
 <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 : SEVENTH</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 (17907)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
								Max	Min	Max	Min	Max	Min	Max	Min		
1	Metrology & Quality Control	MQC	21011	06	01	24	03	100	40	25#	10	--	--	25@	10	<b>50</b>	
2	Automobile Engineering	AEN	21012	06	01	24	03	100	40	--	--	--	--	25@	10		
3	Industrial Fluid Power	IFP	21013	06	01	24	03	100	40	--	--	25#	10	25@	10		
4	Production Engineering & Robotics	PER	21014	05	01	--	03	100	40	--	--	--	--	--	--		
5	Solid Modeling	SMO	21015	05	--	16	--	--	--	--	--	--	--	25@	10		
<b>TOTAL</b>				<b>28</b>	<b>04</b>	<b>88</b>	<b>--</b>	<b>400</b>	<b>--</b>	<b>25</b>	<b>--</b>	<b>25</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 : SEVENTH</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 (17907)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
								Max	Min	Max	Min	Max	Min	Max	Min		
1	Metrology & Quality Control	MQC	21011	03	--	02	03	100	40	25#	10	--	--	25@	10	<b>50</b>	
2	Automobile Engineering	AEN	21012	03	--	02	03	100	40	--	--	--	--	25@	10		
3	Industrial Fluid Power	IFP	21013	04	--	02	03	100	40	--	--	25#	10	25@	10		
4	Production Engineering & Robotics	PER	21014	04	--	--	03	100	40	--	--	--	--	--	--		
5	Solid Modeling	SMO	21015	01	--	02	--	--	--	--	--	--	--	25@	10		
<b>TOTAL</b>				<b>15</b>	<b>--</b>	<b>08</b>	<b>--</b>	<b>400</b>	<b>--</b>	<b>25</b>	<b>--</b>	<b>25</b>	<b>--</b>	<b>100</b>	<b>--</b>	<b>50</b>	
Student Contact Hours Per Week: <b>23 Hrs.</b> <b>THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.</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; vertical-align: middle;"></span> 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 : MG / MC**

**Semester : Seventh**

**Subject Title : Metrology & Quality Control**

**Subject Code : 21011**

### 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

#### Rationale:

The Diploma mechanical Engineer should understand, select and use various measuring instruments as he often comes across measuring different parameters of machined components and the appropriate fitment of interchangeable components in the assemblies.

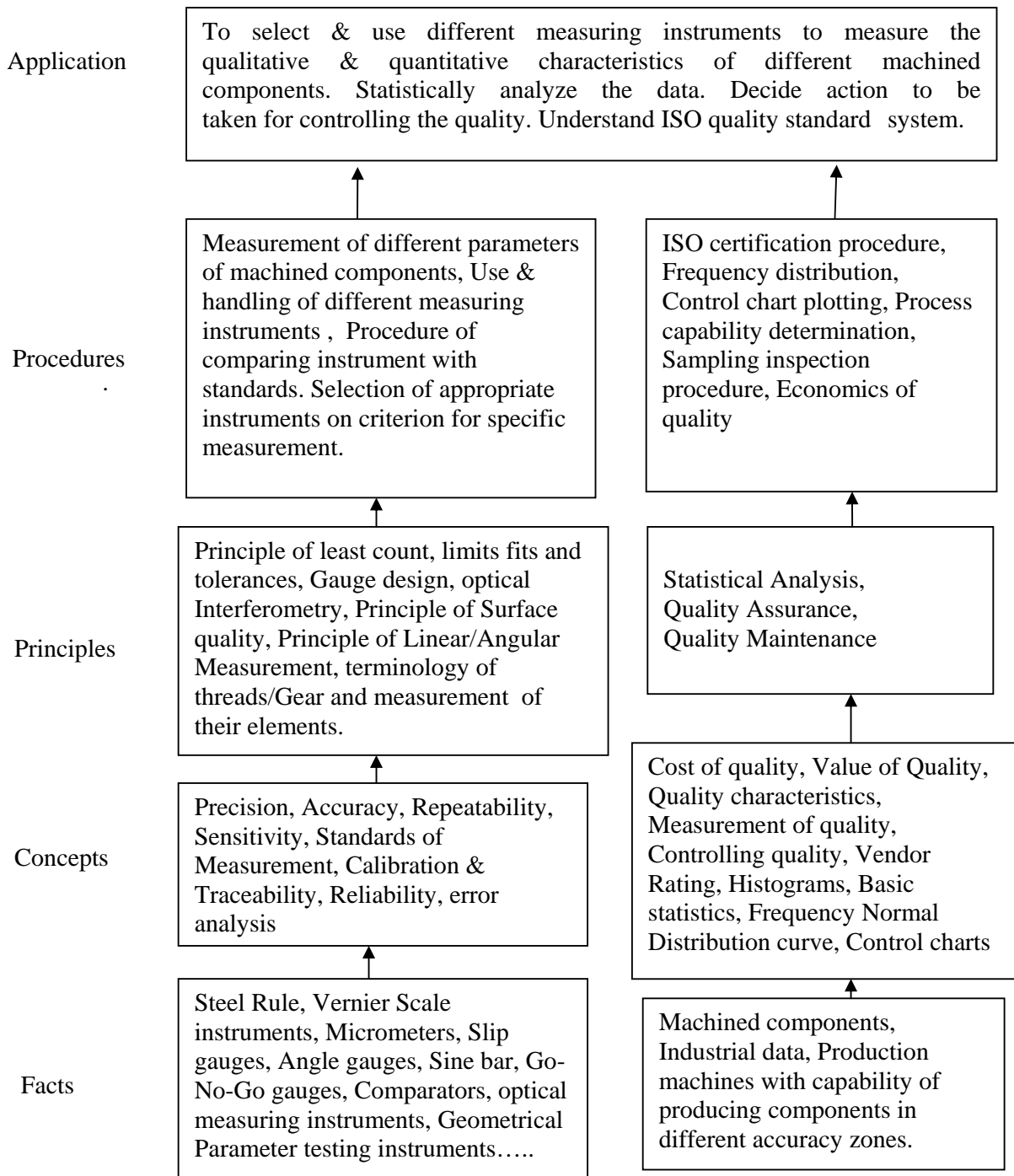
The knowledge of the subject also forms the basis for the design of mechanical measurement systems, design & drawing of mechanical components.

#### Objectives:

##### Students will be able to:

1. Understand and calculate the least count of all basic measuring instruments.
2. Select and use appropriate instrument/s for specific measurement.
3. Understand the systems of limits, fits and tolerances and correlate with machine drawing and manufacturing processes.
4. Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form for understanding the concepts of SQC.
5. Construct, draw and interpret the control charts.

