


|  MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES | | | | | | | | | | | | | | | | |
|--|------------------------------------|--------------|----------|-----------------|-----------|-----------|--------------------|------------|-----------|---------------------------------|-----------|-----------|-----------|------------|-----------|------------|
| 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 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, No Theory Examination, \$ - Common to all branches, #* - Online Examination, β - Common to AE, PG, PT 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 HRS | TH | PR | OR | TW | TOTAL |
| 03 | -- | 02 | 03 | 100 | -- | -- | 25@ | 125 |

NOTE:

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

Rationale:

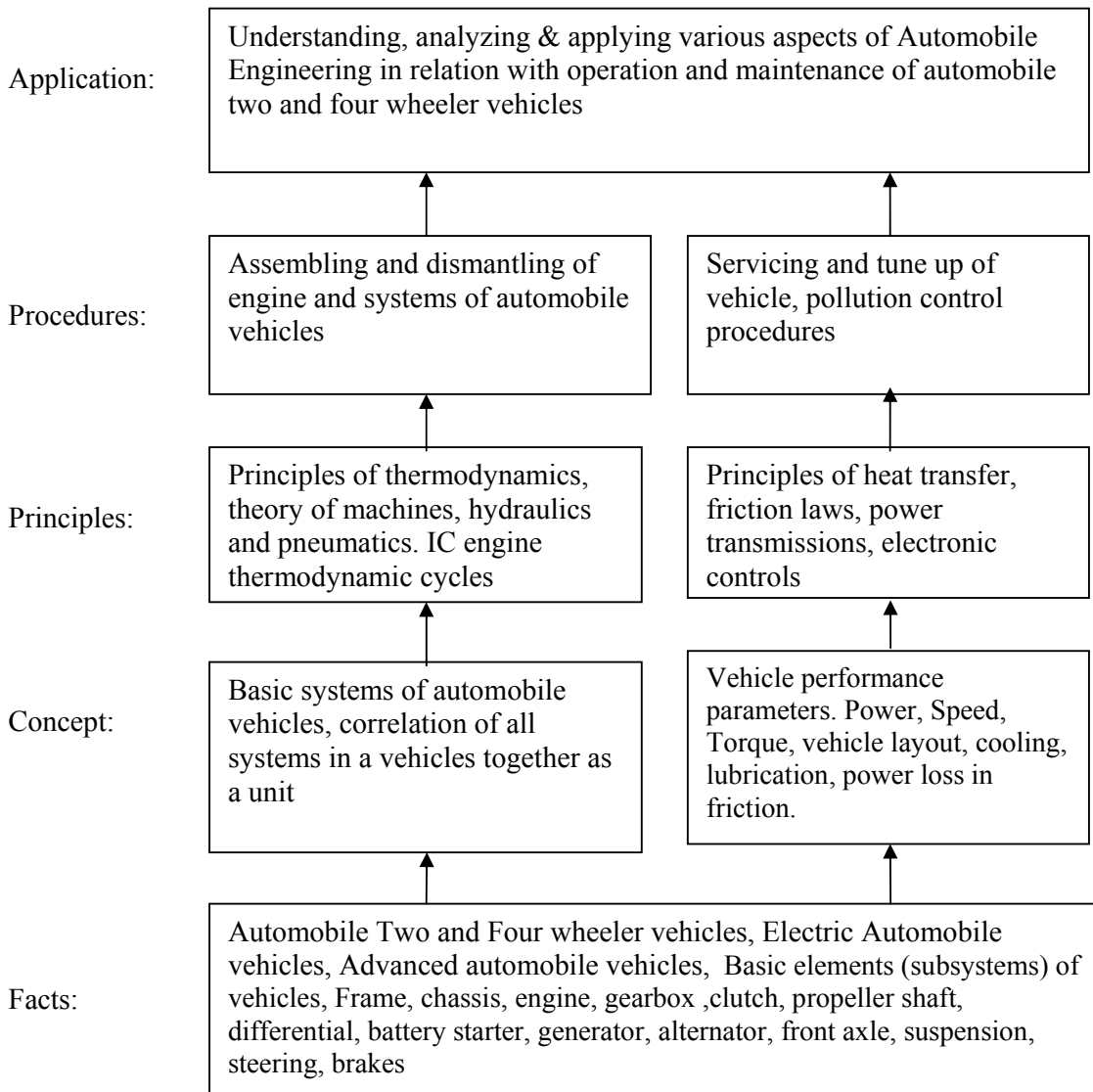
Automobile vehicles a now days are the inseparable part of modern life. The whole progress of the world is based on the development of modern automobiles. The diploma engineers must know about the principles of working, construction, maintenance of automobiles. Different types of vehicles and their capacities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

General Objectives:

Students will be able to:

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

Learning Structure:



Theory:

| Topics and Contents | Hours | Marks |
|---|-------|-------|
| <p>1. Introduction to Automobiles.</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ➤ Draw the vehicle layouts ➤ Understand the concept of aerodynamic shape of vehicle. ➤ State the concept of aerodynamic aspects <p>Contents:</p> <p>1.1 Classification of automobile vehicles, types of automobile vehicles.</p> <ul style="list-style-type: none"> ➤ Two and four wheeler chassis layout of an automobile vehicle, automobile body types, ➤ 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. ➤ Aerodynamic body shapes & advantages <p>1.2 Types of automobile power plants such as petrol engine, diesel engine, gas operated (LPG, CNG), electric power plants, hybrid power Plants (Intorductionary level).</p> | 08 | 16 |
| <p>2. Transmission Systems:</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Describe transmission system of automobiles and their components ➤ Describe suspension systems and components <p>Content:</p> <p>2.1 Need and Requirements of transmission system. Its components and their functions.</p> <p>2.2 Clutch: Function and purpose of clutch, types and construction of clutches as coil spring type and diaphragm type</p> <p>2.3 Gear box- 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 Propeller shaft types and construction, functions of universal and slip joints.</p> <p>2.5 Differential - need, construction and working, differential action and operation</p> <p>2.6 Axle – Hotchkiss and torque tube drives, Rear- full floating axle, semi floating and three quarter floating axle. Front axle.</p> | 10 | 20 |
| <p>3. Control Systems:</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ➤ State steering geometry and requirements ➤ Describe Braking system of automobiles. <p>Content:</p> <p>3.1 Steering System: 08 Marks Purpose of steering system, construction and working of - recirculating ball type and rack and pinion. Wheel Geometry- caster, camber, king pin inclination, Toe In and Toe Out. Power steering (introductory).</p> <p>3.2 Braking System: 10 Marks 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"> ➤ Hydraulic braking systems: Layout & components of hydraulic braking systems ➤ Construction and working of master cylinder and wheel cylinder. ➤ Drum braking system, Disc Braking Systems ➤ Air braking system: layout and working | | |
| <p>4. Suspension Systems, Wheels and Tyres</p> <p>4.1 Necessity and Classification of Suspension System 10 Marks Front and rear suspension system construction and working of Wishbone type, Mac Pherson type, Trailing link type, coiled springs, leaf spring and shock absorbers, air suspension system.</p> <p>4.2 Wheels and Tyres 08 Marks types of wheel-spoked, disc, light alloy cast. Types of rims. Tyres-Desirable properties, types-radial ply, cross ply, tubeless. Tyre specifications. Factors affecting tyre life. Wheel alignment and balancing.</p> | 08 | 18 |
| <p>5. Electrical Systems:</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Sketch and describe battery constructional details ➤ Describe charging system ➤ Describe starting system and lighting system <p>Content:</p> <p>5.1 Battery: 08 Marks Automotive battery construction and operation, battery capacity, Battery ratings, Battery tests Charging System : Need of charging system, Construction and operation of charging system, Alternator principle, construction and working</p> <p>5.2 Starting System : 04 Marks Need of starting system, layout, construction of starting motor, Bendix drive</p> <p>5.3 Lighting System : 04 Marks Layout of lighting system of two wheeler and four wheeler, Wiring harness, cable color codings</p> <p>5.4 Ignition System and their Components 04 Marks Battery, magneto, electronic ignition system.</p> | 10 | 20 |
| <p>6. Automobile Air conditioning System.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand concept of air conditioning system ➤ Appreciate the various parameters of air conditioning ➤ Locate various components of air conditioning systems in a vehicle <p>Introduction, layout of car air conditioning system, components of a system, working of a system, parameter control (Humidity, temperature, purity of air) required. Important precautions while using AC system.</p> | 04 | 08 |
| Total | 48 | 100 |

