

| <div> MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</div> <div>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</div>                                                                                                                                                |                                                                   |              |          |                 |    |    |                    |        |     |                          |     |        |     |        |     |            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------|----------|-----------------|----|----|--------------------|--------|-----|--------------------------|-----|--------|-----|--------|-----|------------|
| COURSE NAME : DIPLOMA IN MECHANICAL ENGINEERING                                                                                                                                                                                                                                                                                                                               |                                                                   |              |          |                 |    |    |                    |        |     |                          |     |        |     |        |     |            |
| COURSE CODE : ME                                                                                                                                                                                                                                                                                                                                                              |                                                                   |              |          |                 |    |    |                    |        |     |                          |     |        |     |        |     |            |
| DURATION OF COURSE : 6 SEMESTERS                                                                                                                                                                                                                                                                                                                                              |                                                                   |              |          |                 |    |    |                    |        |     | WITH EFFECT FROM 2012-13 |     |        |     |        |     |            |
| SEMESTER : FIFTH                                                                                                                                                                                                                                                                                                                                                              |                                                                   |              |          |                 |    |    |                    |        |     | DURATION : 16 WEEKS      |     |        |     |        |     |            |
| PATTERN : FULL TIME - SEMESTER                                                                                                                                                                                                                                                                                                                                                |                                                                   |              |          |                 |    |    |                    |        |     | SCHEME : G               |     |        |     |        |     |            |
| SR. NO                                                                                                                                                                                                                                                                                                                                                                        | SUBJECT TITLE                                                     | Abbreviation | SUB CODE | TEACHING SCHEME |    |    | EXAMINATION SCHEME |        |     |                          |     |        |     |        |     | SW (17500) |
|                                                                                                                                                                                                                                                                                                                                                                               |                                                                   |              |          | TH              | TU | PR | PAPER HRS.         | TH (1) |     | PR (4)                   |     | OR (8) |     | TW (9) |     |            |
|                                                                                                                                                                                                                                                                                                                                                                               |                                                                   |              |          |                 |    |    |                    | Max    | Min | Max                      | Min | Max    | Min | Max    | Min |            |
| 1                                                                                                                                                                                                                                                                                                                                                                             | Automobile Engineering                                            | AEN          | 17526    | 03              | -- | 02 | 03                 | 100    | 40  | --                       | --  | --     | --  | 25@    | 10  | 50         |
| 2                                                                                                                                                                                                                                                                                                                                                                             | Advanced Manufacturing Processes β                                | AMP          | 17527    | 03              | -- | 02 | 03                 | 100    | 40  | --                       | --  | --     | --  | 25@    | 10  |            |
| 3                                                                                                                                                                                                                                                                                                                                                                             | Measurement & Control β                                           | MAC          | 17528    | 03              | -- | 02 | 03                 | 100    | 40  | --                       | --  | --     | --  | 25@    | 10  |            |
| 4                                                                                                                                                                                                                                                                                                                                                                             | Power Engineering                                                 | PEN          | 17529    | 03              | -- | 02 | 03                 | 100    | 40  | 25#                      | 10  | --     | --  | 25@    | 10  |            |
| 5                                                                                                                                                                                                                                                                                                                                                                             | Metrology and Quality Control β                                   | MQC          | 17530    | 03              | -- | 02 | 03                 | 100    | 40  | 25#                      | 10  | --     | --  | 25@    | 10  |            |
| 6                                                                                                                                                                                                                                                                                                                                                                             | Behavioural Science \$                                            | BSC          | 17075    | 01              | -- | 02 | --                 | --     | --  | --                       | --  | 25#    | 10  | 25@    | 10  |            |
| 7                                                                                                                                                                                                                                                                                                                                                                             | CNC Machines β                                                    | CNC          | 17064    | 01              | -- | 02 | --                 | --     | --  | 50#                      | 20  | --     | --  | 25@    | 10  |            |
| 8                                                                                                                                                                                                                                                                                                                                                                             | Professional Practices - III / Industrial Training (Optional)** β | PPT          | 17065    | --              | -- | 03 | --                 | --     | --  | --                       | --  | --     | --  | 50@    | 20  |            |
| TOTAL                                                                                                                                                                                                                                                                                                                                                                         |                                                                   |              |          | 17              | -- | 17 | --                 | 500    | --  | 100                      | --  | 25     | --  | 225    | --  | 50         |
| Student Contact Hours Per Week: 34 Hrs.      THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.                                                                                                                                                                                                                                                                                 |                                                                   |              |          |                 |    |    |                    |        |     |                          |     |        |     |        |     |            |
| Total Marks : 900                                                                                                                                                                                                                                                                                                                                                             |                                                                   |              |          |                 |    |    |                    |        |     |                          |     |        |     |        |     |            |
| @ - Internal Assessment, # - External Assessment, <div></div> No Theory Examination, \$ - Common to all branches, #* - Online Examination, β - Common to AE, PG, PT, MH, MI                                                                                                                                                                                                   |                                                                   |              |          |                 |    |    |                    |        |     |                          |     |        |     |        |     |            |
| ** Students who have done Industrial Training of four week after fourth semester examination during summer vacation will be exempted from activities of Professional Practices-III of Fifth Semester as mentioned in the curriculum for Professional Practices II below and Assessment of Industrial Training will be done in fifth semester under Professional Practices-III |                                                                   |              |          |                 |    |    |                    |        |     |                          |     |        |     |        |     |            |
| 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 : ME/MH/MI****Semester : Fifth for ME and Sixth for MH,MI****Subject Title : Automobile Engineering****Subject Code : 17526****Teaching and Examination Scheme:**

| Teaching Scheme |    |    | Examination Scheme |     |    |    |     |       |
|-----------------|----|----|--------------------|-----|----|----|-----|-------|
| TH              | TU | PR | PAPER<br>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).