**Learning Structure:**



**Theory:**

<b>Topic &amp; Content</b>	<b>Hours</b>	<b>Marks</b>
<p><b>1. Introduction to Metrology</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>To understand the basics of Metrology &amp; calculate the least count of measuring instruments.</li> <li>To understand various standards, comparators, gauge selection and limit system.</li> </ul> <p><b>1.1 Metrology Basics</b> 06 Marks Definition of metrology, objectives of metrology, Categories of metrology, Scientific metrology, Industrial metrology, Legal metrology, Need of inspection, <b>Revision of --Precision, Accuracy, Sensitivity, Readability, Calibration, Traceability, Reproducibility, Sources of errors, Factors affecting accuracy, Selection of instrument, Precautions while using an instruments for getting higher precision and accuracy. Concept of least count of measuring instruments (No questions to be set on revision).</b></p> <p><b>1.2 Standards and Comparators</b> 12 Marks Definition and introduction to line standard end standard, Wavelength standard and their comparison, Slip gauge and its accessories. Definition, Requirement of good comparator, Classification, use of comparators, Working principle of comparators, Dial indicator, Sigma comparator, Pneumatic comparator- high pressure differential type, Electrical (LVDT), Relative advantages and disadvantages.</p>	09	18
<p><b>2. Limits, Fits ,Tolerances and Gauges</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>To understand the basics of limits, fits &amp; tolerances</li> <li>To calculate the basic and gauge tolerances.</li> <li>To understand various types of gauges and their applicability.</li> </ul> <p>2.1 Concept of Limits, Fits, And Tolerances, Selective Assembly, Interchangeability, Hole And Shaft Basis System, Taylor's Principle, Design of Plug, Ring Gauges, IS919-1993 (Limits, Fits &amp; Tolerances, Gauges IS 3477-1973), Study of relation gauges, concept of multi gauging and inspection.</p>	06	08
<p><b>3. Angular Measurement</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>To understand the basics of angular measurement and measure angles using different instruments.</li> </ul> <p>3.1 Concept, Instruments For Angular, Measurements, Working And Use of Universal Bevel Protractor, Sine Bar, Spirit Level, Principle of Working of Clinometers, Angle Gauges (With Numerical on Setting of Angle Gauges). Angle dekkor as an angular comparator.</p>	04	08
<p><b>4. Threads and Gear Metrology</b></p> <p><b>Specific Objectives</b></p> <ul style="list-style-type: none"> <li>To Understand &amp; use various methods of calculating thread elements and elements of gear tooth</li> </ul> <p><b>4.1 Screw thread Measurements</b> 08 Marks ISO grade and fits of thread, Errors in threads, Pitch errors,</p>	06	16

<p>Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch for internal and external threads , Three wire method, Thread gauge, screw thread micrometer, Working principle of floating carriage micrometer.</p> <p><b>4.2 Gear Measurement &amp; Testing</b> 08 Marks Analytical and functional inspection, Measurement of tooth thickness by constant chord method, base tangent method, gear tooth vernier, Errors in gears such as backlash, run out, composite, concentricity. Parkinson gear tester.</p>		
<p><b>5. Testing Techniques</b> <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>To know terminology of surface finish &amp; measure the surface finish of various components.</li> </ul> <p><b>5.1 Measurement of Surface Finish</b> 06 Marks 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 values and their interpretation, Symbol for designating surface finish on drawing, Various techniques of qualitative analysis</p> <p><b>5.2 Machine Tool Testing</b> 04 Marks Parallelism, Straightness, Squareness, Coaxiality, roundness, run out, alignment testing of machine tools such as lathe, milling machine and drilling machine as per IS standard procedure. Study of optical flat for flatness testing.</p>	06	10
<p><b>6. Quality Control</b> <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>To understand the concept of Quality, cost of quality.</li> <li>To understand the concept and principles of TQM.</li> </ul> <p><b>6.1 Quality :</b> 06 Marks Definitions, meaning of quality of produce &amp; services, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Concept of reliability, Cost, Quality assurance, Cost of rework &amp; repair, Quality &amp; Inspection, Inspection stages.</p> <p><b>6.2 Total Quality Management :</b> 06 Marks Principles and concept of total quantity management. a) Quality Audit: Concept of audit practices, lead assessor certification. b) Six sigma: Statistical meaning, methodology of system Improvement. c) Introduction of ISO 9001-2008. ISO-14000 and TS 16949.</p>	07	12
<p><b>7. Statistical Quality Control</b> <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>To know the basics of statistics.</li> <li>To understand different data types and analyze &amp; interpret the data</li> </ul> <p><b>7.1 Statistical Quality Control</b> 20 Marks Basics of Statistical concepts, Meaning and importance of SQC, Variable and attribute Measurement. control charts – inherent and assignable sources of variation, control charts for variables – X &amp; R charts, control charts for attributes p, np, C charts, process capability</p>	10	28

of machine, $C_p$ and $C_{pk}$ calculations, determination of statistical limits, different possibilities, Rejection area, Statistically capable and incapable processes <b>7.2 Acceptance Sampling</b> 08 Marks Concept, Comparison with 100% inspection, Different types of sampling plans, sampling methods, merits and demerits of acceptance sampling. OC Curve.		
<b>Total</b>	<b>48</b>	<b>100</b>

**Practicals:****Skills to be developed:****Intellectual Skills:**

1. To select basic measuring instruments.
2. To calculate least count of various measuring instruments.
3. To collect, record and analyze the data.
4. To interpret the results of data analysis.

**Motor Skills:**

1. Measure the dimensions of component using various instruments.
2. To take care of instruments.
3. To draw various charts and curves related to data.
4. To handle various instruments.

**List of Practical:**

1. Measure various dimensions & dimensional parameters of component using radius gauge, screw pitch gauge, filler gauge, vernier caliper, vernier height gauge, vernier depth gauge, dial type vernier caliper, micrometer, inside micrometer, tube micrometer.
2. Use of dial indicator as mechanical comparator to inspect given components.
3. Inspect the given component using high pressure dial type pneumatic comparator.
4. Set the adjustable snap gauge Go end and No-Go end for a give dimension using slip gauges combination.
5. Measure an angle of a component using Bevel Protractor and verify it by using Sine bar.
6. Measure the angle of component with the angle dekkor / autocollimator.
7. Measure the screw thread elements by using screw thread micrometer and the same using optical profile projector or tool maker's microscope.
8. Measure the gear tooth elements using gear tooth vernier caliper and verify it by using optical profile projector.
9. Measure the surface roughness of sample turning, milling, shaping, grinding and lapping surfaces by using surface roughness measuring instruments.
10. Testing lathe machine / drill machine for parallellism, squareness, trueness, alignment test by using test dial indicator.
11. Draw the frequency histogram, frequency polygon for the samples and calculate mean, mode and median for same.
12. Draw the normal distribution curve and curve and calculate deviation, variance, range and determine the process capability.
13. Draw and interpret the control charts (X&R-bar, P-chart and C-chart) for given data.