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
 - www.hyundai.co.in
 - www.india.ford.com
 - www.marutisuzuki.com
 - 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 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:

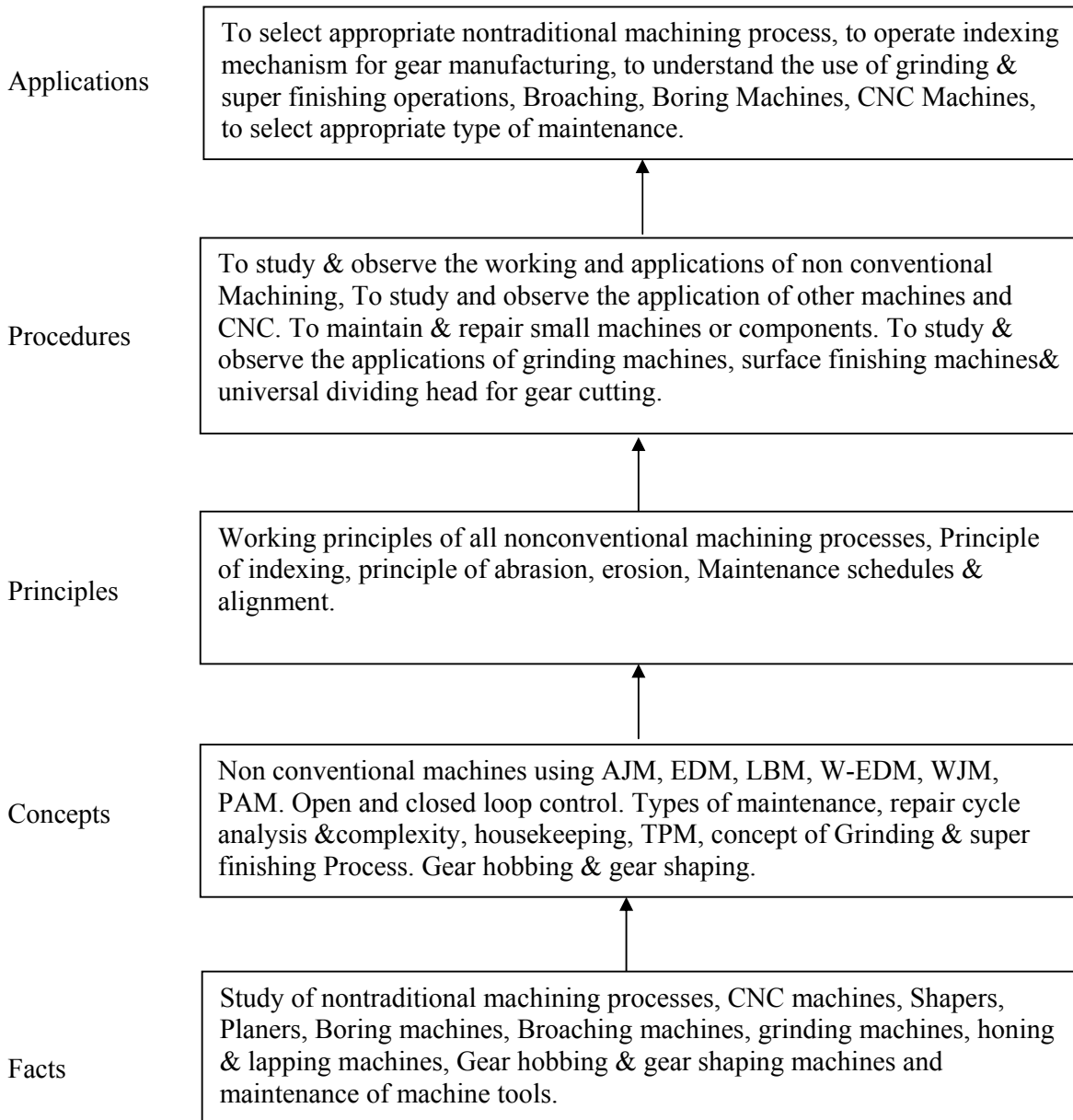
This is a advanced technology subject which is to be taught, after getting conversant with the basic manufacturing processes. It is necessary for a diploma engineer to know about the advancements in the area of manufacturing processes. This subject will impart knowledge & skills necessary for working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

| | | |
|---|-----------|------------|
| Content | | |
| 5.1 Grinding Machines 08 Marks 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. | | |
| 5.2 Super Finishing 06 Marks Methods of surface finishing like honing, lapping, burnishing, polishing and buffing - setup, working, advantages, limitations and applications. | | |
| Topic 6. Maintenance of Machine Tools: Specific Objectives ➤ Know the maintenance methods and procedures. | | |
| Content 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 |
| Total | 48 | 100 |

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 HRS. | TH | PR | OR | TW | TOTAL |
| 03 | -- | 02 | 03 | 100 | -- | -- | 25@ | 125 |