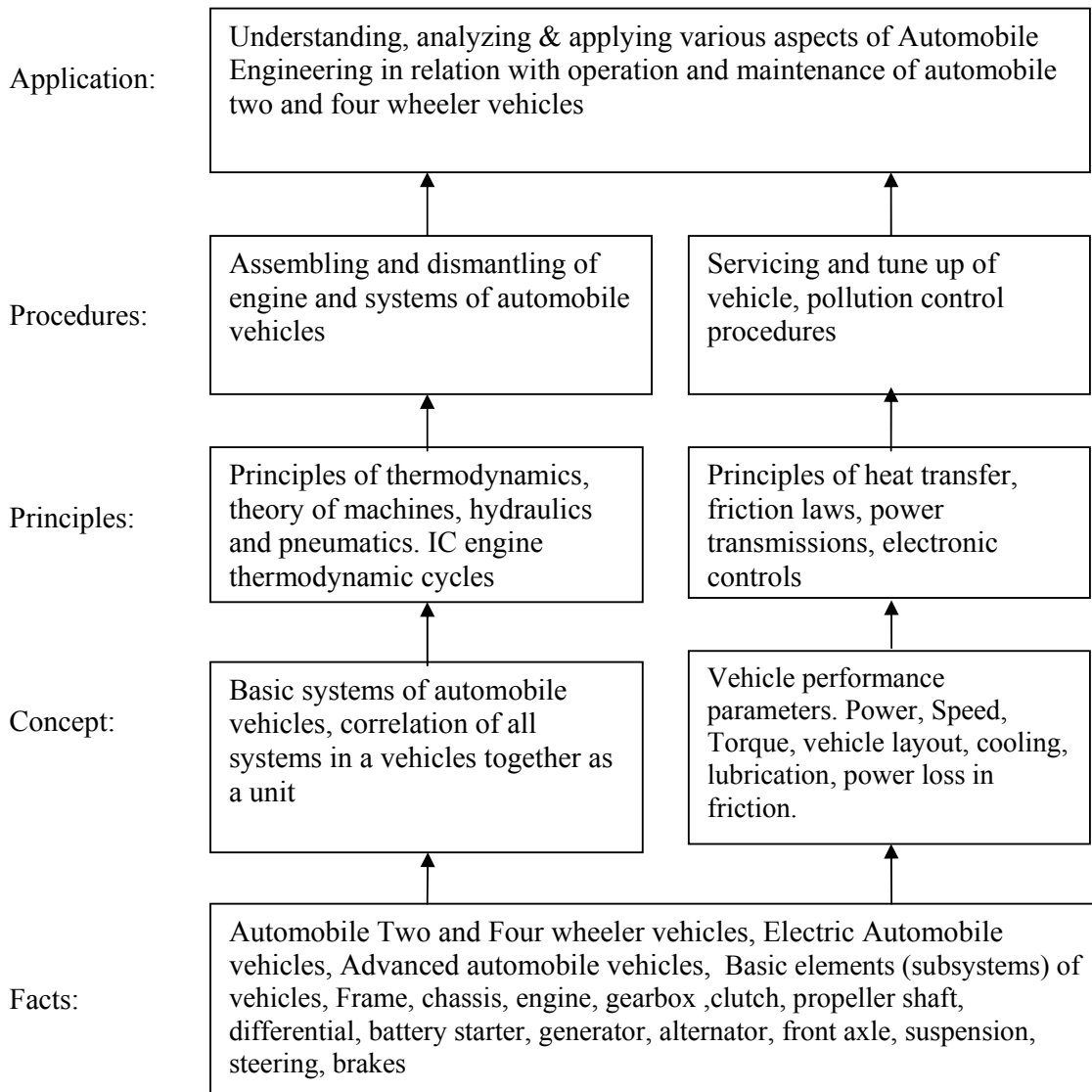
**Rationale:**

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 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| <b>1. Introduction to Automobiles.</b><br>Specific objectives: <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> Contents: <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    |
| <b>2. Transmission Systems:</b><br>Specific Objectives: <ul style="list-style-type: none"> <li>➤ Describe transmission system of automobiles and their components</li> <li>➤ Describe suspension systems and components</li> </ul> Content: <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    |
| <b>3. Control Systems:</b><br>Specific objectives: <ul style="list-style-type: none"> <li>➤ State steering geometry and requirements</li> <li>➤ Describe Braking system of automobiles.</li> </ul> Content: <p>3.1 <b>Steering System:</b> 08 Marks<br/>           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.<br/>           Power steering (introductory).</p> <p>3.2 <b>Braking System:</b> 10 Marks<br/>           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>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |            |
| <b>4. Suspension Systems, Wheels and Tyres</b><br><b>4.1 Necessity and Classification of Suspension System</b> 10 Marks<br>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.<br><b>4.2 Wheels and Tyres</b> 08 Marks<br>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.                                                                                                                                                                                                                                                                                                                                                                   | 08        | 18         |
| <b>5. Electrical Systems:</b><br><b>Specific Objectives:</b> <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> <b>Content:</b><br><b>5.1 Battery:</b> 08 Marks<br>Automotive battery construction and operation, battery capacity, Battery ratings, Battery tests<br>Charging System :<br>Need of charging system, Construction and operation of charging system, Alternator principle, construction and working<br><b>5.2 Starting System :</b> 04 Marks<br>Need of starting system, layout, construction of starting motor, Bendix drive<br><b>5.3 Lighting System :</b> 04 Marks<br>Layout of lighting system of two wheeler and four wheeler, Wiring harness, cable color codings<br><b>5.4 Ignition System and their Components</b> 04 Marks<br>Battery, magneto, electronic ignition system. | 10        | 20         |
| <b>6. Automobile Air conditioning System.</b><br><b>Specific Objectives:</b> <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> 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.                                                                                                                                                                                                                                                                                                                                                                                                     | 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,
  - [www.tatamotors.com](http://www.tatamotors.com)
  - [www.hyundai.co.in](http://www.hyundai.co.in)
  - [www.india.ford.com](http://www.india.ford.com)
  - [www.marutisuzuki.com](http://www.marutisuzuki.com)
  - [www.auto.howstuffworks](http://www.auto.howstuffworks).
  - You tube videos for automobile systems
3. Charts, Models, Transparencies on automobile systems and components.

**Course Name : Mechanical Engineering Group****Course Code : ME/MH/MI/PG/PT/FE/FG****Semester : Fifth for ME/PG/PT/FG and Sixth for MH/MI/FE****Subject Title : Advanced Manufacturing Processes****Subject Code : 17527****Teaching and Examination Scheme:**

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

**NOTE:**

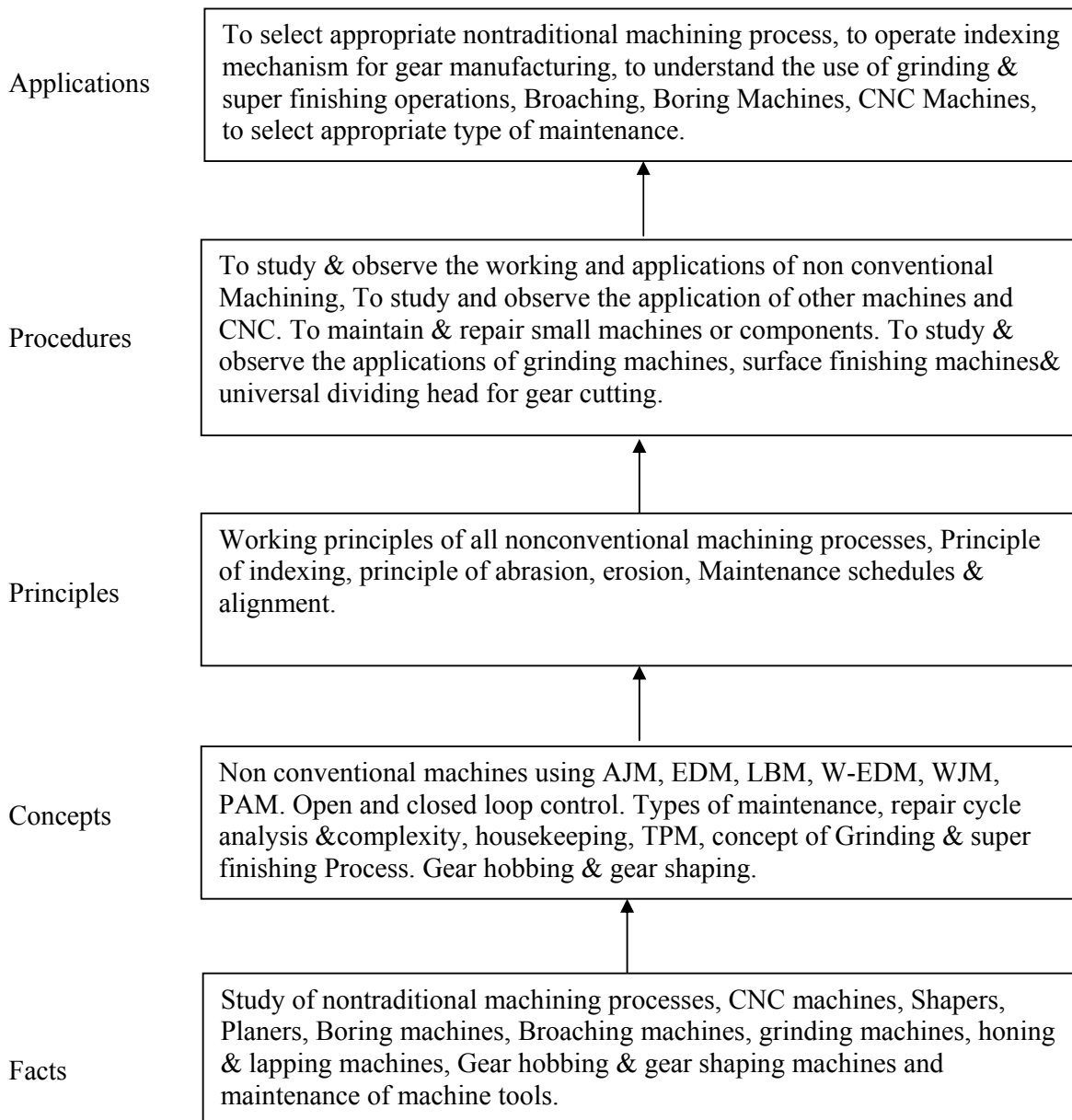
- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

**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:**

| Topic & Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Hours | Marks |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| <b>Topic 1. Non Traditional Machining</b><br><b>Specific Objectives</b> <ul style="list-style-type: none"> <li>➤ Understand different Nontraditional machining processes.</li> </ul> <b>Content</b> <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    |
| <b>Topic 2: Introduction to CNC</b><br><b>Specific Objectives</b> <ul style="list-style-type: none"> <li>➤ Know the Operation and control of CNC machine tools.</li> </ul> <b>Content</b> <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    |
| <b>Topic 3: Other Machining Methods</b><br><b>Specific Objectives</b> <ul style="list-style-type: none"> <li>➤ Understand the working of different Machines.</li> </ul> <b>Content</b> <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    |
| <b>Topic 4: Milling &amp; Gear Cutting</b><br><b>Specific Objectives</b> <ul style="list-style-type: none"> <li>➤ Understand the working of Milling &amp; Gear Cutting machines.</li> </ul> <b>Content</b> <p>4.1 <b>Milling:</b> 10 Marks<br/>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<br/>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    |
| <b>Topic 5. Surface Finishing</b><br><b>Specific Objectives</b> <ul style="list-style-type: none"> <li>➤ Understand the working of Grinding Machines &amp; Surface finishing machines.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 06    | 14    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|
| <b>Content</b><br><b>5.1 Grinding Machines</b> 08 Marks<br>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.<br><b>5.2 Super Finishing</b> 06 Marks<br>Methods of surface finishing like honing, lapping, burnishing, polishing and buffing - setup, working, advantages, limitations and applications. |           |            |
| <b>Topic 6. Maintenance of Machine Tools:</b><br><b>Specific Objectives</b><br>➤ Know the maintenance methods and procedures.<br><b>Content</b><br>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.             |

**Course Name : Mechanical Engineering Group**

**Course code : ME/MH/MI/PG/PT**

**Semester : Fifth for ME/PG/PT and Sixth for MH/MI**

**Subject Title : Measurements and Control**

**Subject Code : 17528**

**Teaching and Examination Scheme:**

| Teaching Scheme |    |    | Examination Scheme |     |    |    |     |       |
|-----------------|----|----|--------------------|-----|----|----|-----|-------|
| TH              | TU | PR | PAPER<br>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).

