
 <b>MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</b> <b>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</b>																
<b>COURSE NAME : DIPLOMA IN MECHANICAL ENGINEERING</b>																
<b>COURSE CODE : MC</b>																
<b>DURATION OF COURSE : 8 SEMESTERS</b>										<b>WITH EFFECT FROM 2013-14</b>						
<b>SEMESTER : SIXTH</b>										<b>DURATION : 16 WEEKS</b>						
<b>PATTERN : CORRESPONDANCE - SEMESTER</b>										<b>SCHEME : G</b>						
SR. NO	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									SW (17906)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)		
								Max	Min	Max	Min	Max	Min	Max	Min	
1	Fluid Mechanics & Machinery	FMM	17988	07	01	24	03	100	40	25#	10	--	--	25@	10	<b>50</b>
2	Measurement & Control	MAC	17989	06	01	22	03	100	40	--	--	--	--	25@	10	
3	Power Engineering	PEN	17990	06	01	24	03	100	40	25#	10	--	--	25@	10	
4	Advance Manufacturing Process	AMP	17991	05	01	22	03	100	40	--	--	--	--	25@	10	
<b>TOTAL</b>				<b>24</b>	<b>04</b>	<b>92</b>	<b>--</b>	<b>400</b>	<b>--</b>	<b>50</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>100</b>	<b>--</b>	<b>50</b>
<b>TOTAL CONTACT HOURS DURING RESIDENT SESSION: 120 HRS [15 days * 8 hrs per day]</b>																
Total Marks : <b>600</b>																
@ - Internal Assessment, # - External Assessment, <span style="background-color: #cccccc; border: 1px solid black; display: inline-block; width: 1em; height: 1em;"></span> No Theory Examination, \$ - Common to all branches.																
Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work																
<b>NOTE:</b>																
1. HOURS MARKED BY * FOR INTERNAL PRACTICAL EXAMINATION TO BE CONDUCTED AT RESSIDENT SESSION.																
2. <b>ONE TEST OF 25 MARKS</b> TO BE CONDUCTED AT RESIDENT SESSION AND MARKS TO BE SUBMITTED TO GPDL PUNE.																
3. 240 HOURS FOR SELF STUDY AT HOME.																
4. ALL PRACTICALS/ORAL EXAMS [EXTERNAL ASSESSMENT INDICATED BY #] TO BE CONDUCTED AT EXAM CENTRE.																
5. ORAL EXAMINATION [INTERNAL ASSESSMENT @] TO BE CONDUCTED AT EXAM CENTRE.																
6. INTERNAL ASSESSMENT @ OF TERM WORK WILL BE DONE AT RESIDENT SESSION.																

 <b>MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</b> <b>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</b>																	
<b>COURSE NAME : DIPLOMA IN MECHANICAL ENGINEERING</b>																	
<b>COURSE CODE : MG</b>																	
<b>DURATION OF COURSE : 8 SEMESTERS</b>										<b>WITH EFFECT FROM 2013-14</b>							
<b>SEMESTER : SIXTH</b>										<b>DURATION : 16 WEEKS</b>							
<b>PATTERN : PART TIME - SEMESTER</b>										<b>SCHEME : G</b>							
SR. NO	SUBJECT TITLE	Abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME										SW (17906)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
								Max	Min	Max	Min	Max	Min	Max	Min		
1	Fluid Mechanics & Machinery	FMM	17988	04	--	02	03	100	40	25#	10	--	--	25@	10	<b>50</b>	
2	Measurement & Control	MAC	17989	03	--	02	03	100	40	--	--	--	--	25@	10		
3	Power Engineering	PEN	17990	03	--	02	03	100	40	25#	10	--	--	25@	10		
4	Advance Manufacturing Process	AMP	17991	03	--	02	03	100	40	--	--	--	--	25@	10		
<b>TOTAL</b>				<b>13</b>	<b>--</b>	<b>08</b>	<b>--</b>	<b>400</b>	<b>--</b>	<b>50</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>100</b>	<b>--</b>	<b>50</b>	

Student Contact Hours Per Week: **21 Hrs.**  
**THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.**  
Total Marks : **600**  
@ - Internal Assessment, # - External Assessment,  No Theory Examination, \$ - Common to all branches.

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subjects is to be converted out of 50 marks as sessional work (SW).
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code number for TH, PR, OR, TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