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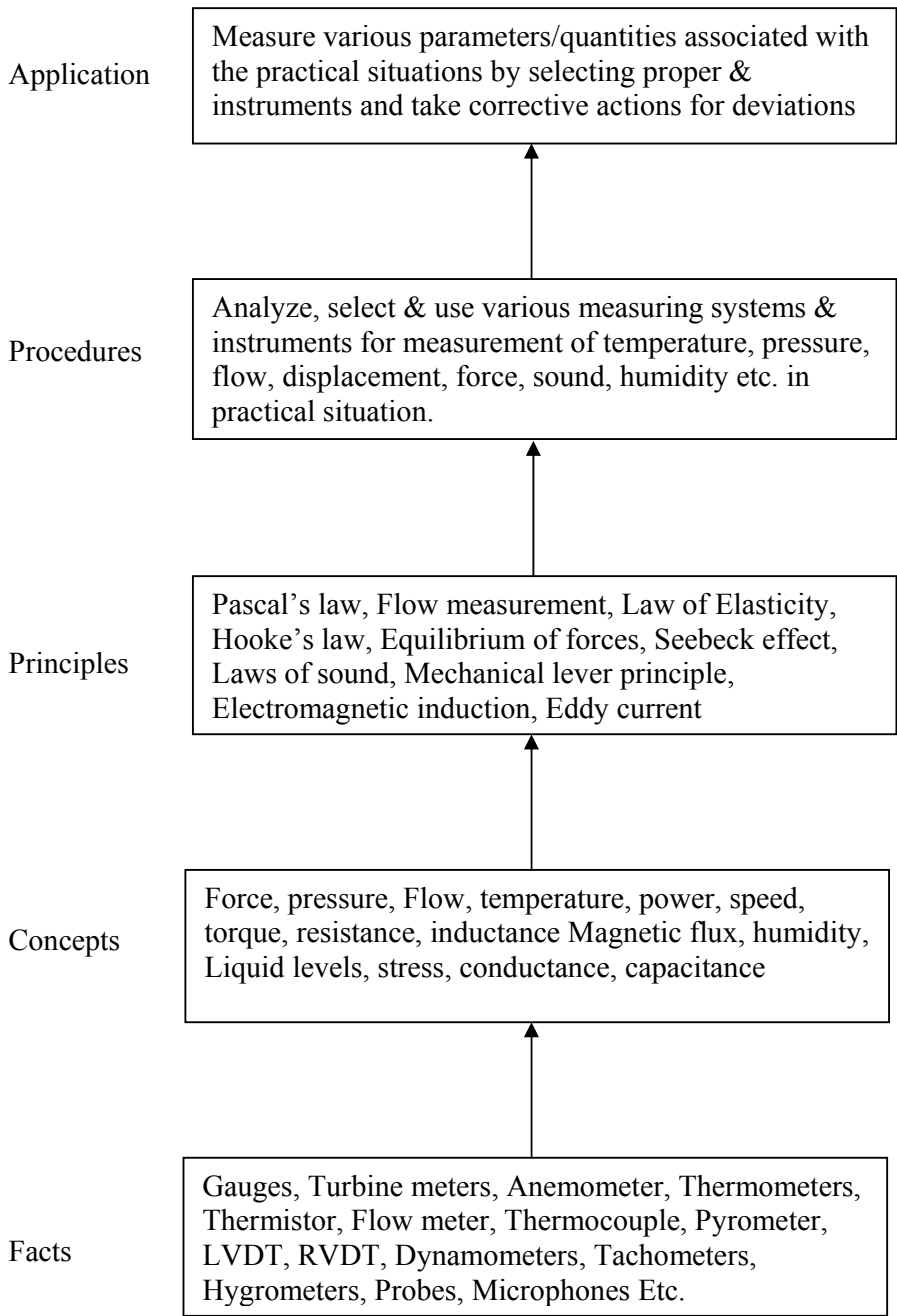
The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid strides, with many types of instrumentation devices, innovations, refinements. The course aims at making a Mechanical Engineering student familiar with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

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

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

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 Understand the methods of measurements and instrument characteristics with demonstration of any one measuring device.
- 2 Displacement measurement by inductive transducer (LVDT)
- 3 Measurement of negative pressure using McLeod gauge / Bourdon tube pressure gauge. Conversion of pressure in different units.
- 4 Measurement of temperature by using Thermocouple.
- 5 Measurement of flow by using rotameter.
- 6 Measurement of strain by using a basic strain gauge and verify the stress induced.
- 7 Speed Measurement by using Stroboscope / Magnetic / Inductive Pick Up.
- 8 Measurement of force & weight by using a load cell.
- 9 Liquid Level Measurement by using Capacitive Transducer system.
- 10 Study of control system with one suitable application (boiler) arranging industrial visit at sugar factory / paper mill / textiles / food processing industry.
- 11 Mini project-A group of 4 students shall take a mini project of searching information about advanced instrumentation / control system using internet and submit its report. Use of this knowledge in project (6th Sem) is highly appreciable.

- 12 Visit various departments/laboratories in own institute and understand how the measurement devices are fitted on machines/equipments, the procedure of measurement and calibration. (viz. Applied mechanics/ Electronics/ Instrumentation dept.)

Learning Resources:**Books:**

| Sr. No. | Author | Title | Publication |
|----------------|-------------------------------|---|--------------------------------------|
| 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:

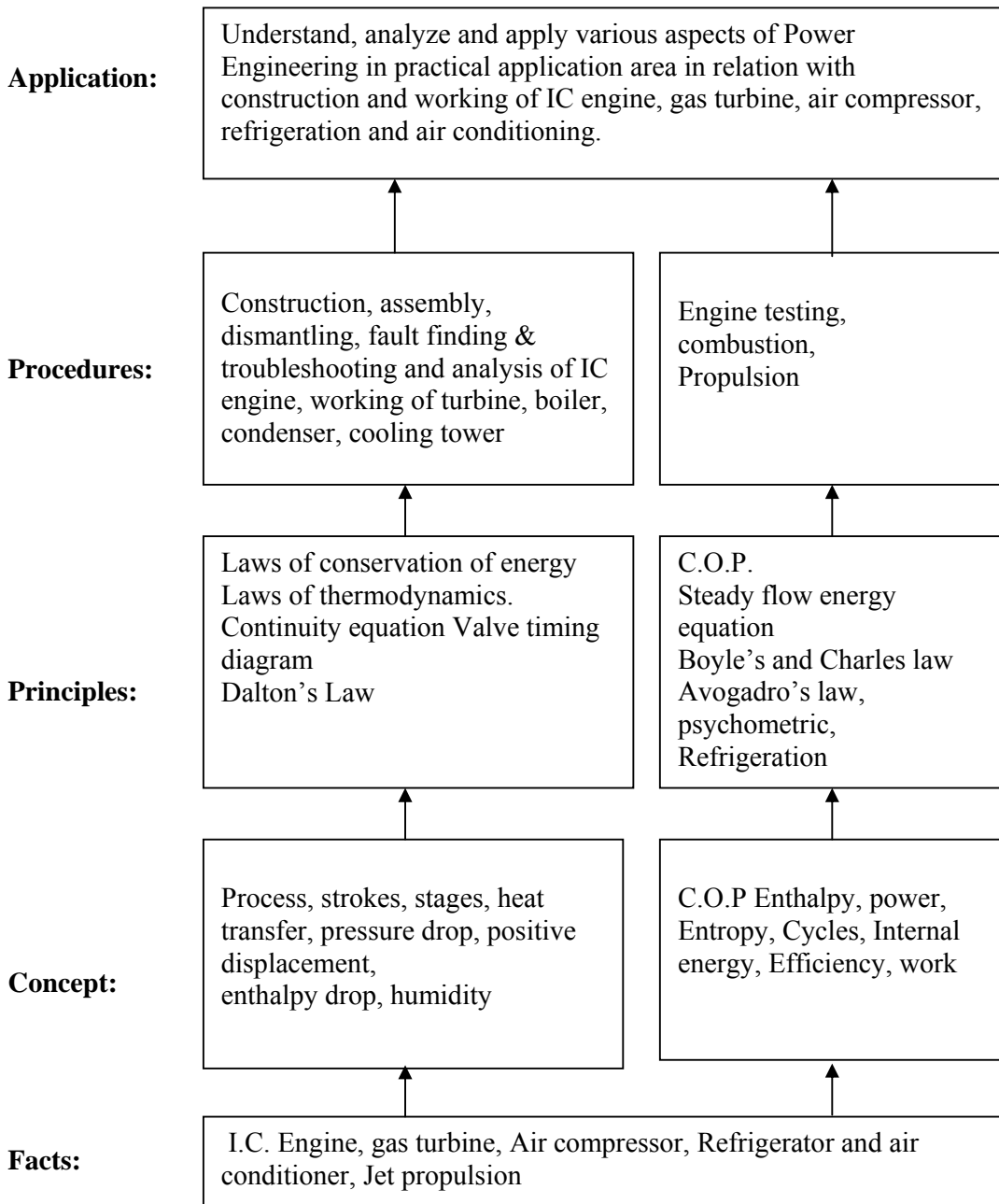
I.C.Engines find applications in almost all sectors of industry and in automobiles. Diploma technicians deal with working, testing and maintenance of I.C. Engines. I.C. Engines are one of the major contributors of air pollution. Hence I.C. Engine pollution control plays a vital role in protecting the 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:



Theory:**Theory:**

| Topic and content | Hrs. | Marks |
|--|------|-------|
| 1. I.C. Engine Specific Objectives <ul style="list-style-type: none"> ➤ Draw air standard cycles. ➤ Explain the combustion and ignition method of I. C. Engine. 1.1 Power Cycles <ul style="list-style-type: none"> • Carnot, Otto, Diesel, Dual, Brayton Cycle, representation on P-V, T-S diagram and Simple numerical on Otto cycle & Carnot cycle. 1.2 Classification and Application of I. C. Engines. <ul style="list-style-type: none"> • Four stroke Engines, Construction and working, valve timing Diagram, Turning moment diagram • Brief description of I.C. Engine combustion (SI & 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 | 10 | 20 |
| 2. I.C. Engine Testing and Pollution Control Specific Objectives: <ul style="list-style-type: none"> ➤ List lubricant and additive ➤ State the pollutants and their effect ➤ Calculate various efficiencies 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 ----- 10 Marks 2.2 List of fuel, lubricant additives and their advantages. ----- 04 Marks 2.3 Pollution Control ----- 10 Marks Pollutants in exhaust gases of petrol and diesel engines, their effects on environment, exhaust gas analysis for petrol and diesel engine, Catalytic Converter, Bharat stage III, IV norms. | 10 | 24 |
| 3. Air Compressor Specific Objectives <ul style="list-style-type: none"> ➤ Explain the concept of single and multistage compressor. ➤ List the methods of energy saving. 3.1 Introduction Uses of compressed air, Classification of air compressors, Definitions of Pressure ratio, Compressor capacity, Free Air Delivered, Swept volume. 3.2 Reciprocating Air Compressor ----- 10 Marks Construction and working of single stage and two stage compressor Efficiency: Volumetric, Isothermal and Mechanical Advantages of multi staging, Intercooling and after cooling. 3.3 Rotary Compressor ----- 10 Marks Construction and working of screw, lobe, vane, (No Numericals) Comparison and applications of reciprocating and rotary compressors Purification of air to remove oil, moisture and dust, Methods of energy saving in air compressors. | 10 | 20 |
| 4. Gas Turbine And Jet Propulsion Specific Objectives <ul style="list-style-type: none"> ➤ Classify gas turbines. ➤ Describe method to improve the efficiency of gas turbine. | 8 | 16 |

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

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. Dismantling & assembly of petrol/diesel engine
2. Construction and Working of four stroke engine
3. Construction and Working of simple carburetor. Draw labeled diagram

4. Trial on single/multi cylinder petrol or diesel engine with heat balance sheet and calculate different performance parameters.
5. Conduct Morse Test on Multi cylinder Petrol engine and find BP, IP, FP.
6. Measure I.C.Engine pollutants with the help of Exhaust gas Analyzer.
7. Trial on two-stage Reciprocating compressor to calculate volumetric efficiency, overall efficiency, free air delivered.
8. Draw a labeled diagram of cooling and lubrication systems of I.C.Engine available in laboratory.
9. Trial on Refrigeration Test Rig for calculation of power consumed, refrigerating effect, C.O.P.
10. Effect, C.O.P.
11. Trace the flow of refrigerant through various components in window air conditioner/
12. Split air conditioner. Draw the schematic diagram.

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 rd 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 rd edition |
| 06 | S. K. Kulshrestha | Thermal Engineering | Vikas Publishing House Pv.t 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 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.

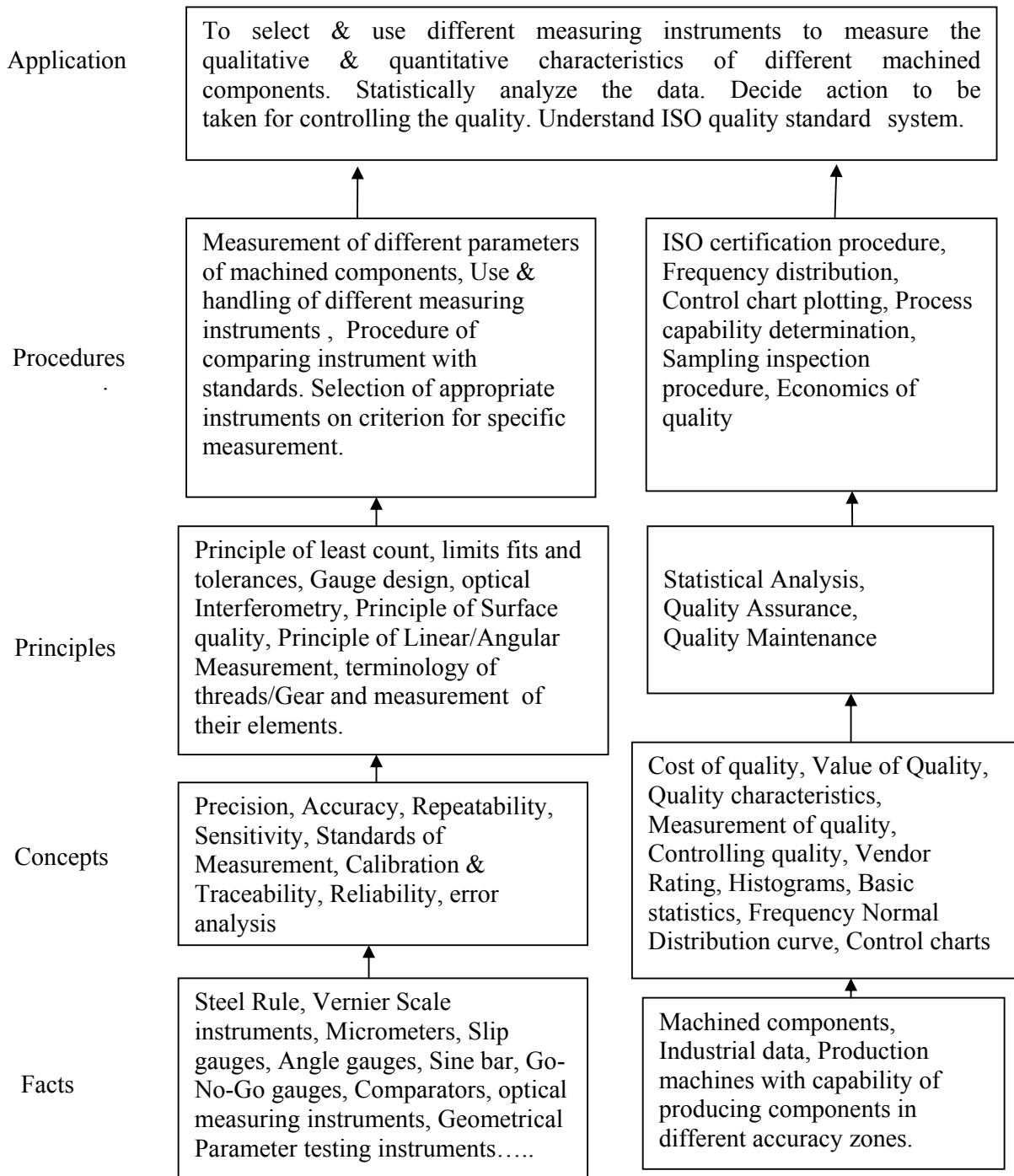
The knowledge of the subject also forms the basis for the design of mechanical measurement systems, design & drawing of mechanical components.