**Assignment:**

1. Visit the industries to collect the data for p and c chart, study the coordinate measuring machine and study the quality management systems.
2. Selection of comparators for the given dimensional data

**Learning Resources:**

Sr. No.	Author	Title of Book	Edition	Publisher
01	R. K. Jain	Engineering Metrology	2010	Khanna Publisher, Delhi.
02	M. Mahajan	Text Book of Metrology	Second Reprint-2010	Dhanpat Rai & Co.
03	I.C. Gupta	A text book of Engineering Metrology	--	Dhanpat Rai and Sons
04	M. Mahajan	Statistical Quality Control	2010	Dhanpat Rai and Sons
05	Douglas C. Montgomery	Statistical Quality Control	Sixth reprint 2011	Wiley India Pvt. Ltd.
06	Dale H. Besterfield and others	Total Quality Management	Third Reprint 2012	Pearson

**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



**Course Name : Diploma in Mechanical Engineering**

**Course Code : MG / MC**

**Semester : Seventh**

**Subject Title : Automobile Engineering**

**Subject Code : 21012**

**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).**

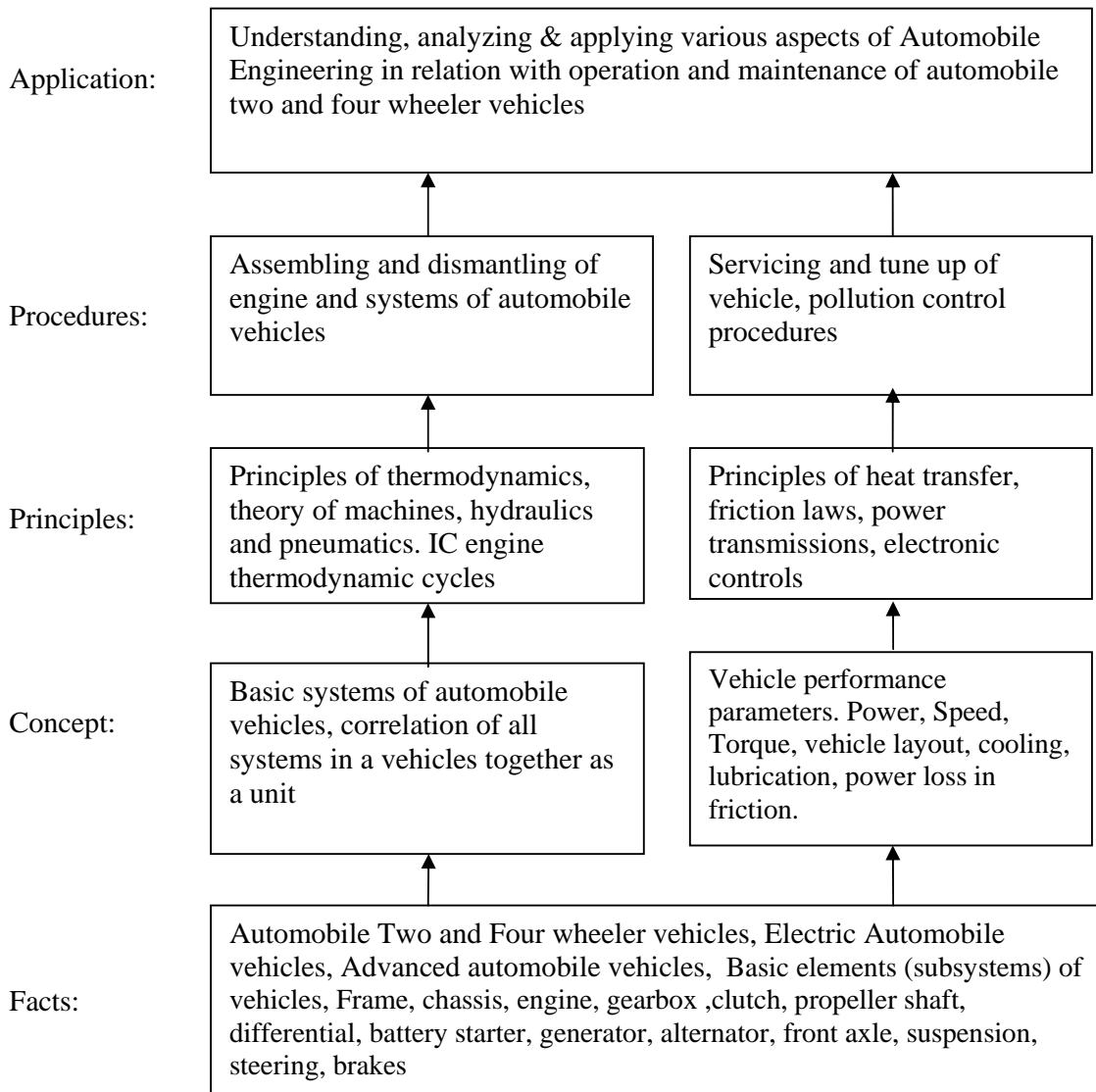
**Rationale:**

Automobile vehicles a now days are the inseparable part of modern life. The whole progress of the world is based on the development of modern automobiles. The diploma engineers must know about the principles of working, construction, maintenance of automobiles. Different types of vehicles and their capacities are introduced in this course so as to give idea about field of scope. Various automobile systems such as engine transmission, cooling and lubrication, vehicle control, etc. are introduced along with their functions, construction and working in the context of vehicle performance. The two wheelers have undergone a phenomenal technological progress. The topic of two wheeler technology is also covered in course. Good knowledge of automobile engineering will lead to better employability of engineering students.

**General Objectives:**

Students will be able to:

1. Know about Automobile market in India.
2. Know the vehicles performance parameters.
3. Understand the detailed construction features of automobile engines.
4. Dismantle and assemble the automobile engines and vehicle systems.
5. Know various advanced features in modern automobile vehicles.
6. Understand and identify various system components with their functions.
7. Compare and select the automobile vehicles based on their features.

**Learning Structure:**

**Theory:**

Topics and Contents	Hours	Marks
<p><b>1. Introduction to Automobiles.</b> Specific objectives:</p> <ul style="list-style-type: none"> <li>➤ Draw the vehicle layouts</li> <li>➤ Understand the concept of aerodynamic shape of vehicle.</li> <li>➤ State the concept of aerodynamic aspects</li> </ul> <p>Contents:</p> <p>1.1 Classification of automobile vehicles, types of automobile vehicles.</p> <ul style="list-style-type: none"> <li>➤ Two and four wheeler chassis layout of an automobile vehicle, automobile body types,</li> <li>➤ Layout of vehicle such as front engine rear wheel drive, front engine front wheel drive, rear engine rear wheel drive, four wheels drive etc. their advantages, comparisons.</li> <li>➤ Aerodynamic body shapes &amp; advantages</li> </ul> <p>1.2 Types of automobile power plants such as petrol engine, diesel engine, gas operated (LPG, CNG), electric power plants, hybrid power Plants (Introductory level).</p>	08	16
<p><b>2. Transmission Systems:</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Describe transmission system of automobiles and their components</li> <li>➤ Describe suspension systems and components</li> </ul> <p>Content:</p> <p>2.1 <b>Need and Requirements of transmission system. Its components and their functions.</b></p> <p>2.2 <b>Clutch:</b> Function and purpose of clutch, types and construction of clutches as coil spring type and diaphragm type</p> <p>2.3 <b>Gear box-</b> constant mesh and synchromesh gear boxes, Epicyclic gear box their construction and operation. Overdrive, transfer case, Two wheeler gear box construction and operation</p> <p>2.4 <b>Propeller shaft</b> types and construction, functions of universal and slip joints.</p> <p>2.5 <b>Differential</b> - need, construction and working, differential action and operation</p> <p>2.6 <b>Axle</b> – Hotchkiss and torque tube drives, Rear- full floating axle, semi floating and three quarter floating axle. Front axle.</p>	10	20
<p><b>3. Control Systems:</b> <b>Specific objectives:</b></p> <ul style="list-style-type: none"> <li>➤ State steering geometry and requirements</li> <li>➤ Describe Braking system of automobiles.</li> </ul> <p>Content:</p> <p>3.1 <b>Steering System:</b> <span style="float: right;">08 Marks</span> Purpose of steering system, construction and working of - recirculating ball type and rack and pinion. Wheel Geometry- caster, camber, king pin inclination, Toe In and Toe Out. Power steering (introductory).</p> <p>3.2 <b>Braking System:</b> <span style="float: right;">10 Marks</span> Need of braking system, types of automotive braking systems for two and four wheeler vehicles – mechanical, hydraulic and air operated</p>	08	18