**Course Name : Diploma in Mechanical Engineering**

**Course Code : MC / MG**

**Semester : Sixth**

**Subject Title : Fluid Mechanics and Machinery**

**Subject Code : 17988**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	25#	--	25@	150

**NOTE:**

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

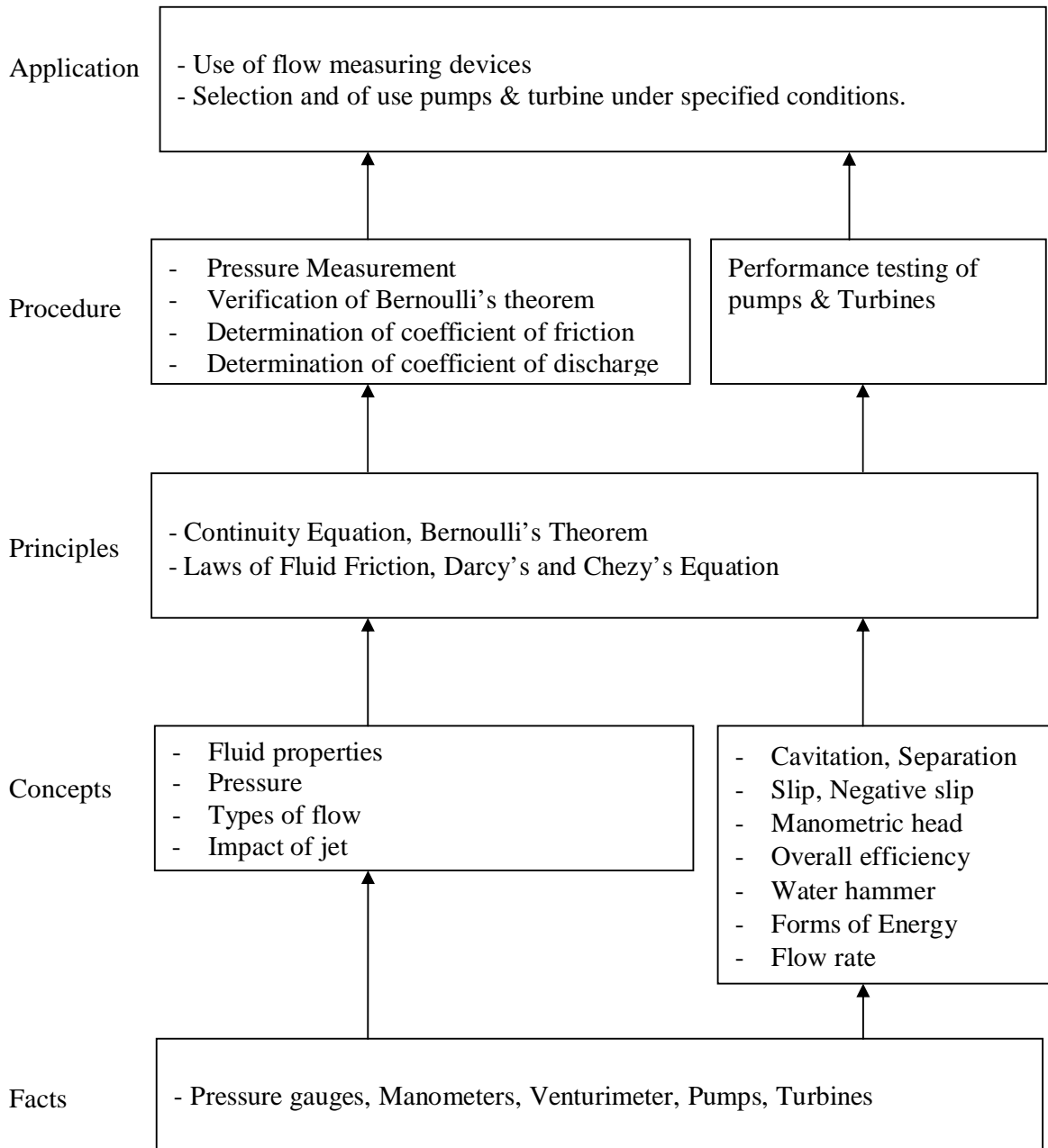
**Rationale:**

Knowledge of fluid properties, fluid flow & fluid machinery is essential in all fields of engineering. Hydraulic machines have important role in water supply, irrigation, power generation and also in most of the engineering segments. This subject requires knowledge of basic engineering sciences, applied mechanics, mathematics etc. The fundamentals of this subject are essential for the subject "Industrial Fluid Power" in sixth semester.

**General Objectives:** The student will be able to

- 1) Define various properties of fluids
- 2) Measure pressure, velocity and flow rate using various instruments.
- 3) State continuity equation, Bernoulli's equation and its applications.
- 4) Estimate various losses in flow through pipes.
- 5) Explain concept of impact of jet on various types of vanes.
- 6) Draw the construction, working of hydraulic pumps and turbines.
- 7) Evaluate performance of turbines and pumps.

**Learning Structure:**



**Theory:**

Topics and Contents	Hours	Marks
<p><b>1. Properties of Fluid and Fluid Pressure</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Define fluid properties.</li> <li>➤ Differentiate between fluid pressure intensity and pressure head.</li> <li>➤ Solve numerical related to properties of fluid, fluid pressure and manometers.</li> </ul> <p>Contents:</p> <p><b>1.1 Properties of Fluid <span style="float: right;">06 Marks</span></b> Density, Specific gravity, Specific volume, Specific Weight, Dynamic viscosity, Kinematic viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility</p> <p><b>1.2: Fluid Pressure &amp; Pressure Measurement <span style="float: right;">14 Marks</span></b></p> <ul style="list-style-type: none"> <li>• Fluid pressure, Pressure head, Pressure intensity</li> <li>• Concept of absolute vacuum, gauge pressure, atmospheric pressure, absolute pressure.</li> <li>• Simple and differential manometers, Bourden pressure gauge.</li> <li>• Total pressure, center of pressure- regular surface forces on immersed bodies in liquid in horizontal, vertical and inclined position</li> </ul>	12	20
<p><b>2. Fluid Flow</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State Bernoulli's theorem and apply it to venturimeter, orifice and pitot tube.</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Types of fluid flows-Laminar, turbulent, steady, unsteady, uniform, non uniform, rotational, irrotational.</li> <li>• Continuity equation, Bernoulli's theorem</li> <li>• Venturimeter – Construction, principle of working, coefficient of discharge, Derivation for discharge through venturimeter.</li> <li>• Orifice meter – Construction, Principle of working, hydraulic coefficients. Derivation for discharge through Orifice meter</li> <li>• Pitot tube – Construction, Principle of Working</li> </ul>	10	14
<p><b>3. Flow Through Pipes</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ State laws of friction and list various losses in flow through pipes.</li> <li>➤ Solve numerical on laws of friction and list various losses in flow through pipes.</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Laws of fluid friction ( Laminar and turbulent)</li> <li>• Darcy's equation and Chezy's equation for frictional losses</li> <li>• Minor losses in fittings and valves</li> <li>• Hydraulic gradient line and total energy line</li> <li>• Hydraulic power transmission through pipe</li> </ul>	10	14
<p><b>4. Impact of Jets</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Explain the impact of jet on vanes in various conditions.</li> </ul>	06	10

<p>➤ Solve numerical on impact of jet on vanes in various conditions.</p> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Impact of jet on fixed vertical, moving vertical flat plates.</li> <li>• Impact of jet on curved vanes with special reference to turbines and pumps</li> </ul>		
<p><b>5. Hydraulic Turbines</b></p> <p>Specific Objectives:</p> <p>➤ Explain working principle of various hydraulic turbines.</p> <p>➤ Calculate work done, power generated and various efficiencies of hydraulic turbines.</p> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Layout and features of hydroelectric power plant, surge tanks and its need.</li> <li>• Classification of hydraulic turbines and their applications.</li> <li>• Construction and working principle of Pelton wheel, Francis and Kaplan turbine.</li> <li>• Draft tubes – types and construction, Concept of cavitation in turbines,</li> <li>• Calculation of Work done, Power, efficiency of turbine</li> </ul>	12	18
<p><b>6. Pumps</b></p> <p>Specific Objectives:</p> <p>➤ Explain working of centrifugal, reciprocating and multistage pumps.</p> <p>➤ Explain the concept of cavitation in pumps.</p> <p>➤ Calculate manometric head, work done and various efficiencies related to the pumps.</p> <p>➤ Select the pump for a given application.</p> <p><b>6.1 Centrifugal Pumps</b> <span style="float: right;"><b>14 Marks</b></span></p> <p>Contents:</p> <ul style="list-style-type: none"> <li>• Construction, principle of working, priming methods and Cavitation</li> <li>• Types of casings and impellers.</li> <li>• Manometric head, Work done, Manometric efficiency, Overall efficiency, NPSH.</li> <li>• Performance Characteristics of Centrifugal pumps.</li> <li>• Trouble Shooting.</li> <li>• Construction, working and applications multistage pumps</li> <li>• Submersible pumps and jet pump</li> </ul> <p><b>6.2 Reciprocating Pump</b> <span style="float: right;"><b>10 Marks</b></span></p> <ul style="list-style-type: none"> <li>• Construction, working principle and applications of single and double acting reciprocating pumps.</li> <li>• Slip, Negative slip, Cavitation and separation.</li> <li>• Use of Air Vessels.</li> <li>• Indicator diagram with effect of acceleration head &amp; frictional head.</li> </ul> <p><b>(No numerical on reciprocating pumps)</b></p>	14	24
<b>Total</b>	<b>64</b>	<b>100</b>