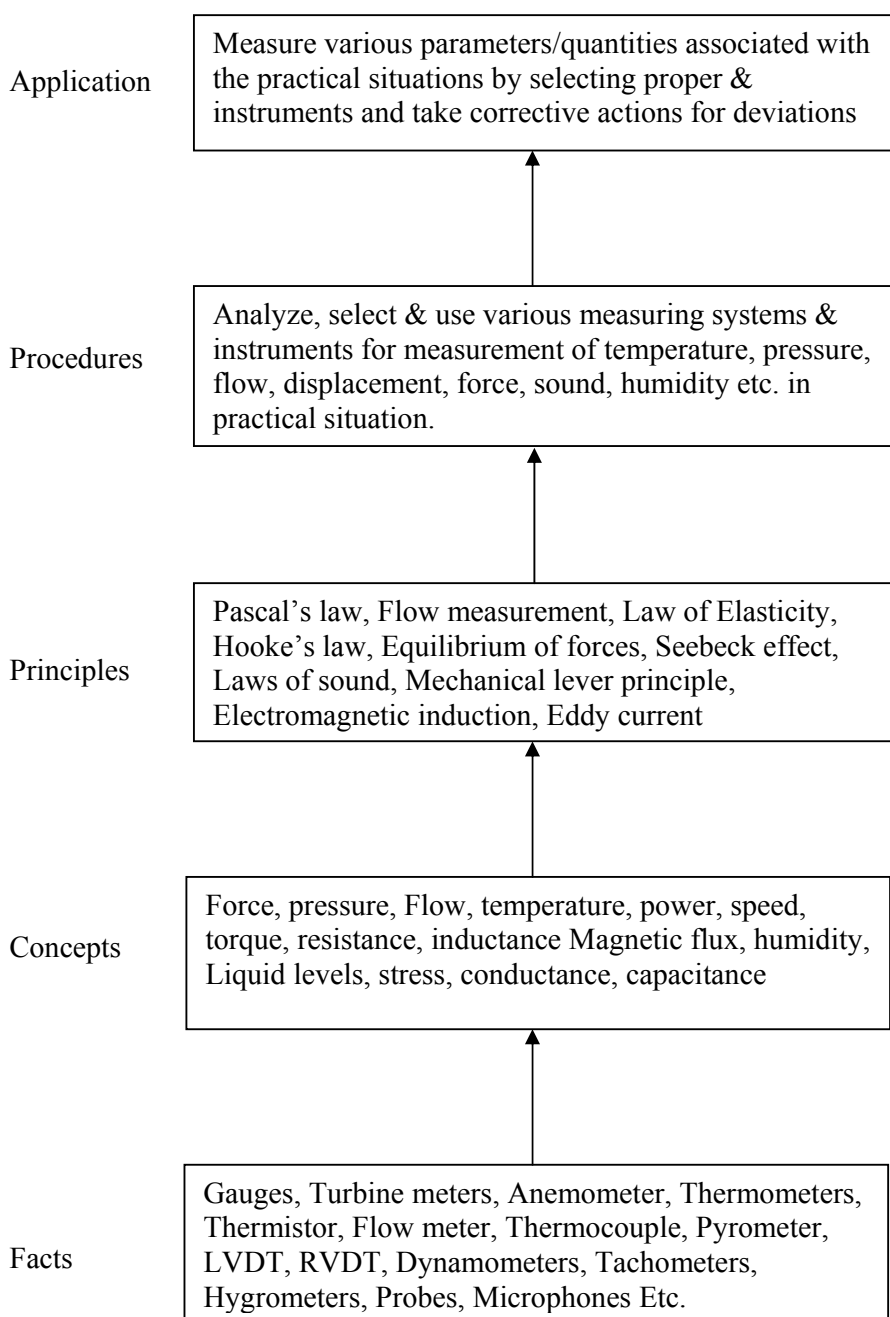
**Rationale:**

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**

| Topic and content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Hours | Marks |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| <b>1: Introduction and significance of Measurement</b><br><b>Specific objectives-</b> The students will be able to understand <ul style="list-style-type: none"> <li>➤ Terminology related to measurement</li> <li>➤ Various types of errors</li> <li>➤ Concept of transducers</li> </ul><br><b>Contents:</b><br><b>1.1 Types of measurement, classification of instruments</b><br><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.<br><b>Dynamic characteristics-</b> Speed of response, Fidelity and Dynamic errors, Overshoot. <b>06 Marks</b><br><b>1.2 Measurement of error-</b> Classification of errors, environmental errors, signal transmission errors, observation errors, operational errors. <b>04 Marks</b><br><b>1.3 Transducers :</b> Classification of transducers, active and passive, resistive, inductive, capacitive, piezo-resistive, thermo resistive <b>08 Marks</b> | 08    | 18    |
| <b>2: Displacement and Pressure Measurement</b><br><b>Specific objectives-</b><br>The students will be able to <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><br><b>Contents:</b><br><b>2.1 Displacement Measurement</b><br>Capacitive transducer, Potentiometer, LVDT, RVDT, Specification, selection & application of displacement transducer. Optical measurement scale and encoders <b>08 Marks</b><br><b>2.2 Pressure Measurement</b><br>Low pressure gauges- McLeod Gauge, Thermal conductivity gauge, Ionization gauge, Thermocouple vacuum gauge, Pirani gauge.<br>High Pressure gauge-Diaphragm, Bellows, Bourdon tube, Electrical resistance type, Photoelectric pressure transducers, piezoelectric type, Variable capacitor type <b>10 Marks</b>                                                                                                                                                           | 10    | 18    |
| <b>3: Temperature Measurement</b><br><b>Specific objectives</b><br>The students will be able to <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><br><b>Content:</b><br><b>3.1 Non-electrical methods-</b> Bimetal, Liquid in glass thermometer and Pressure thermometer <b>04 Marks</b><br><b>3.2 Electrical methods-</b> RTD, Platinum resistance thermometer, Thermistor, Thermoelectric methods - elements of thermocouple, Seebeck series, law of                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 06    | 16    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                      |    |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|--|
| intermediate temperature, law of intermediate metals, thermo emf measurement.<br>3.3 Pyrometers- radiation and optical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 08 Marks<br>04 Marks |    |  |
| <b>4: Flow Measurements</b><br><b>Specific objectives-</b><br>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><br><b>Content :</b><br>4.1 <b>Variable area meter</b> -Rota meter, Variable velocity meter-Anemometer<br><b>06 Marks</b><br>4.2 <b>Special flow meter</b> - Hot wire anemometer, Electromagnetic flow meter, Ultrasonic flow meter ,Turbine meter ,Vortex shedding flow meter<br><b>06 Marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 06                   | 12 |  |
| <b>5: Miscellaneous Measurement</b><br><b>Specific objectives-</b><br>The students will be able to <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><br><b>Content :</b><br>5.1 Introduction to sound measurement and study of Electro dynamic microphone and Carbon microphone.<br>5.2 <b>Humidity measurement</b> –Hair hygrometer, Sling psychrometer,<br>5.3 <b>Liquid level measurement</b> – direct and indirect methods.<br>5.4 <b>Force &amp; Shaft power measurement</b> -Tool Dynamometer (Mechanical Type), Eddy Current Dynamometer, Strain Gauge Transmission Dynamometer.<br>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<br>5.6 <b>Strain Measurement</b> -Stress-strain relation, types of strain gauges, strain gauge materials, resistance strain gauge- bonded and unbounded, types(foil, semiconductor, wire wound gauges), selection and installation of strain gauges load cells, rosettes. | 08                   | 16 |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|
| <b>6 : Control Systems</b><br><b>Specific objectives-</b><br>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><br>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<br>6.2 Comparison of hydraulic, pneumatic, electronic control systems, 06 Marks<br>6.3 Control action: Proportional, Integral, derivative, PI, PD, PID 04 Marks<br>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 : Mechanical Engineering Group****Course code : ME/MH/MI****Semester : Fifth for ME and Sixth for MH/MI****Subject Title : Power Engineering****Subject Code : 17529****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).**