<ul style="list-style-type: none"> <li>➤ Hydraulic braking systems: Layout &amp; components of hydraulic braking systems</li> <li>➤ Construction and working of master cylinder and wheel cylinder.</li> <li>➤ Drum braking system, Disc Braking Systems</li> <li>➤ Air braking system: layout and working</li> </ul>		
<p><b>4. Suspension Systems, Wheels and Tyres</b></p> <p><b>4.1 Necessity and Classification of Suspension System</b> 10 Marks Front and rear suspension system construction and working of Wishbone type, Mac Pherson type, Trailing link type, coiled springs, leaf spring and shock absorbers, air suspension system.</p> <p><b>4.2 Wheels and Tyres</b> 08 Marks types of wheel-spoked, disc, light alloy cast. Types of rims. Tyres-Desirable properties, types-radial ply, cross ply, tubeless. Tyre specifications. Factors affecting tyre life. Wheel alignment and balancing.</p>	08	18
<p><b>5. Electrical Systems:</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Sketch and describe battery constructional details</li> <li>➤ Describe charging system</li> <li>➤ Describe starting system and lighting system</li> </ul> <p><b>Content:</b></p> <p><b>5.1 Battery:</b> 08 Marks Automotive battery construction and operation, battery capacity, Battery ratings, Battery tests Charging System : Need of charging system, Construction and operation of charging system, Alternator principle, construction and working</p> <p><b>5.2 Starting System :</b> 04 Marks Need of starting system, layout, construction of starting motor, Bendix drive</p> <p><b>5.3 Lighting System :</b> 04 Marks Layout of lighting system of two wheeler and four wheeler, Wiring harness, cable color codings</p> <p><b>5.4 Ignition System and their Components</b> 04 Marks Battery, magneto, electronic ignition system.</p>	10	20
<p><b>6. Automobile Air conditioning System.</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Understand concept of air conditioning system</li> <li>➤ Appreciate the various parameters of air conditioning</li> <li>➤ Locate various components of air conditioning systems in a vehicle</li> </ul> <p>Introduction, layout of car air conditioning system, components of a system, working of a system, parameter control (Humidity, temperature, purity of air) required. Important precautions while using AC system.</p>	04	08
<b>Total</b>	<b>48</b>	<b>100</b>

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

1. Locate and identify layout of automobile vehicles.
2. Locate and identify different components of various systems of automobile vehicles.
3. Understand basic engine construction in detail.

4. Refer and interpret Service manuals, Specification charts of automobile vehicles.

**Motor Skills:**

1. Use proper hand tools, equipments in automobile maintenance
2. Assemble and dismantle petrol and diesel engines of car
3. Assemble and dismantle automobile systems.
4. Conduct PUC test on automobile vehicles.
5. Collect and interpret technical specifications of two and four wheeler automobiles from market and internet.

**List of practical:**

**(Conduct any ten experiments of the following.)**

1. Individual student should collect following information-
  - (a) Automobile manufacturers in India-Two or four wheeler vehicles.
  - (b) Advance systems in automobiles like ABS, Safety Air Bag, power operated- mirror / window etc.
2. Observe the chasis of following vehicle like LCV or HCV or Jeep. Draw and describe various components mounted on it.
3. Dismantle and assemble single plate-coil and diaphragm type clutch. List the various tools used while dismantling.
4. Dismantle and assemble synchromesh gear box. Prepare sequence chart while assembling.
5. Dismantle and assemble differential. Prepare sequence chart while assembling.
6. Observe various steering systems of automobile vehicle and make a systematic record.
7. Dismantle brake system and observe various components of it. Write function of important components.
8. Observe and draw various suspension systems with brief description.
9. Visit to automobile service centre, observe various systems and write a report.
10. Inspection of battery like Ah rating, type of battery, no. of cells, vents, charge status by using hydrometer and voltmeter.
11. Conduct PUC test of car on exhaust gas analyzer according to Indian Motor Vehicle act 1989 revised norms (Petrol or diesel) and write a report.
12. Visit to car air-conditioning service centre and prepare report on maintenance.

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

Sr. No.	Author	Title	Publisher/Edition
1.	William Crouse	Automobile Engineering	Tata- McGraw Hill 2009
2	K.K.Jain, R.B.Asthana	Automobile Engineering	Tata- McGraw Hill 2011
3.	H.M.Sethi	Automobile Engineering	Tata- McGraw Hill 2010
4	Shrinivasan	Automobile Engineering	Tata- McGraw Hill 2009
5	Kirpal singh	Automobile Engineering	Standard Publications 2009
6	Joseph heitner	Automotive Mechanics	Wiley 2002

1. Central Motor Vehicle Act Pollution Norms, Service Manuals for different Cars, Motor cycles, Trucks, Technical literature on specifications of different vehicles, Manuals of Exhaust gas analysers, Euro III, Euro IV norms for cars, trucks
2. CDs, PPTs, Video Clips: On various constructional and operational details of working of different automobile systems based on internet web sites as under,
  - a. [www.tatamotors.com](http://www.tatamotors.com)
  - b. [www.hyundai.co.in](http://www.hyundai.co.in)
  - c. [www.india.ford.com](http://www.india.ford.com)
  - d. [www.marutisuzuki.com](http://www.marutisuzuki.com)
  - e. [www.auto.howstuffworks](http://www.auto.howstuffworks).
  - f. You tube videos for automobile systems
3. Charts, Models, Transparencies on automobile systems and components.