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

- 1) Select appropriate flow and pressure measuring devices for a given situation.
- 2) Analyze the performance of pumps and turbines.

**Motor Skills:**

- 1) Use flow and pressure measuring devices.
- 2) Operate pumps and turbines.

**List of Practicals:**

1. Measure water pressure by using Bourdon's pressure gauge and U-tube Manometer. Also measure discharge of water by using measuring tank and stop watch.
2. Calibrate Bourdon's pressure gauge with the help of Dead weight pressure gauge.
3. Verify Bernoulli's theorem.
4. Determine coefficient of Discharge of Venturimeter.
5. Determine coefficient of Discharge, Coefficient of Contraction and Coefficient of Velocity of Sharp edged circular orifice.
6. Determine Darcy's friction factor 'f' in pipes of three different diameters for four different discharges.
7. Determine minor frictional losses in pipe fittings.
8. Determine overall efficiency of Pelton wheel by using Pelton wheel test rig.
9. Determine overall efficiency of Centrifugal Pump & plot its operating characteristics by using Centrifugal pump test rig.
10. Determine overall efficiency of Reciprocating pump by using Reciprocating Pump test rig.

**Assignments**

1. Information collection of Centrifugal, reciprocating, multistage pumps and submersible pumps from local market and from internet. Comparison of various models manufactured by different manufacturers. [The market survey is to be completed in a group of (max.) three to four students and the report of the same is to be included as part of term work.]

**Learning Resources:****1. Books:**

Sr. No	Author	Title	Publication
01	Ojha, Berndtsson, Chnadramouli	Fluid Mechanics and Machinery	Oxford University Press
02	Som S K , Biswas G.	Introduction to Fluid Mechanics and Fluid Machines 3 <sup>rd</sup> Edition	Tata McGraw-Hill Co. Ltd.
03	Modi P.N. Seth S M	Hydraulics and Fluid Mechanics including Hydraulic Machines	Standard Book House New Delhi
04	Subramanya K.	Fluid Mechanics and Hydraulic Machines: problems and solution	Tata McGraw-Hill Co. Ltd.
05	Product catalogues of various pump manufacturers		

**Course Name : Diploma in Mechanical Engineering**

**Course Code : MC / MG**

**Semester : Sixth**

**Subject Title : Measurements and Control**

**Subject Code : 17989**

**Teaching and Examination Scheme:**

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

**NOTE:**

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

**Rationale:**

The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid strides, 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 and methods of control systems for engineering applications.

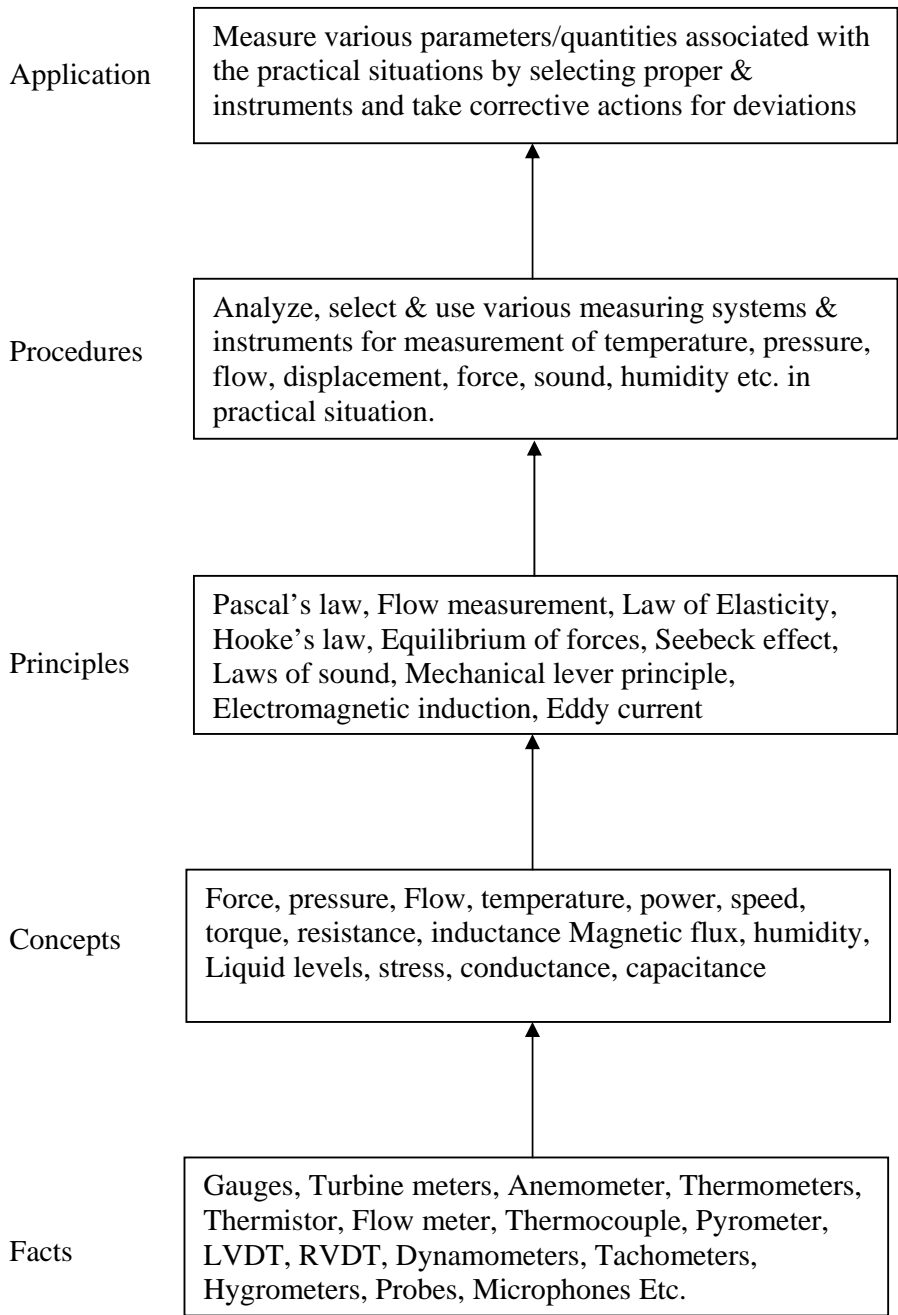
**Objectives:**

Student will be able to:

1. Understand the principle of operation of an instrument.
2. Appreciate the concept of calibration of an instrument.
3. Select Suitable measuring device for a particular application.
4. Identify different types of errors.



**Learning Structure:**



**Contents: Theory**

<b>Topic and content</b>	<b>Hours</b>	<b>Marks</b>
<p><b>1: Introduction and significance of Measurement</b>  <b>Specific objectives-</b> The students will be able to understand</p> <ul style="list-style-type: none"> <li>➤ Terminology related to measurement</li> <li>➤ Various types of errors</li> <li>➤ Concept of transducers</li> </ul> <p><b>Contents:</b></p> <p>1.1 <b>Types of measurement, classification of instruments</b>  <b>Static terms and characteristics-</b> Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis and Dead zone, Drift, Sensitivity, Threshold and Resolution, Repeatability and Reproducibility, Linearity.  <b>Dynamic characteristics-</b> Speed of response, Fidelity and Dynamic errors, Overshoot. <b>06 Marks</b></p> <p>1.2 <b>Measurement of error-</b> Classification of errors, environmental errors, signal transmission errors, observation errors, operational errors. <b>04 Marks</b></p> <p>1.3 <b>Transducers :</b> Classification of transducers, active and passive, resistive, inductive, capacitive, piezo-resistive, thermo resistive <b>08 Marks</b></p>	08	18
<p><b>2: Displacement and Pressure Measurement</b>  <b>Specific objectives-</b>  The students will be able to</p> <ul style="list-style-type: none"> <li>➤ Explain working of displacement transducers</li> <li>➤ Explain construction and working of low pressure and high pressure measuring instruments.</li> </ul> <p><b>Contents:</b></p> <p>2.1 <b>Displacement Measurement</b>  Capacitive transducer, Potentiometer, LVDT, RVDT, Specification, selection &amp; application of displacement transducer. Optical measurement scale and encoders <b>08 Marks</b></p> <p>2.2 <b>Pressure Measurement</b>  Low pressure gauges- McLeod Gauge, Thermal conductivity gauge, Ionization gauge, Thermocouple vacuum gauge, Pirani gauge.  High Pressure gauge-Diaphragm, Bellows, Bourdon tube, Electrical resistance type, Photoelectric pressure transducers, piezoelectric type, Variable capacitor type <b>10 Marks</b></p>	10	18
<p><b>3: Temperature Measurement</b>  <b>Specific objectives</b>  The students will be able to</p> <ul style="list-style-type: none"> <li>➤ Explain electrical and non electrical methods of temperature measurements</li> <li>➤ Describe high temperature measuring instruments such as pyrometers</li> </ul> <p><b>Content:</b></p> <p>3.1 <b>Non-electrical methods-</b> Bimetal , Liquid in glass thermometer and Pressure thermometer <b>04 Marks</b></p> <p>3.2 <b>Electrical methods-</b> RTD, Platinum resistance thermometer, Thermistor, Thermoelectric methods - elements of thermocouple, Seebeck series, law of</p>	06	16

intermediate temperature, law of intermediate metals, thermo emf measurement. 08 Marks		
3.3 Pyrometers- radiation and optical 04 Marks		
<b>4: Flow Measurements</b> <b>Specific objectives-</b> The students will be able to <ul style="list-style-type: none"> <li>➤ Describe variable area, variable velocity flow meters</li> <li>➤ Special flow meters-electro-magnetic and ultrasonic flow meter</li> </ul> <b>Content :</b> 4.1 <b>Variable area meter</b> -Rota meter, Variable velocity meter-Anemometer <b>06 Marks</b> 4.2 <b>Special flow meter</b> - Hot wire anemometer, Electromagnetic flow meter, Ultrasonic flow meter ,Turbine meter ,Vortex shedding flow meter <b>06 Marks</b>	06	12
<b>5: Miscellaneous Measurement</b> <b>Specific objectives-</b> <b>The students will be able to</b> <ul style="list-style-type: none"> <li>➤ Explain characteristic of sound and Measurement of sound intensity</li> <li>➤ Measure shaft power</li> <li>➤ Describe contact and non contact type of speed measuring instruments</li> <li>➤ Explain working of strain gauges</li> </ul> <b>Content :</b> 5.1 Introduction to sound measurement and study of Electro dynamic microphone and Carbon microphone. 5.2 <b>Humidity measurement</b> –Hair hygrometer, Sling psychrometer, 5.3 <b>Liquid level measurement</b> – direct and indirect methods. 5.4 <b>Force &amp; Shaft power measurement</b> -Tool Dynamometer (Mechanical Type), Eddy Current Dynamometer, Strain Gauge Transmission Dynamometer. 5.5 <b>Speed measurement</b> -Eddy current generation type tachometer, incremental and absolute type, Mechanical Tachometers, Revolution counter & timer, Slipping Clutch Tachometer, Electrical Tachometers, Contact less Electrical tachometer, Inductive Pick Up, Capacitive Pick Up, Stroboscope 5.6 <b>Strain Measurement</b> -Stress-strain relation, types of strain gauges, strain gauge materials, resistance strain gauge- bonded and unbonded, types(foil, semiconductor, wire wound gauges), selection and installation of strain gauges load cells, rosettes.	08	16

<b>6 : Control Systems</b> <b>Specific objectives-</b> The students will be able to <ul style="list-style-type: none"> <li>➤ Know various types of control systems and their comparison</li> <li>➤ State field applications of control systems</li> </ul> <b>Contents:</b> 6.1 Block diagram of automatic control system, closed loop system, open loop system, feed back control system, feed forward control system, servomotor mechanism, 06 Marks 6.2 Comparison of hydraulic, pneumatic, electronic control systems, 06 Marks 6.3 Control action: Proportional, Integral, derivative, PI, PD, PID 04 Marks 6.4 Applications of measurements and control for setup for boilers, air conditioners, motor speed control 04 Marks	10	20
<b>Total</b>	<b>48</b>	<b>100</b>