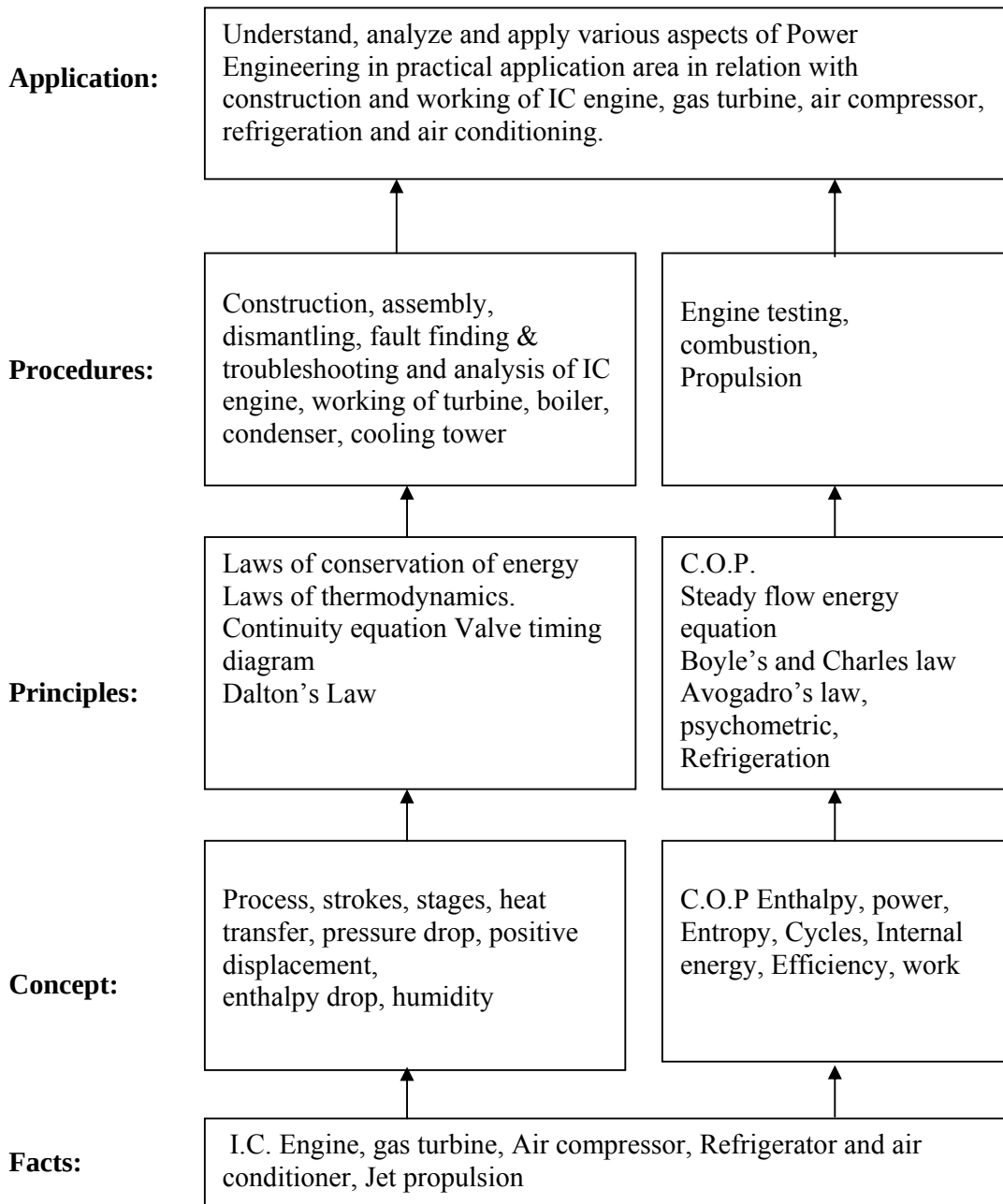
**Rationale:**

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**

| Topic and content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Hrs. | Marks |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| <b>1. I.C. Engine</b><br><b>Specific Objectives</b> <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> 1.1 Power Cycles <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> 1.2 Classification and Application of I. C. Engines. <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    |
| <b>2. I.C. Engine Testing and Pollution Control</b><br><b>Specific Objectives:</b> <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> 2.1 Engine terminology: Stroke, bore, piston speed, MEP, compression & cut-off ratio. Engine Testing - I.P., B.P. Mechanical, Thermal, relative efficiency and, BSFC, Heat Balance sheet. Morse Test, Motoring test<br>----- 10 Marks<br>2.2 List of fuel, lubricant additives and their advantages. ----- 04 Marks<br>2.3 Pollution Control ----- 10 Marks<br>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.                                                                                                   | 10   | 24    |
| <b>3. Air Compressor</b><br><b>Specific Objectives</b> <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> 3.1 Introduction<br>Uses of compressed air, Classification of air compressors, Definitions of Pressure ratio, Compressor capacity, Free Air Delivered, Swept volume.<br>3.2 Reciprocating Air Compressor ----- 10 Marks<br>Construction and working of single stage and two stage compressor<br>Efficiency: Volumetric, Isothermal and Mechanical<br>Advantages of multi staging, Intercooling and after cooling.<br>3.3 Rotary Compressor ----- 10 Marks<br>Construction and working of screw, lobe, vane, (No Numericals)<br>Comparison and applications of reciprocating and rotary compressors<br>Purification of air to remove oil, moisture and dust, Methods of energy saving in air compressors. | 10   | 20    |
| <b>4. Gas Turbine And Jet Propulsion</b><br><b>Specific Objectives</b> <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>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 8    | 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<br>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><br>Specific objectives: <ul style="list-style-type: none"> <li>➤ To describe the components and application of vapour compression system.</li> <li>➤ Describe psychometric processes and air conditioning systems.</li> </ul>                                                                                                                                                                     |           |            |
| 5.1 Refrigeration ----- 08 Marks<br>Tonnes of Refrigeration, coefficient of performance.<br>Vapour compression system, Vapour compression refrigeration cycle<br>Subcooling and superheating, representation on p-h, T-S diagrams.<br>Basic components of Vapour Compression Cycle, their function and location. Simple vapour absorption refrigeration system.<br>Applications- Water cooler, Domestic refrigerator, Ice plant & cold storage. | 10        | 20         |
| 5.2 Psychrometry ----- 08 Marks<br>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<br>Definition and classification of Air conditioning Systems.<br>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 | Acharya Publication                       |
| 05      | P.K. Nag            | Engg. Thermodynamics       | Tata McGraw Hill 23 <sup>rd</sup> edition |
| 06      | S. K. Kulshrestha   | Thermal Engineering        | Vikas Publishing House Pvt Ltd.           |

**Course Name : Mechanical Engineering Group**

**Course Code : ME/PG/PT/MH/MI**

**Semester : Fifth for ME/PG/PT and Sixth for MH/MI**

**Subject Title : Metrology and Quality Control**

**Subject Code : 17530**

### Teaching and Examination Scheme

| Teaching Scheme |    |    | Examination Scheme |     |     |    |     |       |
|-----------------|----|----|--------------------|-----|-----|----|-----|-------|
| TH              | TU | PR | PAPER<br>HRS       | TH  | PR  | OR | TW  | TOTAL |
| 03              | -- | 02 | 03                 | 100 | 25# | -- | 25@ | 150   |

### Rationale:

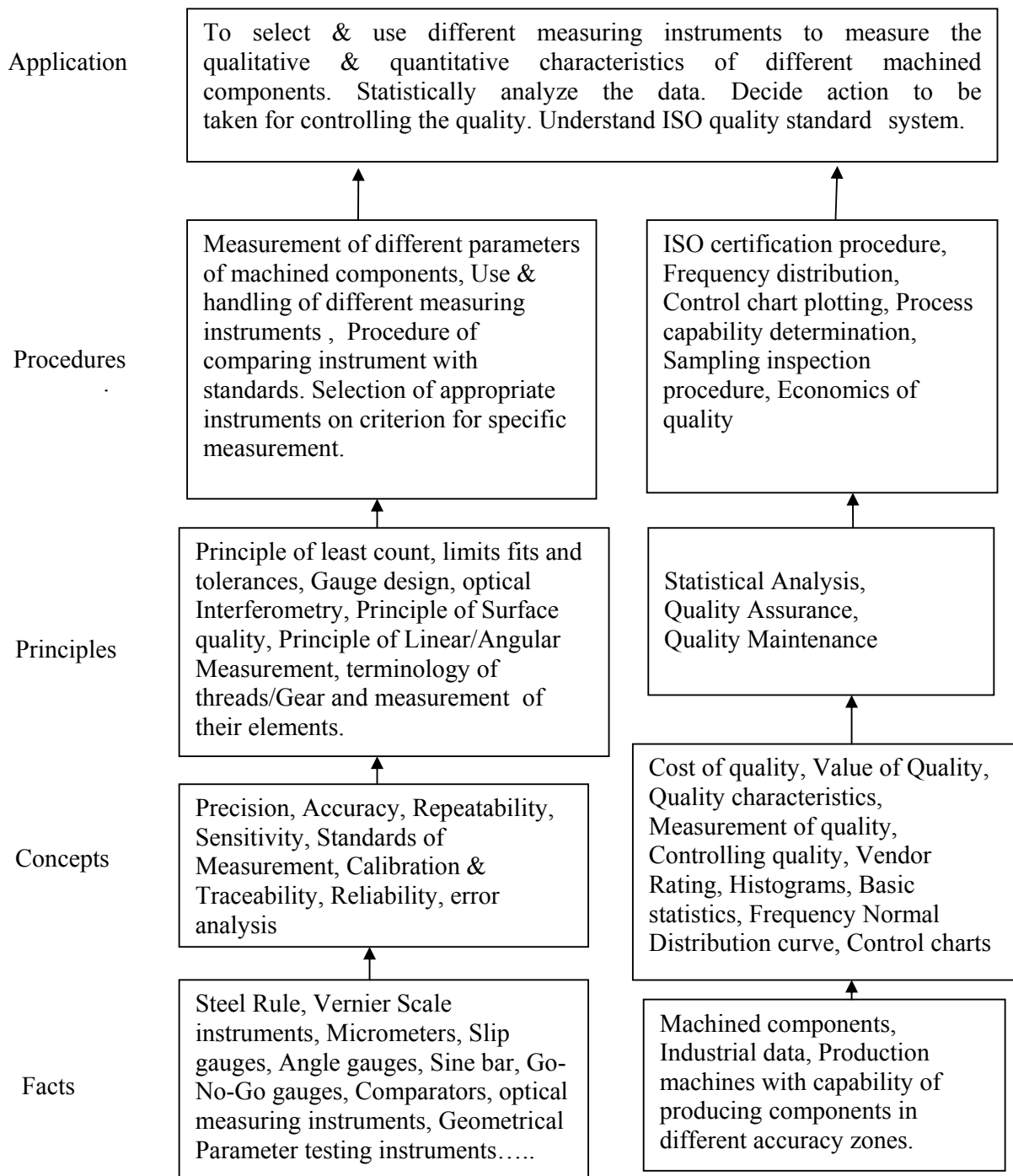
The Diploma mechanical Engineer should understand, select and use various measuring instruments as he often comes across measuring different parameters of machined components and the appropriate fitment of interchangeable components in the assemblies.

