 MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES																	
COURSE NAME : DIPLOMA IN AUTOMOBILE ENGINEERING																	
COURSE CODE : AE																	
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	Two Wheeler Technology	TWT	17521	03	--	02	03	100	40	--	--	--	--	25@	10	50	
2	Hydraulics and Pneumatics (AE)	HAP	17522	03	--	02	03	100	40	--	--	25#	10	25@	10		
3	Advanced Automobile Engines	AAE	17523	03	--	02	03	100	40	25 #	10	--	--	25@	10		
4	Basic Electrical and Electronics	BEE	17524	03	--	02	03	100	40	--	--	--	--	25@	10		
5	Design of Automobile Components	DAC	17525	03	--	02	04	100	40	--	--	25#	10	25@	10		
6	Behavioural Science \$	BSC	17075	01	--	02	--	--	--	--	--	25#	10	25@	10		
7	Solid Modeling	SME	17063	01	--	02	--	--	--	25 #	10	--	--	25@	10		
8	Professional Practices - III / Industrial Training (Optional)** β	PPT	17065	--	--	03	--	--	--	--	--	--	--	50@	20		
TOTAL				17	--	17	--	500	--	50	--	75	--	225	--	50	
<p>Student Contact Hours Per Week: 34 Hrs. THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.</p> <p>Total Marks : 900</p> <p>@ - Internal Assessment, # - External Assessment, No Theory Examination, \$ - Common to all branches, #- Online Examination, β - Common to AE, PG, PT, MH, MI</p> <p>** 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</p> <p>Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work</p> <ul style="list-style-type: none"> ➤ 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 Automobile Engineering**Course Code : AE****Semester : Fifth****Subject Title : Two Wheeler Technology****Subject Code : 17521****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:

There is an increased need of public transport. The public transport systems in cities and in rural area do not meet the requirement effectively. This has led to huge demand of two wheelers.

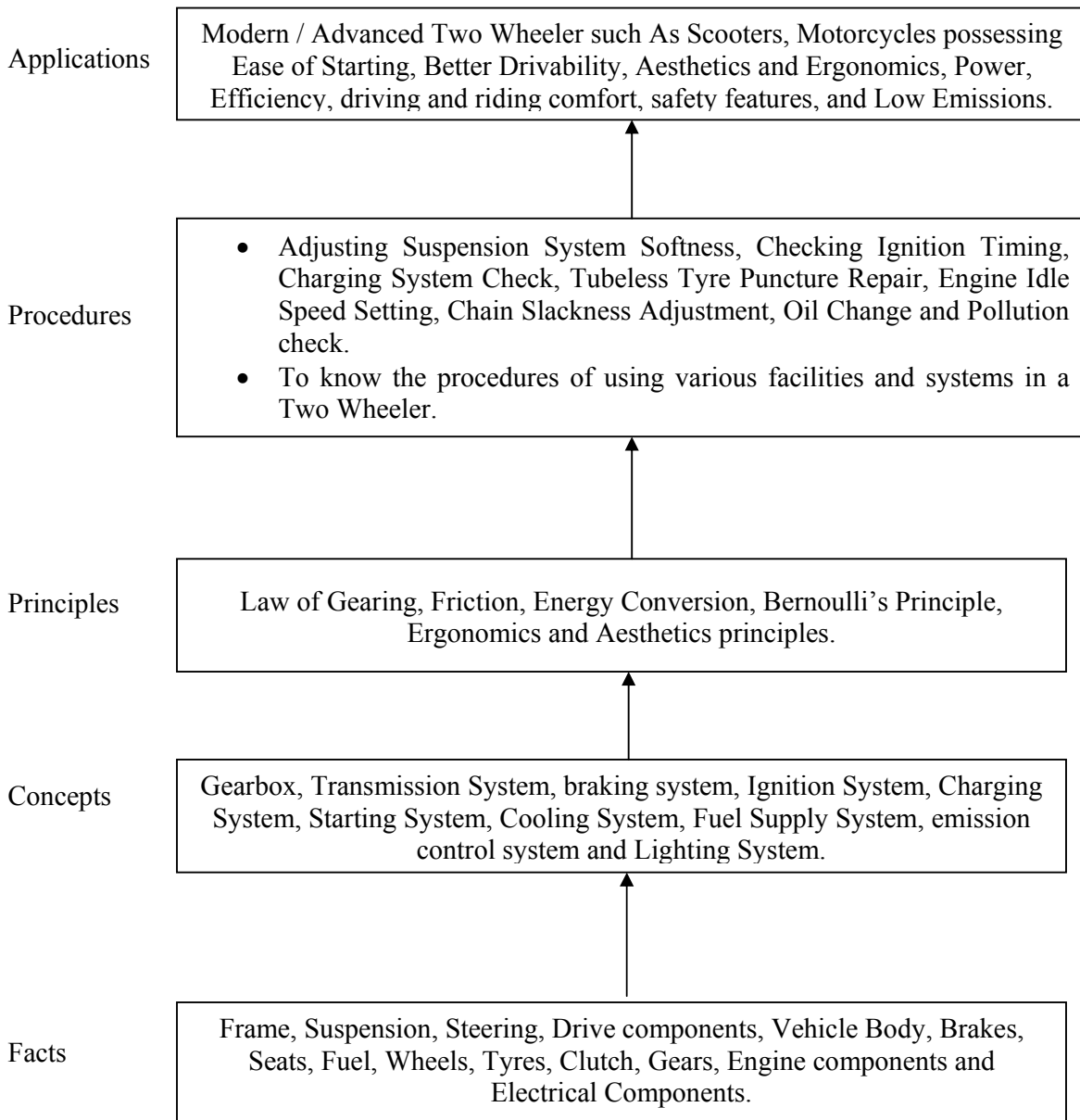
Presently the two wheelers are used by a large section of society as personalized transport. In view of the growth, large employment potential in this field and the manpower required to cater to the same, this subject is included as an elective subject.