Note- Numerical based on chapter 1,4,5 only

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. Analyze the result of calibration of thermister
2. Interpret calibration curve of a rotameter
3. Evaluate the stress induced 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:**

1. Know the measurement and control laboratory and study the specifications of measuring instruments /devices.
2. Understand/identify methods of measurement and study static characteristics of instruments with demonstration of any one measuring instrument.
3. Measure displacement by using inductive transducer. (Linear variable displacement transducer i.e. LVDT) and verify its characteristics.
4. Measure negative pressure or vacuum using McLeod gauge / Bourdon tube pressure gauge.
5. Measure temperature by thermocouple and verifying by thermometer.
6. Measure flow of liquid by rotameter.
7. Measure liquid level by capacitive transducer system.
8. Measure speed of rotating shaft by stroboscope / magnetic / inductive pick up.
9. Measure force or weight by load cell.
10. Measure strain by using basic strain gauge and verify the stress induced.
11. Study of control system with the help of suitable practical application by arranging industrial visit. (Power Engg. laboratory /Strength of Material laboratory/Boiler system/Sugar factory/Paper mill/Textile Industry / Food processing industry etc.)

**Learning Resources:****Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publication</b>
01	D.S.Kumar	Mechanical Measurements & Control	Metropolitan Publications, New Delhi
02	R.K.Jain	Mechanical & Industrial Measurements	Khanna Publications, New Delhi
03	A.K.Sawhney	Mechanical Measurements & Instrumentation	Dhanpat Rai & Sons, New Delhi.
04	E. O. Doebelin	Measurement Systems	Tata McGraw Hill Publications
05	R.V. Jalgaonkar	Mechanical Measurement & Control	Everest Publishing House, Pune
06	C.S. Narang	Instrumentation Devices & Systems	Tata McGraw Hill Publications
07	B. C. Nakra and K.K.Chaudhary	Instrumentation, Measurement and Analysis	Tata McGraw Hill Publication
08	Thomas Beckwith	Mechanical Measurement	Pearson Education
09	James W Dally	Instrumentation for Engg. Measurement	Wiley India

**Course Name : Diploma in Mechanical Engineering**

**Course Code : MC / MG**

**Semester : Sixth**

**Subject Title : Power Engineering**

**Subject Code : 17990**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
03	--	02	03	100	25#	--	25@	150

**NOTE:**

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

**Rationale:**

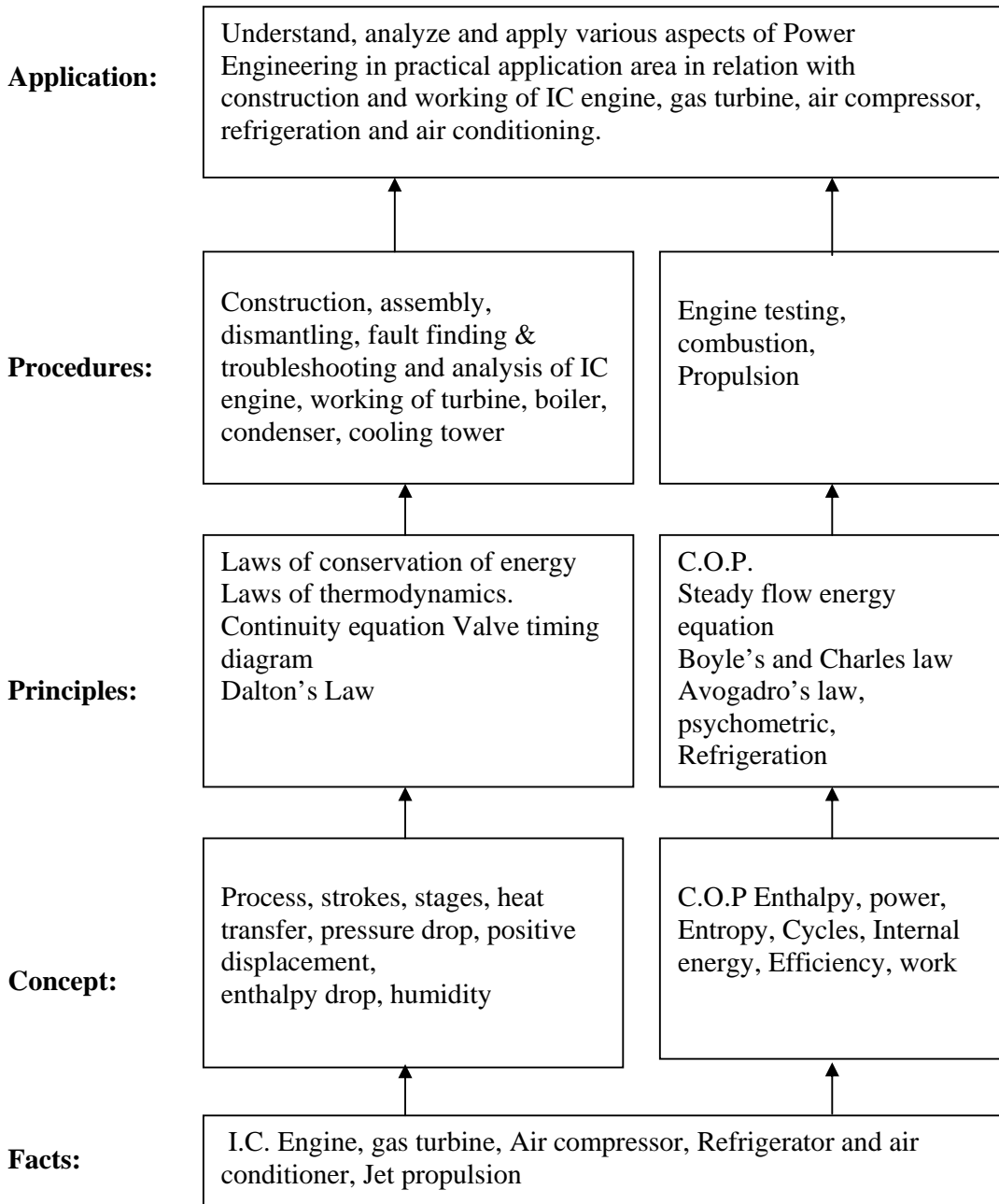
I. C. Engines find applications in almost all sectors of industry and in automobiles. Diploma technicians deal with working, testing and maintenance of I.C. Engines. I.C. Engines are one of the major contributors of air pollution. Hence I.C. Engine pollution control plays a vital role in protecting the environment. Use of air compressors is increasing due to automation. Hence it is necessary to understand constructional features and thermodynamic aspect of air compressor. Gas turbine is used for power generation and for jet propulsion. Diploma engineer should understand the fundamentals of refrigeration and air- conditioning as there are many industrial applications and also many entrepreneurial opportunities in this field.