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:**

| Topic & Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Hours | Marks |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| <b>1. Introduction to Metrology</b><br><b>Specific Objectives</b> <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> <b>1.1 Metrology Basics</b> 06 Marks<br>Definition of metrology, objectives of metrology, Categories of metrology, Scientific metrology, Industrial metrology, Legal metrology, Need of inspection, <b>Revision of</b> --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 ( <b>No questions to be set on revision</b> ).<br><br><b>1.2 Standards and Comparators</b> 12 Marks<br>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. | 09    | 18    |
| <b>2. Limits, Fits, Tolerances and Gauges</b><br><b>Specific Objectives</b> <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> <b>2.1</b> 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 & Tolerances, Gauges IS 3477-1973), Study of relation gauges, concept of multi gauging and inspection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 06    | 08    |
| <b>3. Angular Measurement</b><br><b>Specific Objectives</b> <ul style="list-style-type: none"> <li>To understand the basics of angular measurement and measure angles using different instruments.</li> </ul> <b>3.1</b> 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 04    | 08    |
| <b>4. Threads and Gear Metrology</b><br><b>Specific Objectives</b> <ul style="list-style-type: none"> <li>To Understand &amp; use various methods of calculating thread elements and elements of gear tooth</li> </ul> <b>4.1 Screw thread Measurements</b> 08 Marks<br>ISO grade and fits of thread, Errors in threads, Pitch errors,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 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</p> <p>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></p> <p><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</p> <p>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</p> <p>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></p> <p><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</p> <p>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</p> <p>Principles and concept of total quantity management.</p> <p>a) Quality Audit: Concept of audit practices, lead assessor certification.</p> <p>b) Six sigma: Statistical meaning, methodology of system Improvement.</p> <p>c) Introduction of ISO 9001-2008. ISO-14000 and TS 16949.</p> | 07 | 12 |
| <p><b>7. Statistical Quality Control</b></p> <p><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</p> <p>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,<br>Rejection area, Statistically capable and incapable processes<br><b>7.2 Acceptance Sampling</b> 08 Marks<br>Concept, Comparison with 100% inspection, Different types of sampling plans, sampling methods, merits and demerits of acceptance sampling.<br>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 ( $\bar{X}$ -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 : All Branches of Diploma in Engineering & Technology**

**Course Code : EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/ CO/CM/IF/EE/EP/CH/PS/CD/ED/EI/CV/FE/FG/IU/MH/MI/TX/TC/DC/AU**

**Semester : Fifth for EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/CO/CM/IF/EE/EP/CH/PS/AU and Sixth for CD/MH/IU/CV/FE/FG/MI/ED/EI/DC/TC/TX**

**Subject Title : Behavioural Science**

**Subject Code : 17075**

**Teaching and Examination Scheme:**

| Teaching Scheme |    |    | Examination Scheme |    |    |      |      |       |
|-----------------|----|----|--------------------|----|----|------|------|-------|
| TH              | TU | PR | PAPER<br>HRS       | TH | PR | OR   | TW   | TOTAL |
| 01              | -- | 02 | --                 | -- | -- | 25 # | 25 @ | 50    |

#### **Rationale:**

With increased globalization and rapid changing business expectations, employers are looking for wide cluster of skills to cater to the changing demand. Personality traits and soft skills are playing a key role in a student's career in this changing scenario. Corporate houses look for soft skills that supplement hard skills.

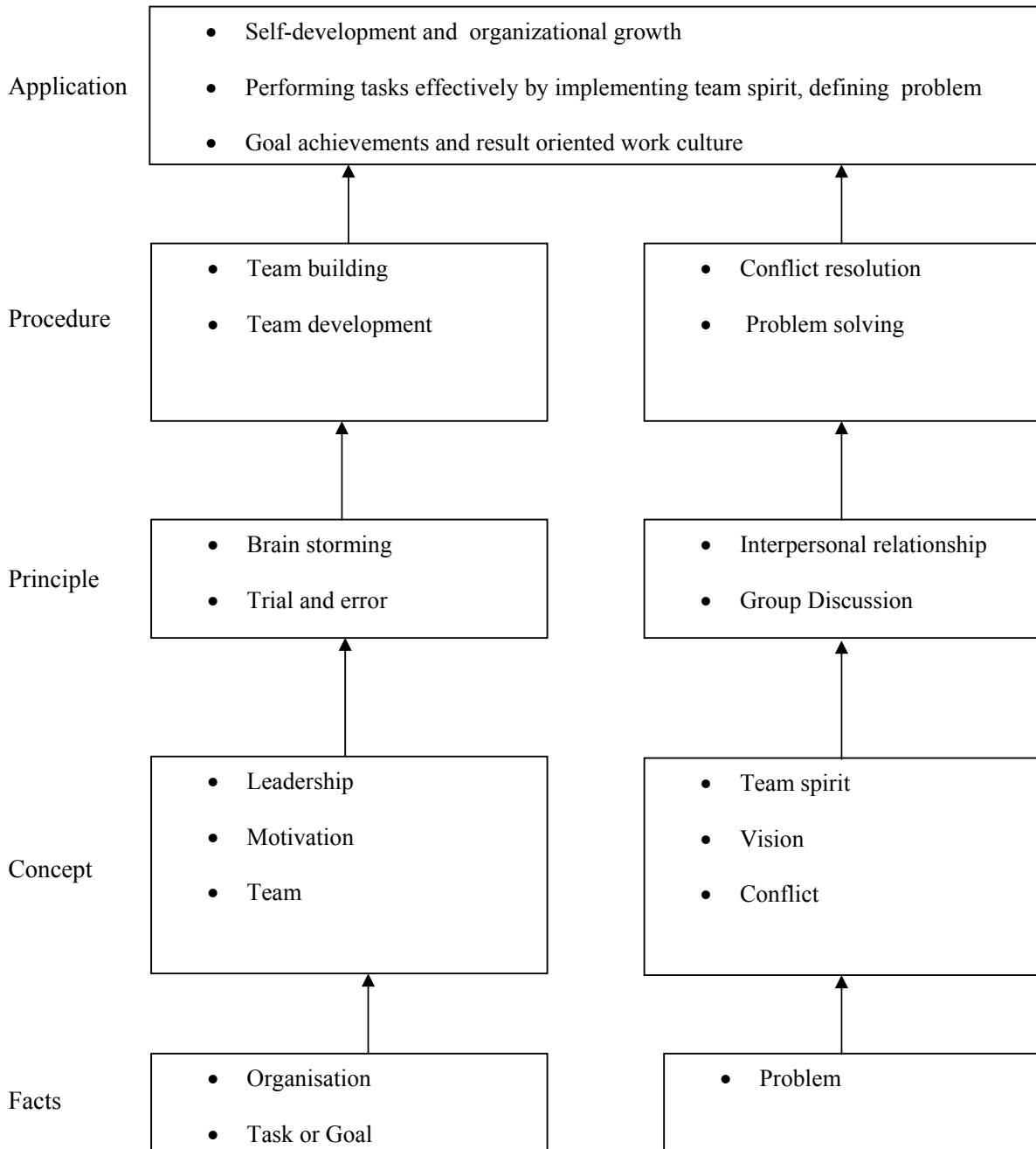
Addition of behavioural science in curriculum is intended to enhance the efficiency of a person so that he can contribute to overall growth of organisation. It aims at developing insight into leadership, team building, motivation, interpersonal relationship, problem solving, decision making and aspects of personality in a technician's profile. Addition of the topic of organizational culture will further mould him/ her in the organisational role.

This subject of 'Behavioural Science' provides a broad base in which a technician can develop a successful career in the world of work.

#### **General Objectives:**

After studying this subject, the students will be able to:

1. Develop him/her as Team leader.
2. Use self-motivation and motivate others.
3. Build a team and develop team spirit among the team members.
4. Improve the interpersonal relationship skills.
5. Learn Problem solving and decision making skills.
6. Discuss a particular topic in a group and face the interview.

**Learning Structure:**

**Theory:**

| Topic and Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Hours |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <b>Topic 1: Leadership</b><br>1.1 Management Education-History, Development, Importance, Areas of specialization, need and importance of behavioural science<br>1.2 Meaning and Types of Leaders, Qualities of leader, Examples<br>1.3 Leadership- Definition, importance, leadership in various organizations<br>1.4 Leadership styles-task -people matrix. Persuasive, Authoritative, Democratic, Delegative Leadership styles. Maturity of followers, situational leadership                                                 | 02    |
| <b>Topic 2: Motivation</b><br>2.1 Meaning<br>2.2 Importance of Motivation<br>2.3 Types of Motivation- Intrinsic, Extrinsic, Examples<br>2.4 Maslow's motivation theory- pyramid of needs, individual and industrial applications<br>2.5 Tips for Motivation                                                                                                                                                                                                                                                                     | 02    |
| <b>Topic 3: Emotional Intelligence</b><br>3.1 Major concepts - emotion, families of emotion, components of emotional expressions<br>3.2 Emotional intelligence, cognitive intelligence<br>3.3 Basic emotional competencies                                                                                                                                                                                                                                                                                                      | 02    |
| <b>Topic 4: Team Building</b><br>4.1 Team- Need, Definition, Difference between group and team<br>4.2 Characteristics of a good team<br>4.3 Steps in team formation- forming, norming, storming, performing, adjourning<br>4.4 Roles of team members<br>4.5 Characteristics of a good team member<br>4.6 Types of teams-Work, mgmt, cross functional, quality circle, self-managed team                                                                                                                                         | 03    |
| <b>Topic 5: Conflict Resolution</b><br>5.1 Definition, types (interpersonal, intrapersonal, groups), indicators of conflicts<br>5.2 Sources of conflict - ego, poorly defined authority and responsibility, power, interests, greed, difference in value system, complex work situations<br>5.3 Skills for conflict resolution<br>5.4 Steps in conflict management -Mapping of conflict, negotiation- steps in negotiation,<br>5.5 Styles of conflict management- collaborating, competing, cooperating, avoiding, compromising | 03    |
| <b>Topic 6: Decision Making</b><br>6.1 Importance of decision making<br>6.2 Definition Characteristics of good decision<br>6.3 Characteristics of good decision                                                                                                                                                                                                                                                                                                                                                                 | 02    |

|                                      |                                                                                                                             |           |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------|
| 6.4                                  | Types of decisions- programmed, non programmed, strategic, tactical, impulsive                                              |           |
| 6.5                                  | Group decision making                                                                                                       |           |
| 6.6                                  | Steps of decision making                                                                                                    |           |
| <b>Topic 7: Interview Techniques</b> |                                                                                                                             |           |
| 7.1                                  | Job search opportunities                                                                                                    |           |
| 7.2                                  | Development of résumé' and cover letter- essentials of a good résumé', contents of Résumé', layout of résumé', cover letter |           |
| 7.3                                  | Group discussion- objectives, do's and don'ts for effective participation, evaluation parameters, suggested topics          |           |
| 7.4                                  | Psychometric tests- Aptitude test, guidelines for preparations for aptitude test, Personality test                          |           |
| 7.5                                  | Personal interview-guidelines for preparing for job interviews, common questions                                            |           |
| <b>Total</b>                         |                                                                                                                             | <b>16</b> |

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

- Develop ability to find his strengths
- Select proper source of information.
- Follow the technique of time and stress management.
- Set the goal.