**Course Name : Diploma in Mechanical Engineering**

**Course code : MG / MC**

**Semester : Seventh**

**Subject Title : Industrial Fluid Power**

**Subject Code : 21013**

**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).**

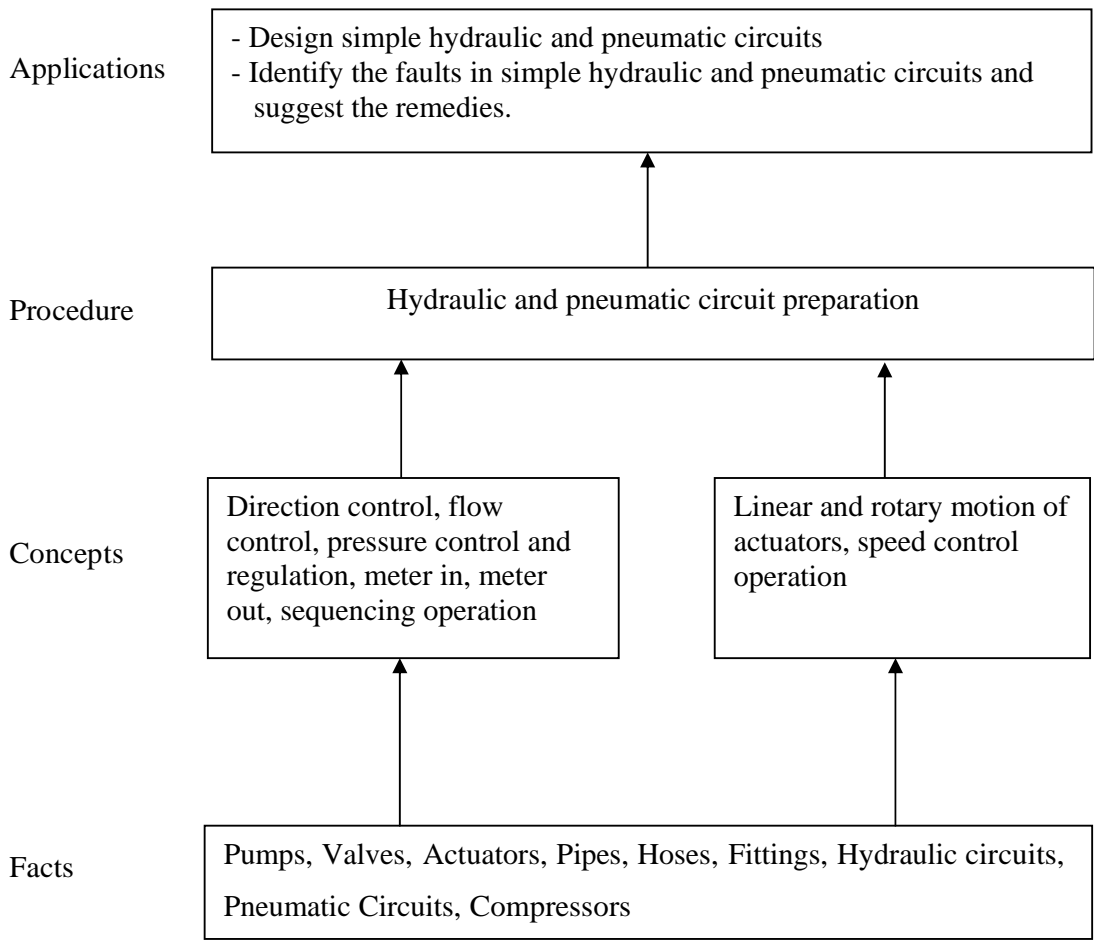
**Rationale:**

Oil hydraulic systems & pneumatic systems are widely used in all fields of engineering as clean source of motive power. Low cost automation systems with the use of pneumatics have become popular as manufacturing aids. Diploma engineers come across such systems in all the segments of industries. This subject will give the students, the basic skills and knowledge of oil hydraulics and pneumatics which will be directly needed in the industrial environment.

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

- 1) Identify various components of hydraulic & pneumatic systems.
- 2) Know the working principle of various components used in hydraulic & pneumatic systems.
- 3) Select appropriate components required for simple hydraulic and pneumatic circuits.
- 4) List the probable causes of faults or defects in the hydraulic & pneumatic circuits.

**Learning Structure:**





**Theory:**

Topic & Content	Hours	Marks
<p><b>Topic 1. Basics of Oil Hydraulic Systems</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Identify various components in simple oil hydraulic circuits.</li> <li>➤ List the types of various components in simple oil hydraulic circuits.</li> <li>➤ Explain the construction and working principle of various components in simple oil hydraulic circuits.</li> </ul> <p>Contents</p> <ul style="list-style-type: none"> <li>• General layout, Applications, Merits and limitations of oil hydraulic systems <b>06 Marks</b></li> <li>• Overview of essential properties of oils used in oil hydraulic circuits <b>06 Marks</b></li> <li>• Construction, working principle, applications and symbols of Vane pump, gear pump, Gerotor pump, screw pump, piston Pump <b>12 Marks</b></li> </ul>	16	24
<p><b>Topic 2. Hydraulic Valves, Actuators and Accessories</b></p> <ul style="list-style-type: none"> <li>➤ Select valves, actuators and accessories for the given application of hydraulic circuit.</li> <li>• <b>Valves</b> <b>12 Marks</b> Construction, principle of working and symbols of Pressure control valves - pressure relief valve - direct, pilot operated, pressure reducing, pressure unloading, Sequence valves, counter balancing Direction control valves - Poppet valve, spool valve, 2/2, 3/2, 4/2, 5/3, methods of actuation. Types of different center positions. check valves, pilot operated check valves Flow control valves - pressure compensated, non pressure compensated flow control valve,</li> <li>• <b>Actuators</b> <b>06 Marks</b> Classification of actuators Construction, working principle and symbols of Rotary Actuators - Hydraulic motors Linear Actuators - Cylinders - single acting, double acting, and their subtypes. Different mounting methods.</li> <li>• <b>Accessories</b> <b>06 Marks</b> Construction, working principle and symbols of Pipes, Hoses, Fittings, Oil filters, Seals and gaskets, Accumulators</li> </ul>	18	24
<p><b>Topic 3. Oil Hydraulic Circuits</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Draw layout of oil hydraulic circuits.</li> <li>➤ Explain working of oil hydraulic circuits.</li> <li>➤ Develop oil hydraulic circuit for different applications.</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>• 'Meter in', 'Meter out', 'Bleed off', Unloading, two cylinder synchronizing, regenerative, counterbalance, dual pump unloading circuits.</li> </ul>	08	12