**General Objectives:**

The Student will be able to:

1. Describe construction and working of I. C. Engines.
2. Calculate various performance parameters by conducting trial on I. C. Engines.
3. Explain working and applications of gas turbines.
4. Explain different types of air compressors and conduct trial on air Compressor.
5. Describe construction, working and application of vapor compression cycle.
6. Appreciate psychometric processes and air conditioning systems.

**Learning Structure:**



**Contents: Theory**

<b>Topic and content</b>	<b>Hrs.</b>	<b>Marks</b>
<p><b>1. I.C. Engine</b>  <b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Draw air standard cycles.</li> <li>➤ Explain the combustion and ignition method of I. C. Engine.</li> </ul> <p>1.1 Power Cycles</p> <ul style="list-style-type: none"> <li>• Carnot, Otto, Diesel, Dual, Brayton Cycle, representation on P-V, T-S diagram and Simple numerical on Otto cycle &amp; Carnot cycle.</li> </ul> <p>1.2 Classification and Application of I. C. Engines.</p> <ul style="list-style-type: none"> <li>• Four stroke Engines, Construction and working, valve timing Diagram, Turning moment diagram</li> <li>• Brief description of I.C. Engine combustion (SI &amp; CI), scavenging, preignition, detonation, supercharging, turbo charging, air fuel ratio requirements, M.P.F.I., Types of sensors, fuel injection pump, battery ignition in SI Engines</li> </ul>	10	20
<p><b>2. I.C. Engine Testing and Pollution Control</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ List lubricant and additive</li> <li>➤ State the pollutants and their effect</li> <li>➤ Calculate various efficiencies</li> </ul> <p>2.1 Engine terminology: Stroke, bore, piston speed, MEP, compression &amp; cut-off ratio. Engine Testing - I.P., B.P. Mechanical, Thermal, relative efficiency and, BSFC, Heat Balance sheet. Morse Test, Motoring test  ----- 10 Marks</p> <p>2.2 List of fuel, lubricant additives and their advantages. ----- 04 Marks</p> <p>2.3 Pollution Control ----- 10 Marks  Pollutants in exhaust gases of petrol and diesel engines, their effects on environment, exhaust gas analysis for petrol and diesel engine, Catalytic Converter, Bharat stage III, IV norms.</p>	10	24
<p><b>3. Air Compressor</b>  <b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Explain the concept of single and multistage compressor.</li> <li>➤ List the methods of energy saving.</li> </ul> <p>3.1 Introduction  Uses of compressed air, Classification of air compressors, Definitions of Pressure ratio, Compressor capacity, Free Air Delivered, Swept volume.</p> <p>3.2 Reciprocating Air Compressor ----- 10 Marks  Construction and working of single stage and two stage compressor  Efficiency: Volumetric, Isothermal and Mechanical  Advantages of multi staging, Intercooling and after cooling.</p> <p>3.3 Rotary Compressor ----- 10 Marks  Construction and working of screw, lobe, vane, (No Numericals)  Comparison and applications of reciprocating and rotary compressors  Purification of air to remove oil, moisture and dust, Methods of energy saving in air compressors.</p>	10	20
<p><b>4. Gas Turbine And Jet Propulsion</b>  <b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Classify gas turbines.</li> <li>➤ Describe method to improve the efficiency of gas turbine.</li> <li>➤ Explain the principles of jet propulsion</li> </ul>	08	16



4.1 Classification and applications of gas turbine, Constant pressure gas turbines. Closed cycle and open cycle gas turbines and their comparison.		
4.2 Methods to improve thermal efficiency of gas turbine Regeneration, inter-cooling, reheating, representation on T-S diagram (no analytical treatment),		
4.3 Jet Propulsion, Principles of turbojet, turbo propeller, Ram jet.		
<b>5. Refrigeration and Air- Conditioning</b> Specific objectives: ➤ To describe the components and application of vapour compression system. ➤ Describe psychrometric processes and air conditioning systems.		
5.1 Refrigeration ----- 08 Marks Tonnes of Refrigeration, coefficient of performance. Vapour compression system, Vapour compression refrigeration cycle Subcooling and superheating, representation on p-h, T-S diagrams. Basic components of Vapour Compression Cycle, their function and location. Simple vapour absorption refrigeration system. Applications- Water cooler, Domestic refrigerator, Ice plant & cold storage.	10	20
5.2 Psychrometry ----- 08 Marks Properties of moist air-DBT, WBT, DPT, Specific humidity and relative humidity, Dalton's law of partial pressure psychrometric chart & psychrometric processes-sensible heating/cooling, humidification, dehumidification, evaporative cooling.		
5.3 Air conditioning systems ----- 04 Marks Definition and classification of Air conditioning Systems. Construction and working of Window air conditioner and split air conditioner.		
<b>Total</b>	<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. Identify components of IC Engines.
2. Understand working principals of IC Engines, Compressors and refrigeration systems.
3. Analyze exhaust gases and interpret the results.
4. Select tools and gauges for inspection and maintenance.

**Motor Skills:**

1. Assemble and dismantle engine according to given procedure.
2. Operate IC Engine test rig, refrigeration test rig for measuring various parameters and plotting them.
3. Operate exhaust gas analyzer for measuring pollutants.

**List of Practical:**

1. Dismantle and assemble single / multi-cylinder four stroke petrol / diesel engine.
2. Dismantle and assemble
  - a) Carburetor of petrol engine
  - b) Fuel pump and fuel injector of diesel engine.
3. Demonstrate

- a) M.P.F.I. system of petrol engine.
- b) C.R.D.I. system of diesel engine.
4. Know and understand the components of cooling and lubrication systems of I. C. engine.
5. Conduct trial on single / multi cylinder petrol / diesel engine for heat balance sheet.
6. Conduct Morse Test on multi cylinder petrol engine to determine its indicated power and mechanical efficiency.
7. Measure I.C. engine pollutants with the help of exhaust gas analyzer.
8. Conduct trial on two-stage reciprocating air compressor to determine its volumetric efficiency and isothermal efficiency.
9. Understand construction and working of a jet engine with the help of model.
10. Conduct trial on refrigeration test rig to determine C.O.P.
11. Identify the components of window air conditioner and trace the flow of refrigerant through various components.

