors	Titles of the Book	Edition	Name of the Publisher
K. K. Jain and R.B. Asthana	Automobile Engineering		Tata Mcgraw hill
William Crouse	Automobile Mechanics		Tata Mcgraw hill
SRINIVASAN	Automobile Mechanics		Tata Mcgraw hill
H.M.Sethi	Automotive Technology		Tata Mcgraw hill
G.B.S. Narang	Automobile Engineering		Khanna Publication
Harold T. Glenn	Auto Mechanics		Bennett & Mcknight
Kirpal Singh	Automobile Engineering Vol. I and Vol. II		Standard Publication
Joseph Hitner	Automotive Mechanics		

#### **C. D.**

- C. D. Prepared By MSBTE under its CAI Package Program.
- C. D. on various Topics of Automobile Engineering By SAE

#### **Reference books :- Nil**

#### **Suggested List of Laboratory Experiments :- Nil**

<b>Suggested List of Assignments/Tutorial :- Nil</b>	

**EXAMINATION SCHEME FOR PRACTICAL SESSIONAL**

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



## West Bengal State Council of Technical Education

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

<b>Name of the Course :</b> Diploma in Mechanical Engineering		
Subject Title:Mechatronics.		
<b>Course code: ME/</b>		<b>Semester : Fifth</b>
<b>Duration : 17 weeks</b>		<b>Maximum Marks : 100</b>
<b>Teaching Scheme:</b>		<b>Examination Scheme:</b>
Theory : 3 hrs/week		<b>Internal Assessment:</b> 10 Marks
		<b>Teacher's assessment (Assignment &amp; Quiz):</b> 05 Marks
Tutorial: hrs/week		<b>End Semester Exam:</b> 35 Marks
Practical : 2 hrs/week		<b>Practical: Internal Sessional continuous evaluation:</b> 25 Marks
Credit: 4		<b>Practical: External Sessional Examination:</b> 25 Marks
<b>Aim :-</b>		
<b>S.No</b>		
1	The integration of electronics engineering, electrical engineering, computer technology, and intelligent control engineering with mechanical engineering is increasingly forming a crucial part in the design, manufacture and maintenance of wide range of engineering products and processes. As a consequence there is a need for a diploma engineers to understand systems used in automation.	
S No	Students should be able to:	
	<div>1. Identify various input and output devices in an automated system.</div> <div>2. Understand and draw ladder diagrams.</div> <div>3. Write simple programs for PLCs.</div> <div>4. Interpret and use operations manual of a PLC manufacturer.</div> <div>5. Use simulation software provided with the PLC.</div> <div>6. Understand interfacing of input and output devices.</div>	
<b>Pre-Requisite:-</b>		
<b>S.No</b>	Elementary knowledge on basic electronics, basic electrical engineering, mechanical device, hydraulic & pneumatic circuit, transducer & sensor.	
1		
<b>Contents</b>		<b>Hrs/week</b>
<b>Chapter</b>	<i>Name of the Topic</i>	<b>Hours</b>
<b>Group A</b>		
01	Concept of Mechatronics, Constituents of Mechatronics System, Application of Mechatronics in manufacturing, Introduction to Sensors & transducers, Principle of working and applications of Limit switches, proximity switches like inductive, capacitive and optical (deflecting and through beam type) , Thumb wheel switches , magnetic reed switches, Optical encoders-displacement measurement, rotary, incremental.	03