<ul style="list-style-type: none"> <li>Sequencing circuit – time dependent and pressure dependent</li> <li>Oil hydraulic circuits for milling machine, shaper machine,</li> </ul>		
<p><b>Topic 4. Introduction to and Components of Pneumatic Systems</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Identify various components in simple pneumatic circuits.</li> <li>➤ List the types of various components in simple pneumatic circuits.</li> <li>➤ Explain the construction and working principle of various components in simple pneumatic circuits.</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>Introduction <b>06 Marks</b> Applications of pneumatic systems General layout, merits and limitations of pneumatic systems Selection of air compressors for pneumatic circuits</li> <li>Valves <b>08 Marks</b> Construction, principle of working and symbols of Pressure regulating valves, Direction control valves, Flow control valves</li> <li>Actuators <b>06 Marks</b> Construction, working and symbols of Rotary Actuators - Pneumatic motors Linear Actuators – Cylinders - single acting, double acting.</li> <li>Accessories <b>04 Marks</b> Construction, working and symbols of Pipes, Hoses, fittings, FRL unit</li> </ul>	14	24
<p><b>Topic 5. Pneumatic Circuits</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Draw layout of simple pneumatic circuits.</li> </ul> <p>Contents:</p> <ul style="list-style-type: none"> <li>Speed control circuits for double acting cylinder and bidirectional air motor <b>08 Marks</b></li> <li>Sequencing circuits - Position based sequencing circuit and time delay circuit <b>08 Marks</b></li> </ul>	08	16
<b>Total</b>	<b>64</b>	<b>100</b>

**Practical:**

Skills to be developed:

**Intellectual Skills:**

1. Prepare simple oil hydraulic & pneumatic circuits.
2. Compare the performance of oil hydraulic & pneumatic systems.
3. Identify the faults & suggest remedies in oil hydraulic & pneumatic circuits.
4. Select proper circuit for given application.

**Motor Skills:**

1. Connect different components in oil hydraulic or pneumatic circuit as per given drawing.
2. Perform repairing and / or replacement of defective components in the oil hydraulic or pneumatic circuit.
3. Draw the oil hydraulic and pneumatic circuits using symbols.

**List of Practicals:**

1. Assemble meter in and meter out oil hydraulic circuits and compare its working. List the applications
2. Assemble sequencing circuit and list its applications.
3. Assemble quick return mechanism oil hydraulic circuit for shaper machine.
4. Assemble pneumatic circuit for speed control of double acting cylinders.
5. Assemble pneumatic circuit for speed control of pneumatic motor and measure the speed of motor.
6. Study of trouble shooting procedures of various hydraulic and pneumatic circuits.
7. Selection of circuit components for simple oil hydraulic circuits such as circuits used for milling machine, shaper machine.

**[Note - Term work shall consist of circuit diagram with ISO symbols, specifications and brief write up for all the above practicals. For practical no 1 - 5, the practical batch size shall be divided in two groups.]**

**Assignments -**

- 1) Market survey of oils used for oil hydraulic circuits - collection of name of manufacturers, detailed technical specifications, trade names, costs, packing sizes
- 2) Study of any one mobile hydraulic system such as in earth moving equipments or any one stationary hydraulic system such as in any machine tool and its detailed report.
- 3) Study of any pneumatic circuit such as circuits used in special purpose machines, low cost automation systems, material handling systems and its detailed report.

**[Assignments to be completed in a group of (max.) four students.]**

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

Sr. No.	Author	Title	Publisher
01	Majumdar S.R	Oil Hydraulic system- Principles and maintenance	Tata McGraw Hill
02	Majumdar S.R	Pneumatics Systems Principles and Maintenance	Tata McGraw Hill
03	Joji B.	Pneumatic Controls	Wiley India Pub.
04	Stewart	Hydraulics and Pneumatics	Taraporewala Publication

**2. Catalogues:**

Various system components' manufacturers' catalogues.

**3. CDs:**

CDs developed by various system components' manufacturers

**Course Name : Diploma in Mechanical Engineering**

**Course code : MG / MC**

**Semester : Seventh**

**Subject Title : Production Engineering & Robotics**

**Subject Code : 21014**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	--	03	100	--	--	--	100

**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 subject is technology subject. A technician is required to work at the highest productivity level. His /her productivity depends on the productivity of two important resources i.e. human resource and equipment resource in the manufacturing system. Hence he/she should learn the techniques for improvement in productivity of these two resources.

A technician is required to plan the production schedule. He / She is required to organize material supply for the manufacturing activities. The total cost of goods produced contains expenditure incurred on material and human resources. The direct and indirect cost of scarce resources can be reduced by the technician by optimizing their use. . Hence he / she should learn, process planning, production planning and control.

Modern manufacturing system employs latest techniques such as JIT, TPM, FMS, 5'S', Kaizen. To keep pace with time, the technician should know all these techniques.

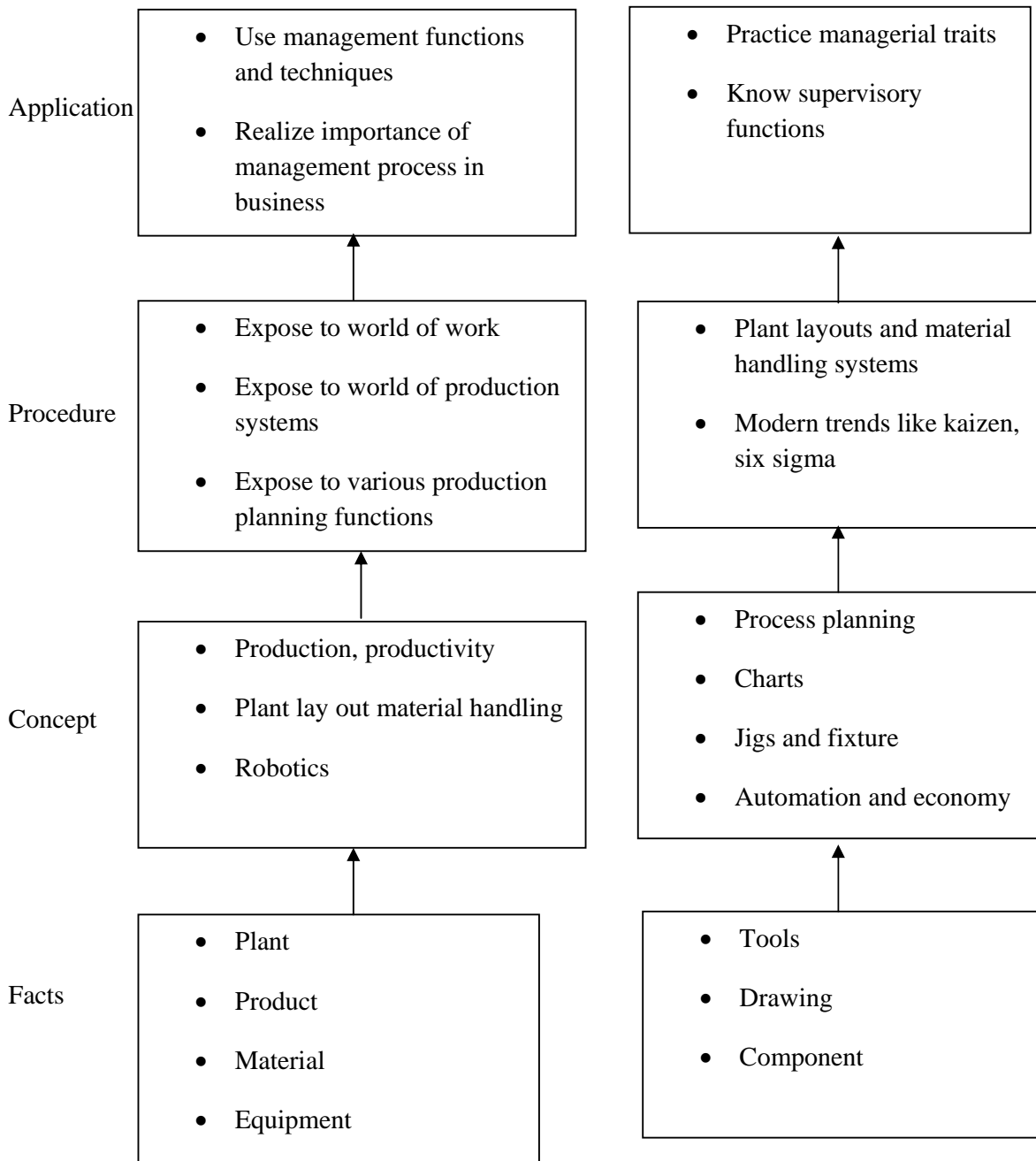
Industrial Robots are going to perform important and difficult functions in modern production system. A technician is expected to be aware of robots and their functioning.