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

| | | |
|--|----|----|
| <p>Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch for internal and external threads , Three wire method, Thread gauge, screw thread micrometer, Working principle of floating carriage micrometer.</p> <p>4.2 Gear Measurement & Testing 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>5. Testing Techniques</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> To know terminology of surface finish & measure the surface finish of various components. <p>5.1 Measurement of Surface Finish 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>5.2 Machine Tool Testing 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>6. Quality Control</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> To understand the concept of Quality, cost of quality. To understand the concept and principles of TQM. <p>6.1 Quality : 06 Marks</p> <p>Definitions, meaning of quality of produce & services, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Concept of reliability, Cost, Quality assurance, Cost of rework & repair, Quality & Inspection, Inspection stages.</p> <p>6.2 Total Quality Management : 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>7. Statistical Quality Control</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> To know the basics of statistics. To understand different data types and analyze & interpret the data <p>7.1 Statistical Quality Control 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 & R charts, control charts for attributes p, np, C charts, process capability</p> | 10 | 28 |

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

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. Measurement of various dimensions & dimensional parameters using instruments such as radius gauge, pitch screw gauge, filler gauge, vernier caliper, vernier height gauge, vernier depth gauge, dial type vernier caliper, micrometer, inside micrometer, tube micrometer.

Note:- * The student should measure at least 3 dimensions of given job and take 5 readings per dimension.

* Individual performing the measurement with one setup on one surface plate and simultaneous 4 to 5 setup should be kept ready for measurement. (At least 10 Vernier calipers, Micrometers with different range i.e. 0-25mm two nos., 25- 50 two nos. Inside micrometer, tube micrometer, V anvil micrometer at least one.)

1. To set the Adjustable snap gauge GO end and NOGO end for a given dimensions using slip gauges.
2. Inspection of given components using Dial Indicator as a mechanical comparator.
3. To check the given component using high pressure Dial type pneumatic comparator.
4. To find unknown angle of component using bevel protractor and verify the same using sine bar/ sine center and slip gauges.
5. To measure the angle of component with the Angle Dekkor / Autocollimator using angle gauge.
6. Measurement of screw thread elements by using screw thread micrometer, screw pitch gauge & their verification with the help of profile projector/tool maker's microscope.
7. Measurement of gear tooth elements by using gear tooth vernier caliper and verification of gear tooth profile using profile projector.
8. To measure surface roughness using surface roughness measuring instrument. Measure surface roughness of turning, milling, shaping, grinding and lapping surfaces.
9. Testing of lathe machine/drill machine for parallelism, squareness, trueness by Test Dial indicator.
10. Draw the frequency histogram, frequency polygon for given samples (min 50 readings) and find mean, mode, median.

11. To draw the normal distribution curve and find standard deviation, variance, range and determine process capability.
12. To draw and interpret the control Charts (X – bar and R – chart, P chart, C chart) for given data.
 - a. **Batch size of students for experiment 2 to 13 shall be 4 to 5.**
 - b. **4 to 5 experimental setups should be arranged simultaneously.**

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 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.

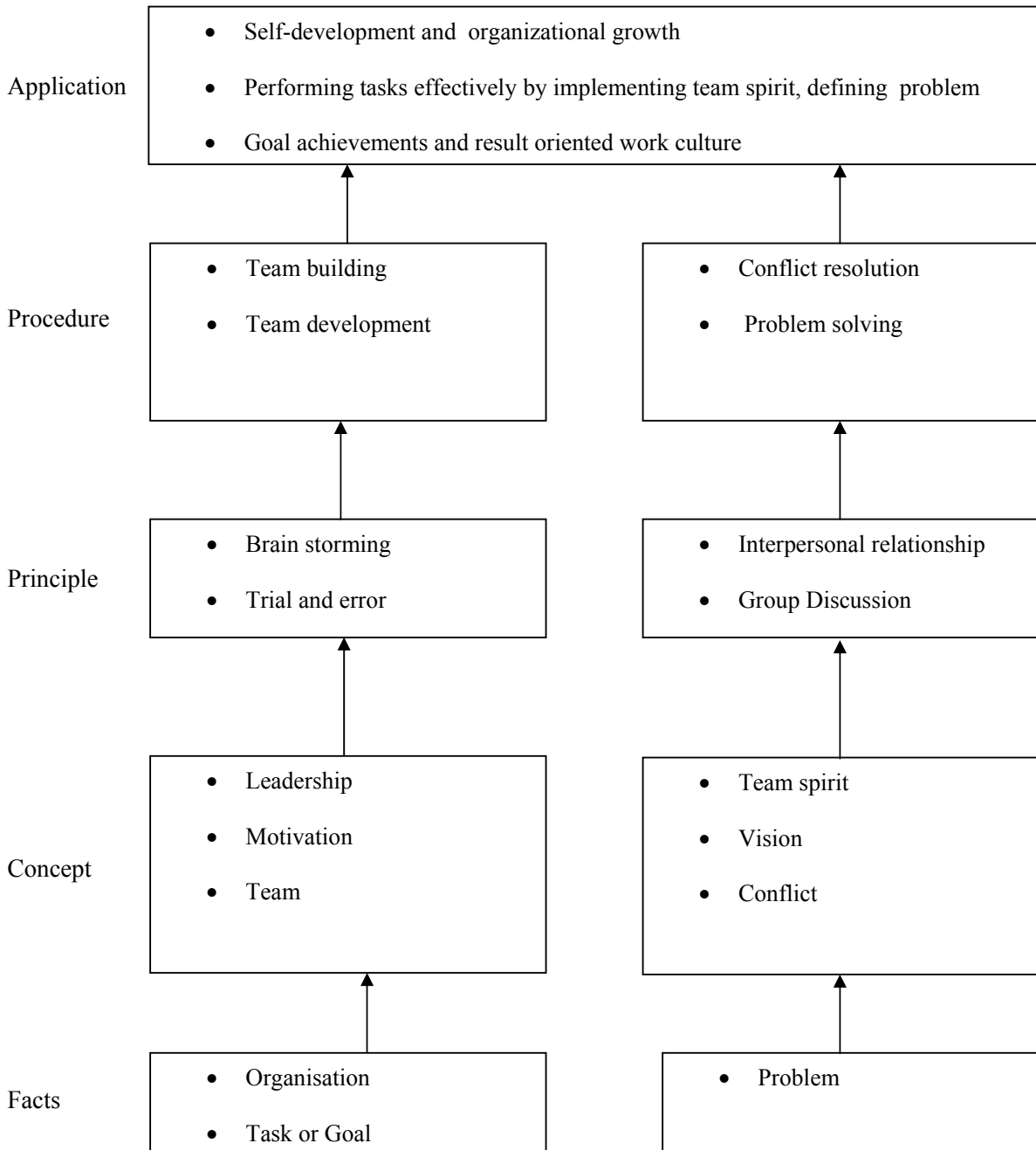
This subject of 'Behavioural Science' provides a broad base in which a technician can develop a successful career in the world of work.