02	<b>Pneumatic, Hydraulic &amp; Electrical Actuation System</b> : Actuator – solenoids – on-off applications, latching, triggering, Types of relays- solid state, Types of motors – DC motors, DC brushless motors, AC motors, stepper motors, servo motors	03
03	<b>Computing Elements in Mechatronics: 8085 Microprocessor</b> - Architecture, Pin configuration, working of microprocessor, and applications. Introduction to ICs used for interfacing such as – Programmable peripheral devices , USART, memory, keyboard, display – LCD,LED,I/O device, ADC, DAC.  <b>8051 Microcontroller</b> - Architecture, Pin configuration, working of microcontroller, Applications. Comparison of microprocessor and microcontroller , advantages and disadvantages <b>Programmable Logic Controller</b> - Introduction, PLC definition, PLC block diagram, Difference between relay panel and PLC, power supply, input/output modules (analog, digital) concepts of sink/source, set/reset, latch/unlatch, advantages and disadvantages. Installation , troubleshooting and maintenance of PLC	05  03  08
<b>Group B</b>		
04	<b>PLC Programming</b> – Ladder diagrams and sequence listing, large process ladder diagram construction, flowcharting as a programming method , Basic PLC functions. Register basics, timer functions, counter functions Intermediate functions – Arithmetic functions, number comparison and number conversion functions  Data handling functions- SKIP, Master control relay, Jump, Move, Block move, Table to register and register to table move functions. FIFO and LIFO functions, File Arithmetic and Logic function PLC digital bit functions and applications Sequencer functions and cascading of sequencers PLC matrix functions Discrete and analog operation of PLC, Networking of PLCs. PLC auxiliary commands and functions,	22
05	Online, offline, stop/run modes of operations, uploading/downloading between PLC and PC, Introduction to SCADA and DCS	04
<b>Suggested List of Assignments/Tutorial :- Nil</b>		

### Practical:

#### Intellectual Skills:

1. Identification of various sensors and transducers used in automated systems

2. Interpretation of circuits in automation
3. Interpretation and use

Motor skills:

1. Use of simulation software for PLCs
2. Preparation of ladder diagrams
3. Testing of interfacing ICs

### List Of Practical:

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

1. Identification and demonstration of different sensors and actuators.
2. Demonstration of the working of various digital to analog and analog to digital converters.
3. Development of ladder diagram, programming using PLC for
  - a) measurement of speed of a motor
  - b) motor start and stop by using two different sensors
  - c) simulation of a pedestrian traffic controller
  - d) simulation of four road junction traffic controller
  - e) lift / elevator control
  - f) washing machine control
  - g) tank level control
  - h) soft drink vending machine control
4. Trace, interpret and demonstrate working of at least two electro pneumatic systems.
5. Trace, interpret and demonstrate working of at least two electro hydraulic systems.

### List of Books:

Sr.No.	Author	Title	Publication
01	Bolton W.	Mechatronics- Electronic control systems in Mechanical and Electrical Engineering	Pearson Education Ltd.
02	Histand B.H. and Alciatore D.G.	Introduction to Mechatronics and Measurement systems	Tata McGraw Hill Publishing
03	John W. Webb and Ronald Reis	Programmable Logic Controllers	Prentice Hall of India
04	NIIT	Programmable Logic Control – Principles and Applications	Prentice Hall of India
	Paul P.L. Regtien	Sensors for Mechatronics	Elsevier
	Appu Kuttan K.K.	Introduction to Mechatronics	Oxford
	Surekha Bhanot	Process Control Principles & Applications	Oxford
05	Kolk R.A. and Shetty D.	Mechatronics systems design	Vikas Publishing, New Delhi

06	Mahalik N.P.	Mechatronics principles, concepts and applications	Tata McGraw Hill Publishing
		Mechatronics	S. Chand

### Internal practical Sessional examination Scheme

Attending classes, practicing programs & submitting respective assignment in time		5x4= 20	
Viva - voce		5	
Total:		25	
<b>Examination Schedule: External practical Sessional examination</b> Examiner: <b>Lecturer / Jr. Lecturer</b>			
For submission of assignment in scheduled time		5x2= 10	
<b>On spot activity</b>		10	
viva voce		05	
Total		25	

G R O U P	Chapter	ONE OR TWO SENTENCE ANSWER QUESTIONS				G R O U P	Chapter	SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS			TO BE SET	<b>TO BE ANSWERED</b>	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	5	10	1	1 x 10 = 100	A	1,2,3	5	<b>FIVE, TAKING AT LEAST TWO FROM EACH GROUP</b>	5	5 x 5 = 25
B	4,5	5				B	4,5	5			