**List of Assignments:**

1. Study of manufacturer's catalogue for Reciprocating/Screw Compressor with respect to application, specifications and salient features.
2. Visit website- <http://library.think.quest.org>, <http://www.grc.nasa.gov> and prepare a brief report on gas turbine and jet propulsion.

**Learning resources:****Books:**

Sr. No.	Author	Title	Publisher
01	M. M. Rathore	Thermal Engineering	Tata McGraw Hill
02	V. Ganeshan	I. C. Engines	Tata McGraw Hill 3 <sup>rd</sup> edition
03	R. K. Rajput	Thermal Engg.	Laxmi Publication, Delhi
04	Patel, Karmchandani	Heat Engine Vol.I, II& III	Achrya Publication
05	P.K. Nag	Engg. Thermodynamics	Tata McGraw Hill 23 <sup>rd</sup> edition
06	S. K. Kulshrestha	Thermal Engineering	Vikas Publishing House Pv.t Ltd.

**Course Name : Diploma in Mechanical Engineering**

**Course Code : MC / MG**

**Semester : Sixth**

**Subject Title : Advanced Manufacturing Processes**

**Subject Code : 17991**

**Teaching and Examination Scheme:**

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

**NOTE:**

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

**Rationale:**

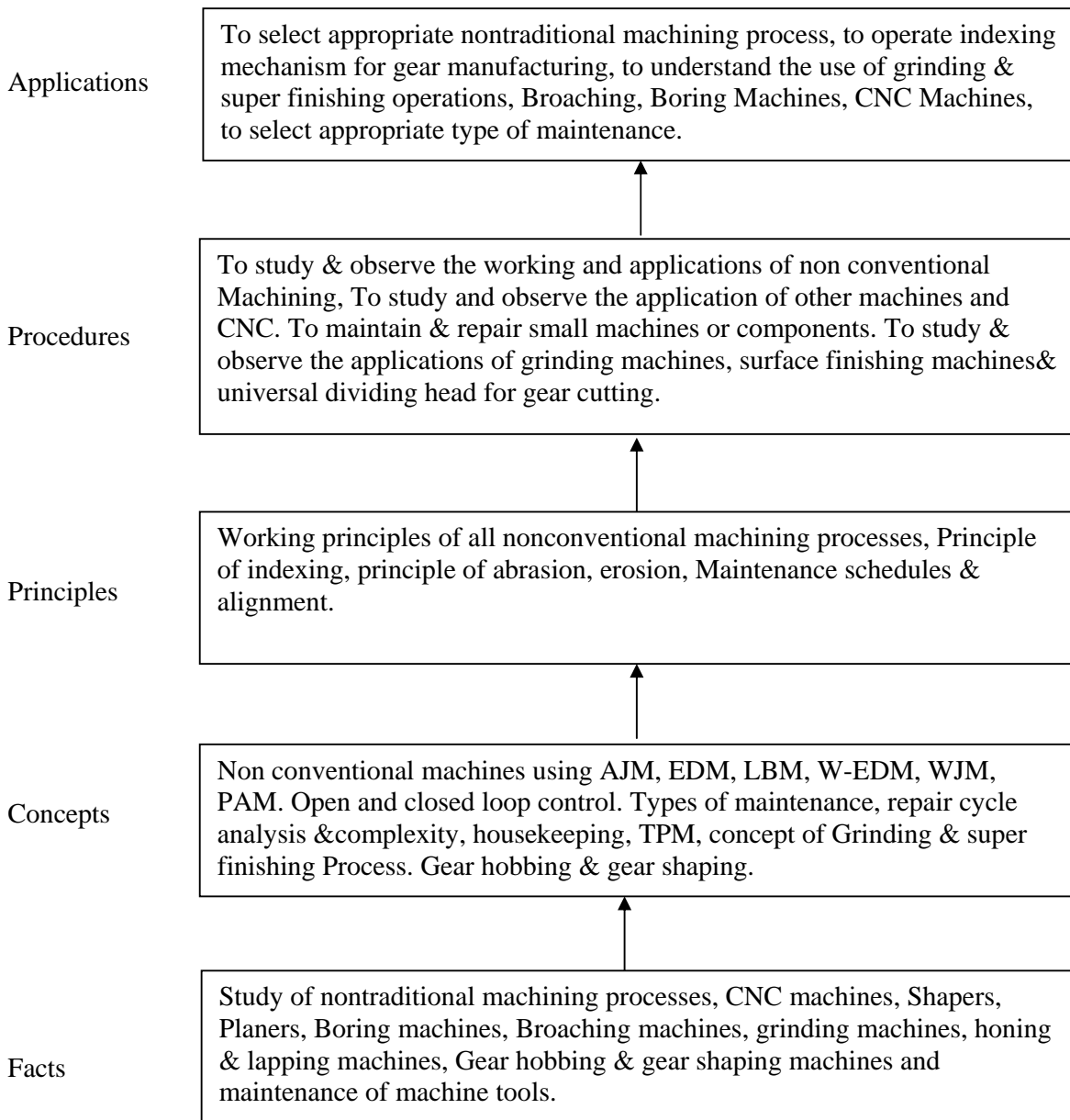
This is a advanced technology subject which is to be taught, after getting conversant with the basic manufacturing processes. It is necessary for a diploma engineer to know about the advancements in the area of manufacturing processes. This subject will impart knowledge & skills necessary for working in modern manufacturing environment. This subject will help the student to get familiarize with working principles and operations performed on non conventional machines, CNC Machines, milling machines, grinding machines, surface finishing machines and maintenance of machine tools.

**Objectives:**

**The student will be able to:**

- 1) Know different Nontraditional machining processes.
- 2) Understand the working of Broaching Machine, Milling Machine, Gear Cutting machines, Grinding Machines, Surface finishing machines.
- 3) Work as a maintenance engineer.
- 4) Know the Operation and control of different CNC machine tools.
- 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.