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 |
|--|-------|
| <p>TOPIC 1: LEADERSHIP</p> <p>Contents:</p> <p>1.1 Introduction – Importance, examples of different types of leaders.</p> <p>1.2 Meaning and Definition of Leadership.</p> <p>1.3 Leadership qualities – Confidence, Vision, Communication Skills, influencing people etc.</p> <p>1.4 Types of Leadership styles, their advantages and disadvantages – Autocratic, Democratic, Delegative, Bureaucratic and Laissez Fairie.</p> | 02 |
| <p>TOPIC 2: MOTIVATION</p> <p>Contents:</p> <p>2.1 Meaning and Definition of motivation.</p> <p>2.2 Types of motivation.</p> <p>2.3 Maslow’s Motivation theory.</p> <p>2.4 Job characteristic model to enhance motivation.</p> | 03 |
| <p>TOPIC 3: TEAM BUILDING</p> <p>Contents:</p> <p>3.1 Definition of Team.</p> <p>3.2 Difference between Group and Team.</p> <p>3.3 Need for formation of good team (vision, trust, cooperation, initiative, etc.)</p> <p>3.4 Approach to Team building (Personality based, activity based, skill based, problem solving based, etc.)</p> | 02 |
| <p>TOPIC 4: CONFLICT RESOLUTION</p> <p>Contents:</p> <p>4.1 Definition of Conflict.</p> <p>4.2 Types of Conflict – Functional and Dysfunctional</p> <p>4.3 Sources of Conflict – Ego, Authority, Frustration etc.</p> <p>4.4 Positive and Negative effects of conflicts.</p> <p>4.5 Methods of Conflict resolution – Compromising, withdrawal, forcing.</p> | 04 |
| <p>TOPIC 5: PROBLEM SOLVING AND DECISION MAKING</p> <p>Contents:</p> <p>5.1 Steps in Problem Solving.</p> <p>5.2 Methods used for solving problems – trial and error method, brain storming, lateral thinking method.</p> <p>5.3 Techniques used for Decision making- Decision tree, Decision Matrix, Mind Mapping etc.</p> | 03 |
| <p>TOPIC 6: GROUP DISCUSSION AND INTERVIEW TECHNIQUES</p> <p>Contents:</p> <p>6.1 GROUP DISCUSSION</p> <ul style="list-style-type: none"> • Objectives of Group Discussion (ability to work in team, speaking and listening skills, leadership, creativity) • Does and Don’ts of Group Discussion. • How to conclude Group Discussion. | 02 |

| | |
|--|-----------|
| 6.2 INTERVIEW TECHNIQUES | |
| <ul style="list-style-type: none"> • Types of Interviews. (patterned, stress, behavioural) • Dress Code, Body Language and Communication Skill. • Probable questions for Interview. • Telephonic or Video Interview. | |
| Total | 16 |

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

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

Motor Skills:

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

List of Practicals / activities:

1. Form a group of 4 or 5 students and discuss the topic 'Qualities of an effective leader'. Each group will prepare its list with justification to the entire class and write an assignment under the guidance of subject teacher.
2. Form a pair of student and each one from pair will ask each other questionnaire on motivation, self-motivation, experiences that motivated him or other which him for success in the past and write an assignment under the guidance of subject teacher based on discussion.
3. Form a group of 4 or 5 students and assign them a group activity such as 'making a shape from match stick (50 to 100 match sticks) without guidance and without group discussion.
4. The group as in activity 3 will now perform the same activity. After group discussion and under guidance of subject teacher, each student from a group will write an assignment for both the activities and write their inferences with reference to group discussion, team development, team building, etc.
5. Form a group of 8 to 10 student and arrange a group activity such as;
 - Industrial visit.
 - Visit to any historical place/fort/museum, etc
 - Housekeeping and cleaning of any laboratory/seminar hall for any function.
 After the execution of activity student will write an assignment under guidance of teacher keeping in mind individual role, purpose of activity, inter dependency of work or task, coordination of person and task involved and final performance.
6. Write an assignment on interpersonal relationship and conflict management with student's personal experience of solving conflicts.
7. Form a group of 20 students and ask them to prepare a list of 8 to 10 problems affecting the institute. Subject teacher should analyze one such problem on black board using 'Fish bone technique' with the participation of students. Students will write an assignment consisting;
 - Apparent problem statement.
 - Analysis of the causes.

- Definition of real problem.
8. The subject teacher starts the session with 'Statement of the problem' written on the black board. After ensuring that all the participants are at the same level of understanding the statement of problem, he initiates NGT (Normal Group Technique) to arrive at maximum possible number of creative solutions.
Based on ranking matrix the group will arrive at feasible solutions and students will write an assignment consisting of;
 - Problem Statement.
 - Model of problem solving.
 - List of creative solution suggested by participants.
 - Write the most feasible solution based on given criteria.
 9. Form a group of 4 to 5 students and give them a topic for GD for 10 to 15 minutes. Teacher should analyse GD on certain parameters and students will write an assignment on aspects of GD and prepare a format (suggested or designed by teacher) which gives details of GD carried out.
 10. Arrange a guest lecture of H.R. Person from industry/expert in interview technique and conduct mock interview of each student. Student should write a report on this activity.
 11. Arrange a visit to industry and gather information about organisation, product, turnover, work culture, vision/mission statement, quality policy, Corporate social responsibility etc and write a report on it.