**Motor Skills:**

- Follow the presentation of body language.
- Work on internet and search for information.
- Prepare slides / transparencies for presentation.

**List of Assignments:**

|    |                                                                                                                                   |
|----|-----------------------------------------------------------------------------------------------------------------------------------|
| 01 | Case study: Employee motivation and leadership.                                                                                   |
| 02 | To build a tower from a given material as a team activity                                                                         |
| 03 | To prepare Jigsaw puzzles (common shapes) from the given jigsaw pieces as a team.                                                 |
| 04 | Case study on conflict Resolution                                                                                                 |
| 05 | Assess your style of conflict resolution                                                                                          |
| 06 | Decision making activity: of Selection of the best suitable company.                                                              |
| 07 | Participate in a guided group discussion                                                                                          |
| 08 | Assessment of self-aptitude in numerical computation, estimation, data interpretation, mechanical, spatial and abstract reasoning |
| 09 | Assessment of self-aptitude in Verbal ability and data checking.                                                                  |
| 10 | Development of résumé' and covering letter                                                                                        |

**Note:** Subject teacher shall guide the students in completing the assignments based on above practicals.

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

| <b>Sr. No.</b> | <b>Author</b>                                      | <b>Name of Book</b>                                           | <b>Publication</b>                  |
|----------------|----------------------------------------------------|---------------------------------------------------------------|-------------------------------------|
| 1              | Subject Experts-MSBTE                              | Handbook and assignment book on Development of Life Skills-II | MSBTE                               |
| 2              | Dr. Kumkum Mukherjee                               | Principles of management and organizational behaviour         | Tata McGraw Hill Education Pvt Ltd. |
| 3              | Dr.T.Kalyana Chakravarti<br>Dr.T.Latha Chakravarti | Soft Skills for Managers                                      | Biztantra                           |
| 4              | Barun K Mitra                                      | Personality Development and soft skills                       | Oxford University Press             |
| 5              | Priyadarshini Patnaik                              | Group discussion and interview skills                         | Foundation Books                    |

**Course Name : Mechanical Engineering Group**

**Course Code : ME/PG/PT/MH/MI/FG/FE**

**Semester : Fifth for ME/PG/PT/FG and Sixth for MH/MI/FE**

**Subject Title : CNC Machines**

**Subject Code : 17064**

**Teaching and Examination Scheme:**

| Teaching Scheme |    |    | Examination Scheme |    |     |    |     |       |
|-----------------|----|----|--------------------|----|-----|----|-----|-------|
| TH              | TU | PR | PAPER<br>HRS       | TH | PR  | OR | TW  | TOTAL |
| 01              | -- | 02 | --                 | -- | 50# | -- | 25@ | 75    |

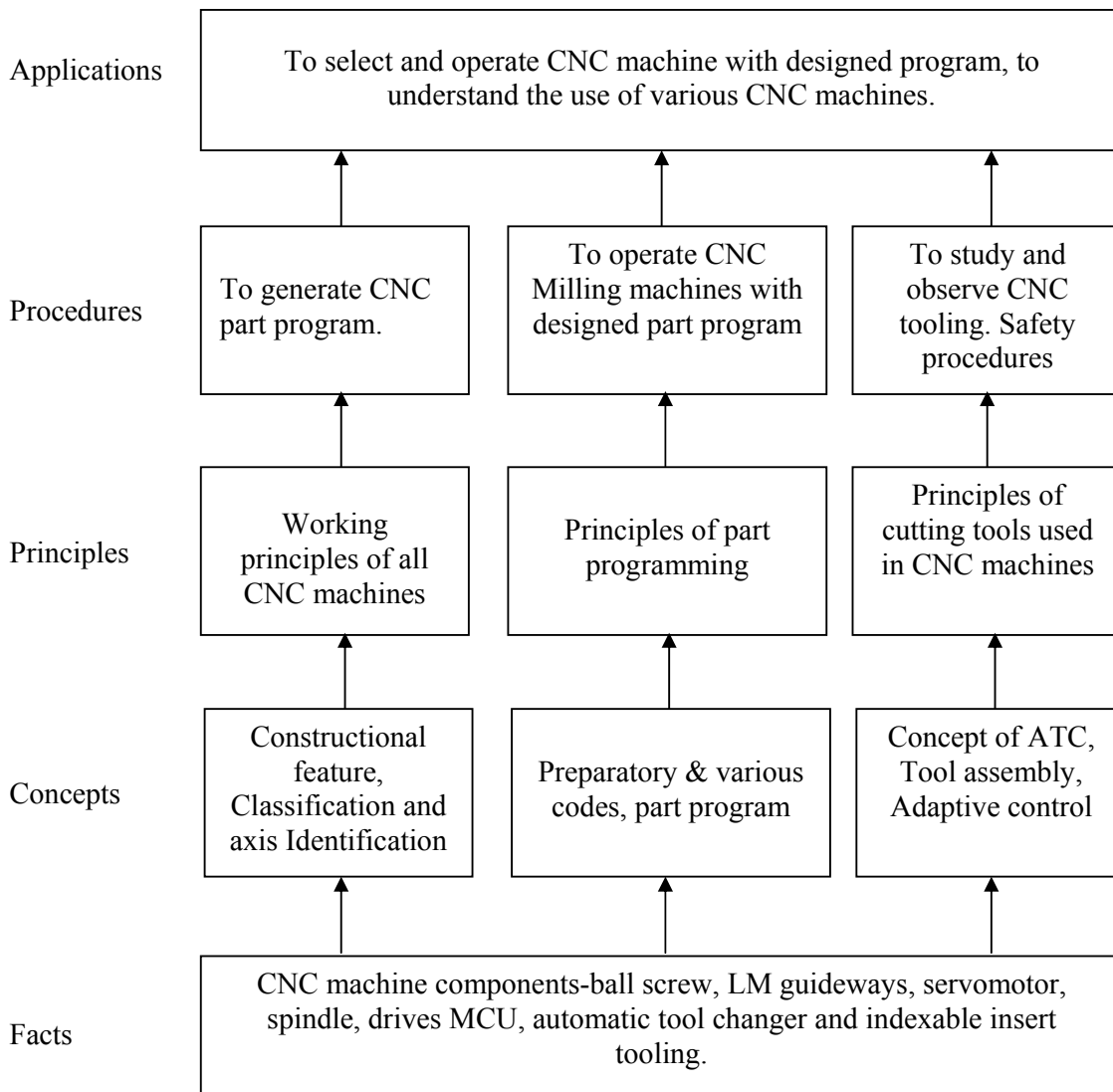
**Rationale:**

This is Technology subject which has relevance with the subjects taught earlier namely Manufacturing Processes and advanced manufacturing processes. After getting conversant with the basic manufacturing processes and production processes, it is necessary for a technician to know about the advancements in the area of manufacturing and production processes. The subject will impart knowledge & skills necessary for working in modern manufacturing demands and environment. This subject will help the student to get familiarized with working principles and operations performed on CNC machining centers, generation of part program and study tooling of CNC machine.

**Objectives:**

The student will be able to

- 1) Know different types of CNC machines,
- 2) Understand the different codes used in CNC programming.
- 3) Know the Operation and control of different CNC machine and equipments.
- 4) Adopt different tooling while working on various CNC machines.

**Learning structure:**

**Theory:**

| Topic and Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Hours |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <b>1. Introduction to CNC machines</b><br><b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ State different types and advancements in CNC machines</li> <li>➤ Describe Construction and working of CNC turn-mill center</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>1.1 Classification of CNC machines</li> <li>1.2 Axis standards and its identification.</li> <li>1.3 Construction and working of CNC turning centre, VMC and HMC</li> <li>1.4 Construction and working of CNC turn mill centre</li> <li>1.5 Construction and working of Multi- axis CNC machines</li> <li>1.6 Construction and working of Pallet type CNC machine</li> <li>1.7 Construction and working of CNC based Coordinate Measuring Machine.</li> </ul>                                                                                       | 4     |
| <b>2. Constructional features and working of CNC machines</b><br><b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ Describe construction and working of the different components, subassemblies, assemblies and peripherals of CNC machines</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>2.1 Bed and machine frame construction.</li> <li>2.2 Spindle constructional details</li> <li>2.3 Constructional details and working of ball screw and L.M. guideways.</li> <li>2.4 Various Spindle drives used in CNC machines.</li> <li>2.5 Working of Machine control unit.</li> <li>2.6 Types of lubrication systems used for CNC machines.</li> <li>2.7 Working of swarf removal arrangement.</li> <li>2.8 Working of hydraulic and pneumatic systems used for chuck, tool and pallet changing in CNC machines.</li> </ul> | 4     |
| <b>3. CNC Part programming</b><br><b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ Describe CNC part programming according to the drawing of the component</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>3.1 NC words, G codes, M codes.</li> <li>3.2 Programming format, word statement, block format.</li> <li>3.3 Tool offsets and tool wear compensation.</li> <li>3.4 Part programming containing Subroutines, Do- loops and Canned cycles.</li> <li>3.5 Introduction to Macro programming.</li> </ul>                                                                                                                                                                                                                                                                                                             | 4     |
| <b>4. Tooling for CNC machines</b><br><b>Specific objectives:</b> <ul style="list-style-type: none"> <li>➤ State types of CNC cutting tools</li> <li>➤ Describe tool presetting procedure</li> </ul> <b>Content:</b> <ul style="list-style-type: none"> <li>4.1 Introduction</li> <li>4.2 Types of CNC Cutting tools</li> <li>4.3 Types of indexable inserts with its geometry</li> <li>4.4 Construction of tool holding assembly</li> <li>4.5 Tool presetting procedure</li> <li>4.6 Working of Automatic Tool Changing (ATC) device and types of tool magazine</li> <li>4.7 Safety Procedures, alarms, fool-proof procedures.</li> <li>4.8 Online measurement of dimensions, cutting forces, Adaptive controls, communication with servers.</li> </ul>                                                                                                        | 4     |

|                                    |           |
|------------------------------------|-----------|
| 4.9 Fixtures used in CNC machines. |           |
| <b>Total</b>                       | <b>16</b> |

**Practicals:**

Skills to be developed.