**General Objectives:**

Students will be able to;

1. Understand importance of productivity and factors for improvement of productivity.
2. Know different production systems and modern trends in manufacturing systems.
3. Apply modern tools in production engineering like six sigma, kaizen, poka yoke, etc.
4. Understand concept of robotics, limitations of human in difficult operation and applications of robots.

**Learning Structure:**



**Theory:**

<b>Topic and Content</b>	<b>Hrs.</b>	<b>Marks</b>
<p><b>Topic 1. Production System</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Define productivity</li> <li>➤ State methods to improve productivity</li> </ul> <p><b>Content:</b></p> <p>1.1 Production - definition ,types of production systems <b>04 Marks</b></p> <p>1.2 Productivity - importance, measurement of productivity, techniques of improving productivity. <b>04 Marks</b></p>	06	08
<p><b>Topic 2. Plant Location, Plant Layout and Material Handling</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Draw layouts for manufacturing unit.</li> <li>➤ State principles of material handling.</li> <li>➤ Correlate plant layout and material handling.</li> </ul> <p><b>Content:</b></p> <p>2.1 Plant Location - Importance of site selection, factors affecting site selection, Government policies, relaxation for backward areas. <b>04 Marks</b></p> <p>2.2 Plant Layout - objectives, types, design principles, characteristics of plant layout, symptoms of bad plant layout. <b>04 Marks</b></p> <p>2.3 Material handling - need, principles and types of material handling devices - conveyor, hoist &amp; crane, forklift truck, trolley, pipe, selection of material handling systems and devices. Automated Guided Vehicles <b>06 Marks</b></p>	10	14
<p><b>Topic 3. Process Planning</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Prepare process sheet for any given component.</li> <li>➤ Select machine tool for given manufacturing process.</li> </ul> <p><b>Content:</b></p> <p>3.1 Planning of processes from raw material to finished product, factors affecting process planning, <b>08 Marks</b></p> <p>3.2 Deciding sequence of operations, operation sheet, combined operations, and determination of inspection stages. <b>08 Marks</b></p>	10	16
<p><b>Topic 4. Production Planning and Control (PPC)</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ State importance of PPC system in industry.</li> <li>➤ Describe techniques of production control.</li> </ul> <p><b>Content:</b></p> <p>4.1 Definition ,functions and importance of PPC, Meaning of Control, Progressive Control <b>06 Marks</b></p> <p>4.2 Gantt chart, Flow Process Sheet, Line balancing, <b>06 Marks</b></p>	06	12
<p><b>Topic 5. Work Study</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Calculate standard time for given activity</li> <li>➤ Prepare process chart</li> </ul> <p><b>Content:</b></p> <p>5.1 Method Study- Definition, Objectives, Procedure, Selection of</p>	08	12

work. <b>04 Marks</b> 5.2 Recording Techniques:- Process Charts - Outline process chart, Flow process chart, Two Handed process chart, Multiple activity Chart, Flow diagram, String diagram, Travel chart. <b>04 Marks</b> 5.3 Work Measurement – Objectives, procedure, Time Study, Time Study Equipments. Stop Watch Time Study, Allowances, Calculation of Standard Time, <b>04 Marks</b>		
<b>Topic 6. Jigs and Fixtures</b> <b>Specific Objectives:</b> <ul style="list-style-type: none"> <li>➤ Understand importance and use of jigs and fixtures in industries</li> <li>➤ Understand principles of jig and fixture design and design a jig/fixture for given component</li> </ul> <b>Content:</b> 6.1 Introduction. Difference between jig and fixture, Different components of Jig/ fixture, Types of jigs and fixtures. <b>04 Marks</b> 6.2 Types of locators and clamping devices, 3-2-1 principle of location, Fool proofing of jigs and fixture, General principles of jig and fixture design. <b>08 Marks</b>	08	12
<b>Topic 7. Modern Trends in Production Engineering</b> <b>Specific Objectives:</b> <ul style="list-style-type: none"> <li>➤ Describe kaizen technique.</li> </ul> <b>Content:</b> 7.1 Just In Time manufacturing - Pull and push types of manufacturing systems. Waste management technique, Concept of ERP. <b>06 Marks</b> 7.2 Basic concepts of <ul style="list-style-type: none"> <li>➤ Kaizen</li> <li>➤ Concept and meaning of 5S</li> <li>➤ Lean manufacturing</li> </ul> <b>04 Mark</b>	06	10
<b>Topic 8. Robotics</b> <b>Specific Objectives:</b> <ul style="list-style-type: none"> <li>➤ State concept of robotics</li> <li>➤ State limitations of human in difficult operation</li> <li>➤ State applications of robots.</li> </ul> <b>Contents:</b> 8.1 Robotics - Introduction, Robot anatomy and structure, specification, working and basic components, Various configuration, Degree of freedom and application. <b>04 Marks</b> 8.2 Sensors - Classification, Basic configuration. <b>04 Marks</b> 8.3 Power sources for robotics, Actuators - Mechanical, Electrical, Hydraulic, and Pneumatic. <b>04 Marks</b> 8.4 Concept of grippers – Screw and vacuum actuated gripper, end effectors. <b>04 Marks</b>	10	16
<b>Total</b>	<b>64</b>	<b>100</b>

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

<b>Sr. No.</b>	<b>Author</b>	<b>Name of Book</b>	<b>Publication</b>
1	L.C. Jhamb	Industrial Management	Everest
2	James C. Rigs	Production System, Planning, Analysis & Control	N.Y.Wiley & Sons
3	O.P. Khanna	Industrial Engineering and Management	Dhanpat Rai & Sons
4	P. H. Joshi	Jigs & Fixtures	Tata McGraw Hill
5	Taiichi Ohno	Toyota Production system	Productivity Press
6	Richard D.Klafter Michael Negin	Robotic Engineering	P.H.I
7	C.Ray Asfahl	Robots and Manufacturing Automation	John Wiley and Sons.
8	R.K. Rajput	Robotics & industrial Automation	S Chand.