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

Learning Resources:

Books:

| Sr. No. | Author | Name of Book | Publication |
|---------|--|---|-------------------------------------|
| 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 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 HRS | TH | PR | OR | TW | TOTAL |
| 01 | -- | 02 | -- | -- | 50# | -- | 25@ | 75 |

Rationale:

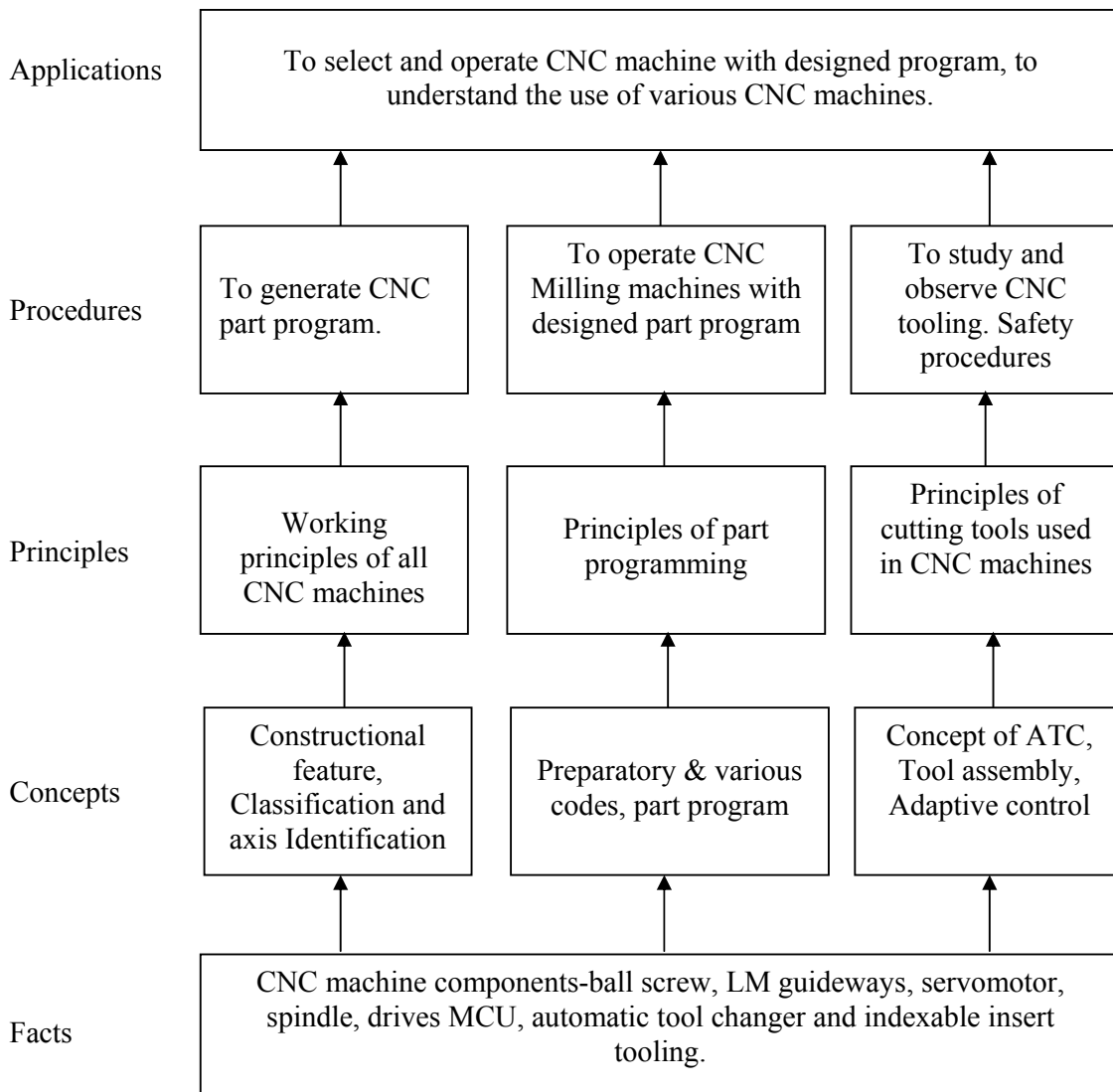
This is Technology subject which has relevance with the subjects taught earlier namely Manufacturing Processes and advanced manufacturing processes. After getting conversant with the basic manufacturing processes and production processes, it is necessary for a technician to know about the advancements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

| | |
|------------------------------------|-----------|
| 4.9 Fixtures used in CNC machines. | |
| Total | 16 |

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 (6th 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

| Sr. No. | Author | Title | Publisher |
|----------------|--------------------------|---|---|
| 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. 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 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.