**Intellectual Skills:**

- 1) To select the appropriate CNC machine for the given component.
- 2) To select the appropriate tools for the given component.
- 3) To generate programme for the given component.
- 4) To calculate the cycle time for the given component.

**Motor Skills:**

- 1) To feed the programme to CNC machine.
- 2) To conduct the programme in single block mode and dry run.
- 3) To carry out job production on CNC machine.
- 4) To carry out changes in job and carry out compensation.

**Notes:**

- 1) The College/Institute should purchase at least one CNC production machine.
- 2) The requisite time of practical mentioned in the scheme should be allotted to the students. A group of 4-5 students can handle machine for 30mins in 2 hrs. practical. Whenever students are free they can approach the lab in charge to work on machines.
- 3) Students can model components required for their project (6<sup>th</sup> sem) on 3D modeling software, thereafter if students manufacture these components on CNC machines, it is highly appreciable.
- 4) The Workshop Superintendent/ HOD should personally see that the CNC Practicals are conducted in his Institute.

**Guidelines for Practical Examination**

An examiner must prepare 6 assignments on turning and 6 assignments on milling. See that the task can be completed in 1 hr. A group of 4 students can pick up **one** assignment randomly. The group should write part programme, enter into machine, dry run and manufacture the component. Evaluation of students based on their contribution in activities shall be done by the internal as well as external examiner.

**List of practical**

1. One practical on single block mode & dry run on CNC turning center for production job part programme (Batch of 4-5 students) and verification using any simulation software.
2. One practical on single block mode & dry run on CNC milling for production job part programme (Batch of 4-5 students) and verification using any simulation software.
3. One job on CNC lathe having plain turning, taper turning, step turning, threading, boring and grooving (Batch of 4-5 students).
4. One job on CNC milling having following operations – face milling, slotting, contour machining (Batch of 4-5 students)
5. One assignment on indexable inserts used in CNC tooling with its geometrical details and ISO codes, nomenclature.
6. Conduct a practical on presetting of a milling cutter or one assignment on tool presetting procedure.
7. Visit to CNC machine (Production) shop having turning and machining centre to observe construction and working of CNC turning and vertical machining centre, write visit report and draw plant layout.

8. One assignment on CNC programming containing subroutines, do-loop and canned cycle
9. Visit to industry having CNC-CMM machine and inspect various dimensions and geometry of production component.

**List of Books**

| <b>Sr. No.</b> | <b>Author</b>            | <b>Title</b>                                  | <b>Publisher</b>                                                     |
|----------------|--------------------------|-----------------------------------------------|----------------------------------------------------------------------|
| 1              | HMT, Bangalore           | CNC Machines                                  | New age International Limited                                        |
| 2              | P. N. Rao                | CAD/CAM Principles Applications               | Tata McGraw Hill                                                     |
| 3              | Pabla B. S. & M. Adithan | CNC Machines                                  | New age International Limited                                        |
| 4              | Groover , Zimmers        | CAD/CAM Computer Aided Design & Manufacturing | Pearson                                                              |
| 5              | HMT, Bangalore           | Mechatronics                                  | Tata McGraw Hill                                                     |
| 6              | Chougule N. K.           | CAD/CAM/CAE                                   | Scitech Publication Pvt. Ltd.                                        |
| 7              | Binit Kumar Jha          | CNC Programming Made Easy                     | Vikas Publishing House Pvt. Ltd. New Delhi.<br>Revised Edition 2010. |

Note: Practice of Programming is required for students using Simulation Software

**Course Name : Mechanical Engineering Group**

**Course Code : AE/ME/PG/PT/MH/MI**

**Semester : Fifth for AE/ME/PG/PT/FG and Sixth for MH/MI/FE**

**Subject Title : Professional Practices-III**

**Subject Code : 17065**

**Teaching and Examination Scheme:**

| Teaching Scheme |    |    | Examination Scheme |    |    |    |     |       |
|-----------------|----|----|--------------------|----|----|----|-----|-------|
| TH              | TU | PR | PAPER<br>HRS       | TH | PR | OR | TW  | TOTAL |
| --              | -- | 03 | --                 | -- | -- | -- | 50@ | 50    |

**Rational:**

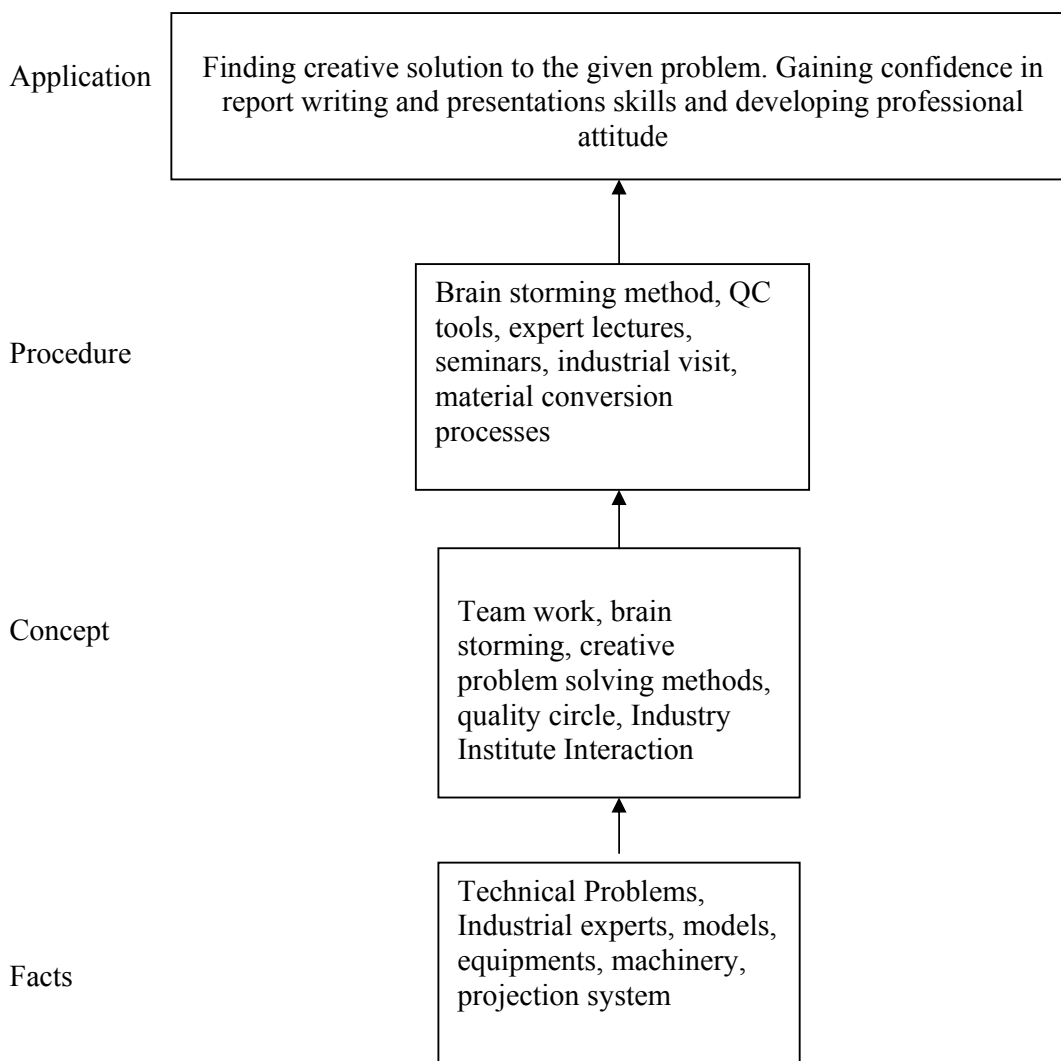
Overall professional development of diploma mechanical engineers is the need of the day for enabling them to sustain in competitive global environment.

Professional development of Diploma engineering students is to be done by exposing them to various simulative situations in the industries. This can be achieved by inculcating attitude to face the problems, get alternative solutions and validation of the selected alternatives. This is achieved by involving students in activities such as inviting experts from various industries for sharing their experiences, arranging industrial visits, quality circles, seminars and mini projects activities etc.

**General Objectives:**

Student will be able to:

1. Identify, select and solve the problems.
2. Acquire information from different sources.
3. Prepare technical report and present seminar using power projection system.
4. Interact with peers to share thoughts.
5. Make them work with their own hands.
6. Work in a team and develop team spirit.