Name of the Course : DIPLOMA IN MECHANICAL ENGINEERING (POWER PLANT ENGINEERING (ELECTIVE-I))		
Course code:		Semester : Third
Duration :		Maximum Marks : 100
Teaching Scheme		Examination Scheme:
Theory : 3 hrs/week		Internal Assessment: 10 Marks
Tutorial: hrs/week		Teacher's assessment (Assignment & Quiz): 05 Marks
Practical : 2 hrs/week		End Semester Exam: 35 Marks
Credit: 4		Practical: Internal Sessional continuous evaluation:25 Marks
		Practical: External Sessional Examination:25 Marks
Aim :-		
S.No		
1	Industries are expected to generate their own power and supply the excess power to national grid. Alternate energy sources are also harnessed to meet the increasing demand. To study the layout, components of different power plants and economic aspects of power plants.	
Objective :-		
S No	The student will able to	
1	Get familiar with present and future power scenario of India.	
2	Calculate efficiency of power generation cycles.	
3	Understand working of high pressure boilers, coal and ash handling systems of power plant.	
4	Draw layout, understand the working and compare different power plants.	
5	Enlist sources of waste heat and explain method of heat recovery.	
6	Explain constructional features of non conventional energy source devices.	
7	Appreciate economical and operational aspects of power plants.	
Pre-Requisite:-		
	Knowledge of basic thermodynamics & heat power	
Contents		Hrs/week
Chapter	Name of the Topic	Hours
Group:A		
01	Introduction to power plant 1.1 Power scenario in India 1.2 Types of power plants – Hydro, Nuclear, Thermal, Future trends in Power sector.	02
02	Steam power plant 2.1 Layout of steam power plant, general features of selection of site 2.2 High pressure boilers – Construction and working of Sub-critical and Super-critical boilers. 2.3 Chronological development of Boilers [Stoker Fired,Pulvarised Fuel Fired Boiler, Front Fired boilers, Tangentially Fired Boiler, Bottom Fired Boiler] 2.4 Coal and ash handling system- equipments for in plant handling of coal such as belt conveyor, screw conveyor, bucket elevator, Coal crushing, Pulverized fuel handling system, Ball mill, Pulverized fuel and their advantages, Multi retort stoker, Pulverized fuel burner, Hydraulic and pneumatic ash handling, Electrostatic precipitator. 2.5 Boiler Feed water treatment 2.6 Environmental aspects of steam power plant - water pollution, air pollution, emission standard and its control 2.7 Generator Cooling System.	08
Group:B		

03	<b>Nuclear power plant</b> 3.1 Fusion and fission reaction, general criteria for selection of site. 3.2 Elements of nuclear power station, layout, types of nuclear reactors. 3.3 Nuclear fuels, coolant & moderators. 3.4 Working of PWR, BWR, CANDU, BREEDER type reactor. 3.5 Safety precautions and waste disposals.	05
04	<b>Gas turbine power plant</b> 4.1 General Layout, selection of site, Gas turbine power plants in India. 4.2 components of gas turbine plants, gas turbine Fuels. 4.3 Comparison of Gas turbine plant with diesel and Steam power plant. 4.4 Environmental impact of gas turbine power plant. Waste Heat recovery	05
<b>Group:C</b>		
05	5.1 Sources of waste heat 5.2 Heat recovery forms & methods – Sensible and latent Heat recovery. 5.3 Use of waste heat- Agricultural, green house, Animal shelter, Aqua cultural uses, process heating. 5.4 waste Heat recovery boilers	05
06	<b>Non conventional power generation plants</b> 6.1 Geothermal power plant- types, economical justification 6.2 Tidal power plant- factors affecting suitability of site, working of different tidal power plants, advantages and disadvantages 6.3 Wind power plant- different types, advantages and Disadvantages. 6.4 Solar power plant 6.5 Magneto Hydro dynamics power plant 6.6 Small hydro power plant 6.7 Introduction to Plasma technology in Power Generation.	10
07	<b>Economics and operational aspects</b> 7.1 Prediction of load, selection of types of generation, number of generating units. 7.2 Load duration curves, cost analysis, elements, controlling the cost of power plant (simple numerical) 7.3 Major electrical equipments in power station- generator, step-up transformer, switch gear, electrical motors	8
	<b>Total</b>	43
<b>Practical:</b> Skills to be developed: Intellectual skills: 1. Understand working of various power plants. 2. Understand constructional features and working of devices used in non conventional energy sources. 3. Understand economical and operational aspects of power plants. 4. Calculate the efficiency of power generation cycles. Motor skills: <b>List of Experiments/Studies:</b> 1. List technical details of components and subsystems of power plants. a)HP & LP Heater feed cycle b)Condenser Cooling System including Cooling Tower. c)Generator Cooling System. d)HP & LP Bypass system. e)Turbine sealing system. 2. Draw layouts of different power plants 3. Operate devices using solar energy inputs		