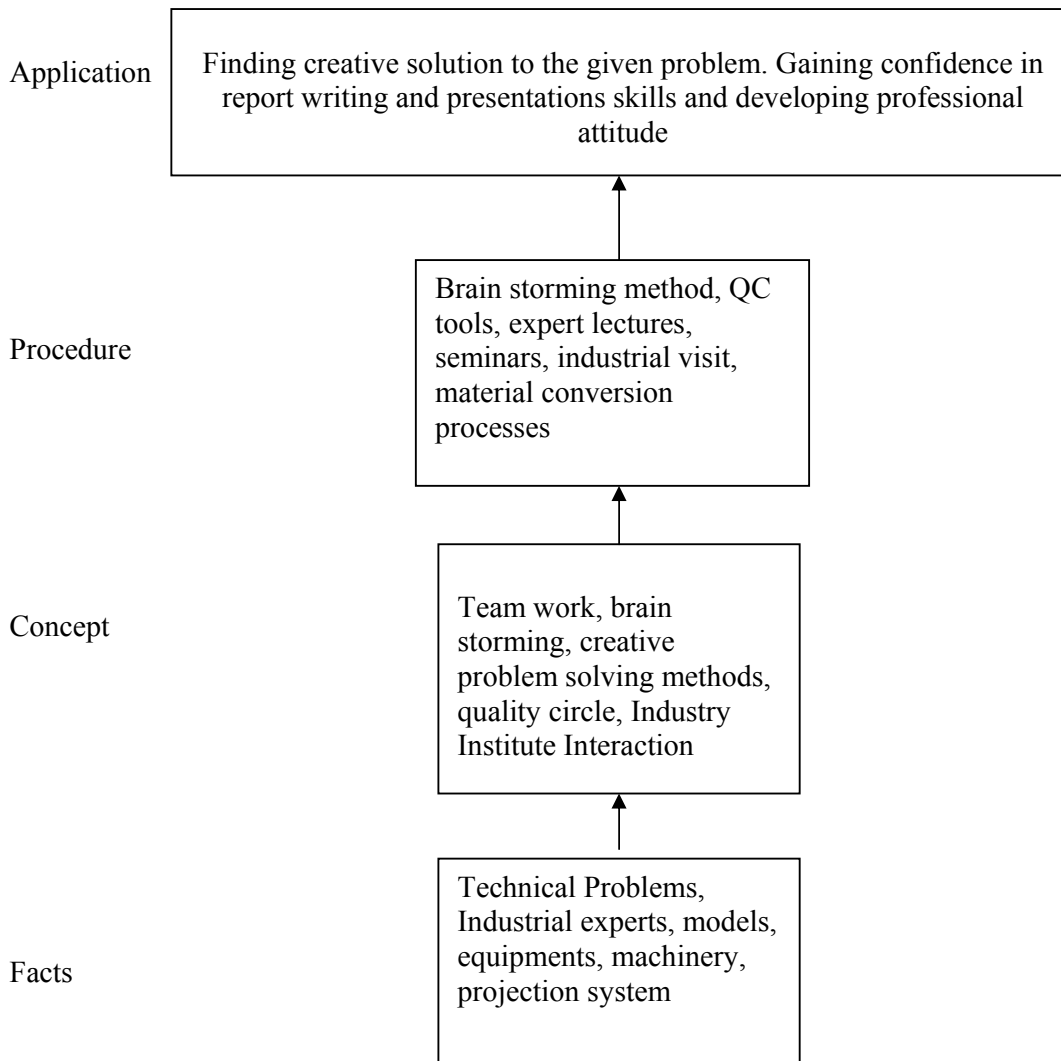
Professional development of Diploma engineering students is to be done by exposing them to various simulative situations in the industries. This can be achieved by inculcating attitude to face the problems, get alternative solutions and validation of the selected alternatives. This is achieved by involving 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>1. Idea Generation for final semester Project selection:</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"> • Development of working models. • Development of attachments to machine tools. • Reconditioning of existing equipments, machines in the Institute. • Industrial Problem Solving. • Interdisciplinary Projects. • Use of Non conventional Energy sources. • Use of appropriate technology. • Agro based projects to reduce drudgery of farmers. • Ergonomic equipments • Jig, fixtures, dies, special purpose tools • Any project on Low Cost Automation • Automation Problems in industries • Experimental setups required in laboratories for measurement of parameters and component performance. • Any other project suitable for Industry and Institute. <p>Note:- 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>3. The Professionals/ Industrial Expert Lecture/s</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"> • Vehicle testing. Vehicle aerodynamics & design. • Modern automobiles systems, Hybrid motor vehicles, electric vehicles, MPFI, ABS etc. • Environmental pollution & control, Automobile pollution, norms, act. • Earth moving machines. • Biotechnology • Nanotechnology • CAD, CAM, Computer Integrated Manufacturing, Material resources planning, Enterprise resources planning • Product design and modeling, Rapid prototyping • Programmable logic controllers, Automation, Robotics, Automated Guided Vehicles, Non industrial robots, • TQM, 5S, JIT, KAIZEN, Lean Manufacturing., World class Manufacturing, Pokayoke, Total Productive Maintenance, Six Sigma. • Packaging technology • Appropriate technology • LPG / CNG conversion kit. • Current HR Policies, Labor Act. • ISO implementation, • Import – Export policies and procedures, Taxation. • IPO, Mutual Fund, FPO, Share- Commodity trading and Investment. • Role of Insurance, Value Assessors in industry and society, Vehicle valuers, • Trends in modern agriculture engineering • Sustainable development, Green Environment, Solar and alternative fuels, Rain water harvesting, Disaster management. • Innovation Principles. • Opportunities in software industries. • Supply chain management. E-commerce. • Energy Audit. • Road Safety, Road Signs, Prevention of accidents on Roads, First aid. <p>Note: The brief report to be submitted on these lectures by each student as a part of Term work</p> | 06 |
|--|----|

| | |
|--|-----------|
| <p>4. Students Quality Circles: 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 - Poor vocabulary of Diploma Engineering students Poor practical skills of Diploma Engineering students Poor Journal preparation of Diploma Engineering students Poor Entrepreneurial abilities of Diploma Engineering students 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 www.qcfihq.com</p> | 12 |
| <p>5. Seminar : 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>6. Mini Projects : (in a group of 4-5 students)</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 : CNC Programming and manufacturing, Advanced mechanism, Model making--conveyors, agro equipments, wax/ thermocol prototypes, factory layouts, string diagrams,. Standard Operating Procedures for various machines 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 |
| Total | 48 |

Note for Industrial In-plant Training

PART A - Term Work / Assignments mentioned in the curriculum of Professional Practices-III

PART B - In plant Training (Minimum Two Weeks)

The students who are willing to undergo In Plant Training should complete minimum two weeks training in summer vacation at the end of IVth Semester examination in following types of organizations

1. Small scale industry
2. Private Ltd organization / industry
3. Public Ltd organization
4. Machine shop / Work shop
5. Tool room

6. Press shop
7. Die manufacturing unit
8. CNC shop/Center
9. Fabrication shop
10. Foundry
11. Heat treatment shop
12. Surface plating shop
13. Rubber components manufacturing unit
14. Plastic manufacturing unit
15. Tyre retreading shop
16. Four wheeler/two wheeler service station
17. Earth moving machinery
18. Rice mill / Sugar mill / Food industry
19. Farm equipment manufacturing unit
20. CAD / CAM design unit
21. Any other relevant industry/shop in the field of Mechanical / Automobile / Production Engineering

Student should complete his report (Duly typed and bound) and submit along with Term Work in **PART - A**

Note – Student should attach the certificate along with training report duly certified by the competent authority (Ex. Engineer/Manager/Director/Owner etc.) from the concerned industry for the validity of in plant training

Guidelines for contents in the report

- Name and type of industry
- Plant layout (Actual)
- No of departments / employees
- Nature of product / manufacturing process/service etc.
- Types of machines / equipments used and their maintenance.
- Machine specifications/make/capacity/efficiency etc.
- Measuring instruments used, their types and applications.
- Name of components/items/subcomponents/assemblies/subassemblies produced.
- Raw materials used / inventory control.
- Quality systems employed - TQM/Kaizen / 5S / Quality circle.
- Information about customer and competitor
- Conclusion - knowledge gained by the student, skills developed / learned / enhanced.
- Opinion / view of student about in plant training.
- Any other relevant information.

Guidelines for assessment of Term Work and in plant training report

The assessment of Term Work and in plant training report shall be done on following basis

| Assignments completed as per PART A (converted from D4 format) | In plant training | Total Term Work Marks |
|--|-------------------|-----------------------|
| 40 | 10 | 50 |

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, 5S, KAIZEN 6 SIGMA TRIZ TQM SPC TPM SMED ERP | QCFI Publication, Secunderabad Visit website www.qcfihq.com for details |
| 04 | Paul Trott | Innovation Management and New Product Development 4 th 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

3. Web Sites:

www.start2think.com
www.Innovationgoldmine.com
www.engineeringforchange.org
www.qcfihq.com
www.wikipedia.com
www.slideshare.com
www.teachertube.com

Industrial Training (Optional)

- Students who have completed industrial training in summer vacation after 4th Semester will be granted exemption for activities related to topic 1 to 4.
- These students shall submit report of Industrial training signed and certified by authorities from Industry. Student will give seminar on industry training attended by him.
- Evaluation will be done on seminar and report submitted by student.