**Learning Structure**

**Contents:**

| Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Practical Hours |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <p><b>1. Idea Generation for final semester Project selection:</b></p> <p>The student should use innovation principles for Idea generation .These ideas should lead to selection of Project. Head of Department should allot the project guides for the activity and form groups of four students per project.</p> <p>Following are some of the guidelines for projects selection.</p> <ul style="list-style-type: none"> <li>• Development of working models.</li> <li>• Development of attachments to machine tools.</li> <li>• Reconditioning of existing equipments, machines in the Institute.</li> <li>• Industrial Problem Solving.</li> <li>• Interdisciplinary Projects.</li> <li>• Use of Non conventional Energy sources.</li> <li>• Use of appropriate technology.</li> <li>• Agro based projects to reduce drudgery of farmers.</li> <li>• Ergonomic equipments</li> <li>• Jig, fixtures, dies, special purpose tools</li> <li>• Any project on Low Cost Automation</li> <li>• Automation Problems in industries</li> <li>• Experimental setups required in laboratories for measurement of parameters and component performance.</li> <li>• Any other project suitable for Industry and Institute.</li> </ul> <p><b>Note:-</b> The project group should submit their progress report, activity planning, any preliminary calculations to evaluate the project to be submitted at the end of the semester.</p> <p>The student should submit a report for the project which will have proportional weightage in the term work</p> | 06              |

**2. Industrial Visits**

Structured industrial visits be arranged and report of the same shall be submitted by the individual student, to form a part of the term work.

Following are the suggested types of Industries/ Fields. The subject teacher(s) have liberty to select nearby organization/industry

- Automobile manufacturing / press component / auto component manufacturing units to observe the working of SPM / Non Conventional Manf process / CNC / FMS / Robots
- Refrigeration and air conditioning manufacturing / servicing units / industries / workshops
- Automobile service stations for four wheelers/Wheel Balancing unit for light and/or heavy motor vehicles/exhaust gas analysis and vehicle testing / PWD / ST workshop.
- Co-ordinate measuring machine to observe its construction working specifications and applications.
- Engine Testing unit to gather details regarding the testing procedures/parameters etc.
- Food processing/ Dal mill/ Oil Mill/ Automated bakery unit.
- Textile industry / Textile machinery manufacturing / garment manufacturing / embroidery / textile printing and dyeing units.
- Hydro electric and Thermal power plants.
- Automotive Research Association of India, Pune, Central Institute of Road Transport, Pune, Vehicle Research and Development establishment, Ahmednagar.
- Safety museum at Central Labour Institute, Sion, Mumbai
- Common Facility Center by MSME, GOI.
- Auto Cluster projects of MSME, GOI.
- CIPET and IGTR Aurangabad
- Tyre retreading, paint manufacturing, foundries, forging unit, heavy fabrication unit, steel and wooden furniture manufacturing
- Agricultural equipments manufacturing units.
- Hardware and Machinery stores selling agro equipments
- Plastic injection molding, extrusion, blow molding.
- Stone crushers / hot mix plant/ service stations of JCBs and other earthmoving equipments
- Note:- One Industrial visits be arranged per practical batch of students.

06

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| <p><b>3. The Professionals/ Industrial Expert Lecture/s</b></p> <p>Experts / Professionals from different field/industries are invited to deliver lectures of 2 Hrs. duration at least TWO occasions. The topics may be selected by the teacher / industry expert to develop required skills .The following topics may serve guidelines.</p> <ul style="list-style-type: none"> <li>• Vehicle testing. Vehicle aerodynamics &amp; design.</li> <li>• Modern automobiles systems, Hybrid motor vehicles, electric vehicles, MPFI, ABS etc.</li> <li>• Environmental pollution &amp; control, Automobile pollution, norms, act.</li> <li>• Earth moving machines.</li> <li>• Biotechnology</li> <li>• Nanotechnology</li> <li>• CAD, CAM, Computer Integrated Manufacturing, Material resources planning, Enterprise resources planning</li> <li>• Product design and modeling, Rapid prototyping</li> <li>• Programmable logic controllers, Automation, Robotics, Automated Guided Vehicles, Non industrial robots,</li> <li>• TQM, 5S, JIT, KAIZEN, Lean Manufacturing., World class Manufacturing, Pokayoke, Total Productive Maintenance, Six Sigma.</li> <li>• Packaging technology</li> <li>• Appropriate technology</li> <li>• LPG / CNG conversion kit.</li> <li>• Current HR Policies, Labor Act.</li> <li>• ISO implementation,</li> <li>• Import – Export policies and procedures, Taxation.</li> <li>• IPO, Mutual Fund, FPO, Share- Commodity trading and Investment.</li> <li>• Role of Insurance, Value Assessors in industry and society, Vehicle valuers,</li> <li>• Trends in modern agriculture engineering</li> <li>• Sustainable development, Green Environment, Solar and alternative fuels, Rain water harvesting, Disaster management.</li> <li>• Innovation Principles.</li> <li>• Opportunities in software industries.</li> <li>• Supply chain management. E-commerce.</li> <li>• Energy Audit.</li> <li>• Road Safety, Road Signs, Prevention of accidents on Roads, First aid.</li> </ul> <p><b>Note:</b> The brief report to be submitted on these lectures by each student as a part of Term work</p> | 06 |
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| <p><b>4. Students Quality Circles:</b><br/>The students should form Quality Circles consisting of group of six to eight students and brain storm on various problems faced by students, use QC tools to find root causes and alternative solutions.</p> <p>Following are some of the problems undertaken by students Quality Circle -<br/>Poor vocabulary of Diploma Engineering students<br/>Poor practical skills of Diploma Engineering students<br/>Poor Journal preparation of Diploma Engineering students<br/>Poor Entrepreneurial abilities of Diploma Engineering students<br/>Students and teacher can select different problems according to their priorities. The students should prepare QC register and Case Study presentation. Present this case study in the class.</p> <p>Such Quality Circles can participate in State level and National Level Conventions organized by Quality Circle Forum of India. For additional information visit website <a href="http://www.qcfihq.com">www.qcfihq.com</a></p> | 12        |
| <p><b>5. Seminar :</b><br/>Seminar topic may be related to the subjects of fifth semester / topics from guest lectures. Students shall submit a report of at least 5 typed pages (font size 12 all Margins 1" A4 size) (Presentation time – 10 minutes per student)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 06        |
| <p><b>6. Mini Projects : (in a group of 4-5 students)</b></p> <p>Students can choose any mini project of their interest. Mini Projects means a short term project which may be completed in 2 to 3 months and with a limited scope. Suggestive topics for guidance are as follows :<br/>CNC Programming and manufacturing, Advanced mechanism, Model making--conveyors, agro equipments, wax/ thermocol prototypes, factory layouts, string diagrams,. Standard Operating Procedures for various machines<br/>Students and teachers are free to select any techno-viable mini project.</p> <p>Students shall arrange exhibition of all mini projects in the class/hall and present the task to the audience/ experts/examiners. The student shall submit a brief report (Max. 5 pages) of the mini project.</p>                                                                                                                                                                                                            | 12        |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>48</b> |

**Students not opting for Industrial Training have to complete the work assigned under various components of Professional Practices as mentioned above. This work will be assessed as term work for professional practices with marks given out of 50.**

**For Students completing industrial training after IV<sup>th</sup> semester for four week the assessment will be done as per the guidelines given below:**

**Guidelines for assessment of Industrial Training report and seminar are given below:**

**Note:**

For the students who have undergone industrial training of four weeks duration in the summer vacation of fourth semester will be assessed as follows:

1. Industrial Training report duly certified by competent authority in the industry: **20 Marks**

2. Seminar on industrial training:  
3. Mini project as mentioned above

**15 Marks****15 Marks****Learning Resources:****1. Books:**

| Sr. No. | Author                               | Title                                                                                                               | Publisher                                                                                                         |
|---------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| 01      | NRDC, Publication Bi Monthly Journal | Invention Intelligence Journal                                                                                      | National Research Development Corporation, GOI.                                                                   |
| 02      | DK Publishing                        | How things works encyclopedia                                                                                       | DK Publishing                                                                                                     |
| 03      | QCFI Publication, Secunderabad       | Quality Circle Concepts and Implementation,<br>5S,<br>KAIZEN<br>6 SIGMA<br>TRIZ<br>TQM<br>SPC<br>TPM<br>SMED<br>ERP | QCFI Publication, Secunderabad<br>Visit website<br><a href="http://www.qcfihq.com">www.qcfihq.com</a> for details |
| 04      | Paul Trott                           | Innovation Management and New Product Development 4 <sup>th</sup> Ed.(2008)                                         | Pearson Education                                                                                                 |
| 05      | Joe Tidd                             | Managing Innovation,3rd Ed.                                                                                         | Wiley India                                                                                                       |

**2. CD-ROM:**

Federation of Indian Chambers of Commerce and Industries (FICCI) has developed 7 internationally acclaimed CD-ROM titles on various aspects of Quality Management & Business Excellence, which enable the organizations in achieving their 'mission critical objectives' in a cost-effective manner.

- Developing continuous improvement as an organizational strategy.
- Strategies for becoming a customer driven organization.
- Six Sigma - A breakthrough strategy.
- Seven steps to World Class Manufacturing.
- Maximizing business results and competitive advantages.
- Concise Encyclopedia of Business Excellence.
- Developing a passion to excel.

For more details log on to: [www.ficci.com/fqf03/index.htm](http://www.ficci.com/fqf03/index.htm)

**3. Web Sites:**

[www.start2think.com](http://www.start2think.com)  
[www.Innovationgoldmine.com](http://www.Innovationgoldmine.com)  
[www.engineeringforchange.org](http://www.engineeringforchange.org)  
[www.qcfihq.com](http://www.qcfihq.com)  
[www.wikipedia.com](http://www.wikipedia.com)  
[www.slideshare.com](http://www.slideshare.com)  
[www.teachertube.com](http://www.teachertube.com)