Name of Authors	Titles of the Book	Edition	Name of the Publisher
P. K. Nag	Power plant engineering		Tata Mcgraw hill
Fredrick T. Mosse	Power plant engineering		East-West press
A. Chkrabarti and M. L. Soni	A text book of Power System Engineering		Dhanpat Rai and Co
Arora and Domkundwar	A course in power plant engineering		Dhanpat Rai and Co
Thomas C. Elliott,	Standard handbook of power plant engineering 1997		Tata McGraw Hill
<b>2. Computer Based Training Packages/Computer Aided Instructions Packages/CDs:</b> 1. Power Plant Familiarization Vol-I to IV. - Ash Handling System. - Gas Turbine and combined cycle power plant. - Power Station Safety. - Environmental pollution & pollution control. - Pulverizes and feeders. - Renewable energy sources, ( Developed by National Power Training Institute , South Ambazari Road, Nagpur )			
<b>Reference books :- Nil</b>			
<b>Assignments:</b>			
	Visit to steam power plants/nuclear power plants/wind power plants/ Hydro power plants and prepare a report.(Any one Plant).		
	Collect information & Technical details of nuclear power plants.		
	Collect information & Technical details of Steam power plants.		
	Collect information & Technical details of Solar & Wind power plants.		
	Study of economic and operational aspects of power plants (simple numerical).		
	Assignment on Coal & Ash Handling system.		
	Assignment on Waste Heat recovery systems.		
<b>Suggested List of Laboratory Experiments :- Nil</b>			
<b>Suggested List of Assignments/Tutorial :- Nil</b>			

### **EXAMINATION SCHEME FOR PRACTICAL SESSIONAL**

<b>Internal Examination: Examiner-</b> Lecturer in Mechanical Engg. / Jr. Lecturer			
Five No. of Experiments / Study attended & respective lab note submitted in due time.	5 x 3 = 15		
VIVA VOCE	10		
<b>TOTAL</b>	25		
<b>External Examination: Examiner-</b> Lecturer in Mechanical Engg. / Jr. Lecturer			
Submission of Signed Lab Note Book (for five	5 x 2 = 10		

experiments / study)			
On spot experiment / study (one for each group consisting 15 students / explanation on study item)	10		
VIVA VOCE	5		
	25		