**Learning Structure:**



**Theory:**

<b>Topic &amp; Content</b>	<b>Hours</b>	<b>Marks</b>
<p><b>Topic 1: Non Traditional Machining</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Understand different Nontraditional machining processes.</li> </ul> <p><b>Content</b></p> <p>1.1 Need and importance, classification 04 Marks</p> <p>1.2 AJM, WJM, EDM, W-EDM - setup, working, process parameters, advantages, disadvantages and applications. 08 Marks</p> <p>1.3 PAM, LBM - setup, working, process parameters, advantages, disadvantages and applications. 08 Marks</p>	10	20
<p><b>Topic 2: Introduction to CNC</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Know the Operation and control of CNC machine tools.</li> </ul> <p><b>Content</b></p> <p>2.1 Introduction, advantages of CNC, open loop and closed loop control, axis identification, absolute &amp; incremental coordinate system- G codes and M codes 08 Marks</p> <p>2.2 Fundamental part programming - simple lathe and milling programmes. Dry run, Jog Mode, Block by Block execution, Safety Procedures, Adaptive controls, Displays and indicators. 08 Marks</p>	08	16
<p><b>Topic 3: Other Machining Methods</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Understand the working of different Machines.</li> </ul> <p><b>Content</b></p> <p>3.1 Introduction, classification of Broaching machines, basic parts of horizontal broaching machine &amp; their functions, applications, advantages and limitations of Broaching machine. 08 Marks</p> <p>3.2 Capstan, turret lathe &amp; automats, Planer and planomiller function of parts &amp; operations. 04 Marks</p> <p>3.3 Boring Machines – types, tools and operations. 04Marks</p>	08	16
<p><b>Topic 4: Milling &amp; Gear Cutting</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Understand the working of Milling &amp; Gear Cutting machines.</li> </ul> <p><b>Content</b></p> <p>4.1 <b>Milling:</b> 10 Marks Introduction, classification ,basic parts of column &amp; knee type milling machine &amp; their functions, standard milling cutters, milling operations like plain milling, side milling, straddle milling, gang milling, face milling - slot milling, slitting. Up milling &amp; down milling, cutting parameters.</p> <p>4.2 <b>Gear Cutting:</b> 12 Marks Introduction, gear manufacturing methods, universal dividing head &amp; indexing methods, gear shaping &amp; gear hobbing - setup, working, advantages, disadvantages, applications, gear finishing methods-grinding, shaving, burnishing.</p>	10	22
<p><b>Topic 5: Surface Finishing</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>➤ Understand the working of Grinding Machines &amp; Surface finishing machines.</li> </ul> <p><b>Content</b></p>	06	14

5.1 <b>Grinding Machines</b> Classification and working of grinding machine - surface, cylindrical, centreless, grinding wheel specifications, grinding wheel dressing & truing. Selection criteria for grinding wheel. Balancing of grinding wheels, safety precautions.	08 Marks		
5.2 <b>Super Finishing</b> Methods of surface finishing like honing, lapping, burnishing, polishing and buffing - setup, working, advantages, limitations and applications.	06 Marks		
<b>Topic 6: Maintenance of Machine Tools</b> <b>Specific Objectives</b> ➤ Know the maintenance methods and procedures. <b>Content</b> Need and importance of maintenance activity, Types of maintenance, Basic maintenance practices for simple machine elements, viz Bearing, Coupling, Shaft and pulley, gears, chains, machine belts. Repair cycle analysis, Repair complexity, Maintenance manual, Maintenance records.		06	12
<b>Total</b>		<b>48</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

- 1) Compare an appropriate non conventional machining process for required component.
- 2) Write part programming for a component.
- 3) Know the significance of various super finishing methods.
- 4) Calculations for indexing for a spur gear cutting, helical gear cutting.
- 5) Select the grinding machine parameters.
- 6) Identify the maintenance procedure for a machine.

**Motor Skills:**

- 1) Use the indexing mechanism.
- 2) Operate CNC Lathe & CNC milling machine.
- 3) Operate grinding machine
- 4) Carry out maintenance of machines.
- 5) Use and operate different hand tools required for repair and maintenance.
- 6) Identify and rectify the faults in the given sub assembly.

**List of Practical:**

- 1) Industrial visit to observe at least one nontraditional machining process and write a report individually on visit.
- 2) One simple Job on CNC Lathe Machine and Verification on simulation software (One job /max. four students).
- 3) One simple Job on CNC Milling Machine and Verification on simulation software (One job /max. four students)
- 4) Industrial visit to observe Broaching machine, Boring machine, Planer machine and report on the same.
- 5) One job of gear cutting (spur gear /helical gear) by using simple indexing method (max. four students per job).
- 6) One job containing surface grinding / cylindrical grinding operation. (max. four students per job).
- 7) Industrial visit to observe at least one super finishing process.

- 8) Maintenance procedure for any two machines/machine elements with reference to type of faults, causes & remedies. (In a group of 4-5 students)
- 9) Teacher can suggest topics (ind. visit/non conv. man. process etc.) for ppt files and students (4 students) should present in practical batch.

**Notes:**

1. The workshop instructor should prepare the specimen job in each shop as demonstration/ before the students (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

Sr. No.	Equipment /Software	Group Size	Remark
1	Simulation software for Turning on 20 PCs	One student	Institute can establish a separate simulation, CAD, CAM, CAE, computational facility lab. Internet facility is must. Teacher can download good videos and help students to understand the principles. Students can observe various videos on machining, calibration, maintenance of machine tools.
2	Simulation software for Milling on 20 PCs		
3	Videos demonstrating Non Conventional machining and other machines on 20 PCs		
4	Simulation software for Grinding on 20 PCs		
5	Videos on maintenance of machine tools		

**Learning Resources:****Books:**

Sr.No.	Author	Title	Publisher
01	S. K. Hajra Chaudary, Bose, Roy	Elements of workshop Technology-Volume II	Media Promoters and Publishers Limited
02	O. P. Khanna & Lal	Production Technology Volume- II	Dhanpat Rai Publications.
03	P.K.Mishra	Nonconventional Machining	Narosa Publishing Houswe
04	H.P.Garg	Industrial Maintenance	S.Chand& Co.
05	L.R.Higgins	Maintenance Engg. Handbook	McGraw Hill
06	B. L. Juneja, G.S.Sekhon, Nitin Seth	Fundamental of metal cutting and machine tools	New age international ltd.
07	P.C.Sharma	Production Engg.	Dhanpat Rai Publications.
08	S.F.Krar,A.R.Gill,P.Smid	Technology of Machine Tools	Tata-McGraw Hill
09	HMT	Production Technology	Tata-McGraw Hill
10	B.S.Pabla &M.Adithan	CNC Machines	New Age International Ltd.