**Course Name : Diploma in Mechanical Engineering**

**Course code : MG / MC**

**Semester : Seventh**

**Subject Title : Solid Modeling**

**Subject Code : 21015**

**Teaching and Examination Scheme**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
01	--	02	--	--	--	--	25@	25

**Rationale:**

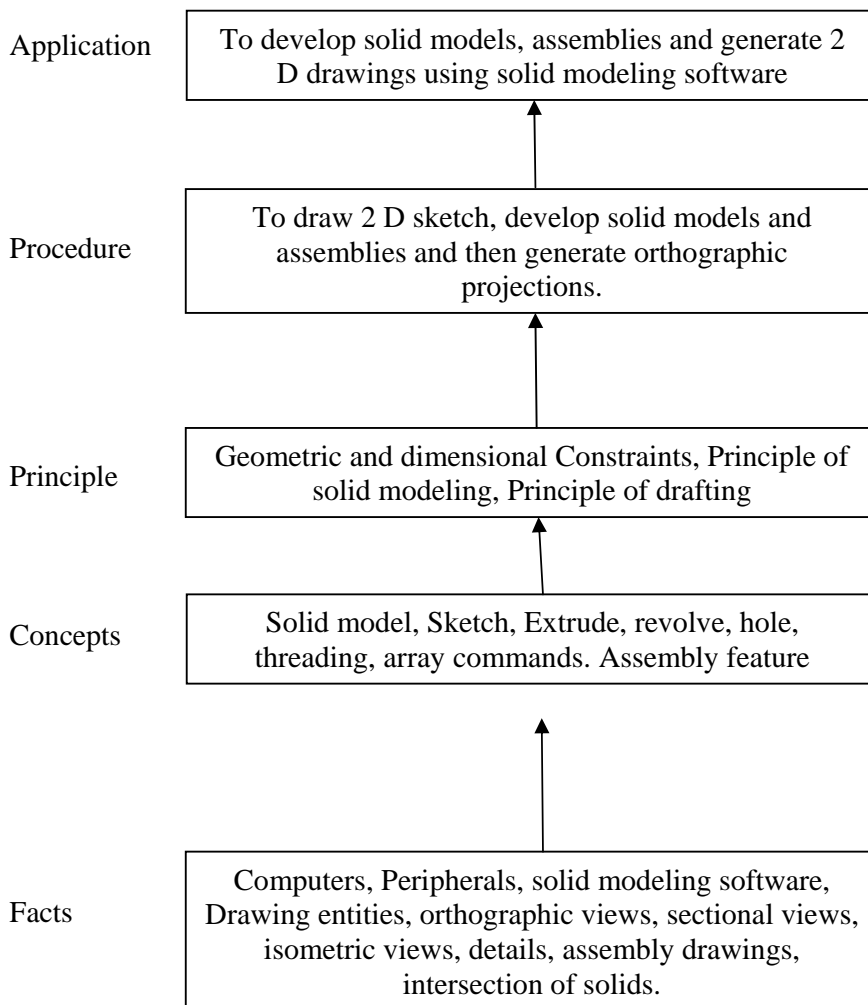
Technically 3 dimensions refers to objects that are constructed on 3 planes (X,Y,Z). The process of creating 3 dimensional (3D) computer graphics can be divided into 3 basic phases - 3D modeling, 3D animation & 3D rendering. 3D models means solid model is usually originated on the computer by engineer using some kind of solid modeling softwares. Solid modeling is a process of developing a mathematical representation of any 3 dimensional object. The solid model may be created using solid modeling softwares. Solid models are often animated for some uses.

Today 3D models are used in wide variety of engineering fields. Three dimensional computer graphics are widely used for product design, assembly design etc. As a diploma engineer he should have the knowledge of solid modeling software to visualize the machine components & assembly like cars, machine tools and earth movers etc.

**General Objectives:**

Students will be able to

- 1) Use appropriate commands
- 2) Develop solid models from 2 D drawing.
- 3) Use of printers / plotters.

**Learning Structure:**

**Theory:**

<b>Topic and Content</b>	<b>Hours</b>
<b>Topic 1: Introduction to Solid Modeling</b> <b>Content:</b> Introduction, Applications, Benefits, Need, Hardware Requirements, Different Software packages used for Solid Modeling.	02
<b>Topic 2: Working in 2 D environment</b> <b>Content:</b> <b>2.1 Working in Sketcher mode</b> – Line, Profile, Circle, Arc, Rectangle and their sub options. <b>2.2 Constraints</b> - Dimensioning constraint, Geometrical constraint.	02
<b>Topic 3: Creation of solid models</b> <b>Content:</b> <b>3.1 Working in 3 D environment</b> -Creating 3D Solid Models of simple machine parts. <b>3.2 Intersection of solids</b> – Intersect 2 solid components by inserting new body option, Boolean operations – Union, subtract, intersection.	04
<b>Topic 4: Assembly Drawing</b> <b>Content:</b> <b>4.1 Assembly Drawing</b> - Preparation of Assembly drawing by using assembly features. (Assembly of minimum 4-5 components) <b>4.2 Exploded view</b> – Explode the assembly.	04
<b>Topic 5: Working in Drafting Mode</b> <b>Content:</b> <b>5.1 Orthographic projections</b> – Generate orthographic projections which will include all types of views – front view, top view, side view, sectional views, isometric views, auxiliary views. <b>5.2 Dimensioning Commands</b> – Apply dimensions, dimensional and geometrical tolerances. <b>5.3 Bill of material</b> – Prepare part list table and name plate	03
<b>Topic 6: Plotting drawing</b> <b>Content:</b> Page set up, Plot command.	01
<b>Total</b>	<b>16</b>

**Note:** Multimedia projection facility shall be used during lecture sessions along with computer facility e.g. laptop, computer, LCD projector.

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

- 1) Interpret a drawing to draw in solid Modeling software.
- 2) Use command dialogue box.

**Motor Skills:**

- 1) Use toolbars.
- 2) Use printers or plotters.

**Guideline for Practical:**

- 1) One student per computer terminal.
- 2) For assembly drawing practical work select any one assembly like oldham's coupling, cotter Joint, knuckle Joint, stop valve, piston and cylinder assembly, lathe tool post, bearing block assembly, screw jack, tail stock etc.

**List of Practicals:**

1. Creation of minimum 4 different 2 D sketches
2. Creation of at least 5 solid models using solid modeling features.
3. Creation of 2 assembly drawings each of at least 5 components.
4. Generation of orthographic projections front view, top view, side view, isometric view.
5. Generation of sectional view.
6. Generation of auxiliary view.
7. Intersection of solids (at least 2 assignments)
8. Plotting of above drawings on A2/A3 size sheet.

**Note:** Use of any one Solid Modeling Software of Latest Version is recommended.

**Practical Examination:** (2 Hours for each student)

Creation of 3D Model and their 2 D views from the given part drawing followed by oral examination based on above term work. (One candidate on one computer terminal.)