### **EXAMINATION SCHEME**

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

<b>Name of the Course : Mechanical Engineering</b>		
<b>Subject Title: Professional Practices-III</b>		
<b>Course code: ME/</b>		<b>Semester : Fifth</b>
<b>Duration :</b>		<b>Maximum Marks : 50</b>
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
Theory : hrs/week		Mid Semester Exam: Marks
Tutorial: hrs/week		Assignment & Quiz: Marks
Practical : 2 hrs/week		End Semester Exam: Marks
Credit: 1		<b>Practical: Internal Sessional continuous evaluation:25 Marks</b>
		<b>Practical: External Sessional Examination:25 Marks</b>
<b>Aim :-</b>		
<b>S.No</b>		
1	To develop general confidence, ability to communicate and attitude, in addition to basic technological concepts through Industrial visits, expert lectures, seminars on technical topics and group discussion.	
<b>Objective :-</b>		
S No	The student will able to	
1	<input type="checkbox"/> Acquire information from different sources.	
2	<input type="checkbox"/> Prepare notes for given topic.	
3	<input type="checkbox"/> Present given topic in a seminar.	
4	<input type="checkbox"/> Interact with peers to share thoughts.	
5	<input type="checkbox"/> Prepare a report on industrial visit, expert lecture	
<b>Pre-Requisite:-Nil</b>		
<b>Contents</b>		<b>Hrs/week</b>
<b>Chapter</b>	<b>Name of the Topic</b>	
01	<b>Student Activities</b> – Students in a group of 3 to 4 shall perform <b>ANY ONE</b> of the following activities (Other similar activities may be considered) and write a report as a part of term work. <b>Activities :-</b> 1. Collection of data regarding loan facilities or other facilities available through different organizations / banks to budding entrepreneurs 2. Survey and interviews of successful entrepreneurs in near by areas 3. Survey of opportunities available in thrust areas identified by Government or DIC. 4. Measuring Screw thread parameters on floating carriage dial micrometer and select the optimum diameter of wire. 5. Survey of data regarding different types of pumps with specifications from manufacturers catalogue, local markets, end users (any other engineering products may be considered for survey) 6. Survey of farm implements used by farmers	5
02	<b>Group Discussion :</b> The students should discuss in group of six to eight students and write a brief report on the same, as a part of term work. The topic of group discussions may be selected by the faculty members. Some of the suggested topics are ( <b>any one</b> )- i) CNG versus LPG as a fuel. ii) Petrol versus Diesel as a fuel for cars. iii) Trends in automobile market.	5

	iv) Load shading and remedial measures. v) Rain water harvesting. vi) Trends in refrigeration Technology. vii) Disaster management. viii) Safety in day to day life. ix) Energy Saving in Institute. x) Nano technology.		
03	<u>CAM SOFTWARE COURSE</u> 1. Introduction of <b>CAM</b> software. 2. Identify Different <b>icons</b> and <b>tool bar</b> on the Screen. 3. Import <b>Model</b> for machining. 4. <b>Position</b> the Model to <b>Reference zero</b> point. 5. <b>Measure</b> the Model for Tool Selection. 6. Define the <b>Block</b> from which the part will be cut. 7. Define the cutting <b>Tools</b> to be used. 8. Define the cutting <b>feed, rapid movement and rpm</b> . 9. Define Set up options ( <b>Rapid Move Heights – Start and End Point</b> ). 10. Define <b>Boundary</b> for selected area machining. 11. Create a <b>Roughing Tool Path</b> Strategy. 12. Create a <b>Finishing Tool Path</b> Strategy. 13. Edit <b>Tool Path</b> . 14. Tool Path <b>Transformation</b> . 15. <b>Animate</b> and <b>simulate</b> the tool path. 16. Create an <b>NC Program</b> and output as a post-processed <b>nc</b> data file. 17. <b>Save</b> the <b>CAM Project</b> to an external directory.	20	
	<b>Total</b>	30	
<b>Text Books</b>			
Name of Authors	Titles of the Book	Edition	Name of the Publisher
Mark Ratner and Daniel Ratner	Nanotechnology		Pearson Educatuion, New Delhi
Yoram Korem	Computer Control of Manufacrting System		Mcgraw Hill Publication
Sunil Chopra, Peter Meindl	Supply Chain Management		Pearson Education, New Delhi
<b>Reference books :- Nil</b>			
<b>Suggested List of Laboratory Experiments :- Nil</b>			
<b>Suggested List of Assignments/Tutorial :- Nil</b>			

Internal Practical Sessional Examination		
Chapter	Topic	
1	Submission of Report on student activity by scheduled date	5
2	Group Discussion	5

<b>3</b>	<b>Practice of CAM</b>	<b>10</b>
	<b>Viva - voce</b>	<b>5</b>
	<b>Total:</b>	<b>25</b>
	<b>External Practical Sessional Examination</b>	
	<b>Examiner: Lecturer/ Jr. Lecturer</b>	
	<b>Submission of signed report &amp; assignment</b>	<b>5</b>
	<b>On spot CAM activity</b>	<b>10</b>
	<b>Viva voce</b>	<b>10</b>
	<b>Total:</b>	<b>25</b>