General Objectives:

Students will be able to

1. Carry out the recommended procedures of the servicing using a service manual.
2. Select a suitable two wheeler for specific requirements of user.
3. Understand various mechanical, electrical and electronic systems and modern features used in two wheelers.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
<p>1: Frames, Body and Transmission system</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know various types of frames, bodies, select a suitable type of frame for particular application. ➤ Compare types of clutches, gearboxes and their applications. <p>Contents:</p> <p>1.1 Type of frames 04Marks</p> <ul style="list-style-type: none"> • Single cradle frame, Double cradle frame, Tubular frame (Single Down-tube frame using the engine as a stressed member), • Body- Monocoque Construction. <p>1.2 Selection of Transmission system components. 04Marks</p> <ul style="list-style-type: none"> • Cable Actuated Wet Multi-disc clutch, Centrifugal clutch. • Chain drive, Belt drive with variator mechanism, Gear drive. <p>1.3 Working of Gear box, its comparison with four wheelers. 04Marks</p> <ul style="list-style-type: none"> • Gear ratios in scooter and motorcycle. • Working of Constant mesh gear box. 	05	12
<p>2: Engines, Fuel Supply System, Lubrication System and Emission Control System</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand engine features and its working. ➤ Understand working of Induction system, Exhaust System, Fuel Supply System, Lubrication System and Emission Control System. <p>Contents:</p> <p>2.1 Induction and Exhaust system. 18 Marks</p> <p>Induction System</p> <ul style="list-style-type: none"> • Air filter/ Air Cleaner: construction and function - Washable oiled sponge element, washable Dual foam wet type. • Two Stroke Engines - Arrangement of Ports in the cylinder, Decompression Valve arrangement. • Four Stroke Engines - Overhead Valve and Overhead cam arrangements. Advantages of Multiple valves. <p>Fuel supply system</p> <ul style="list-style-type: none"> • Gravity feed and vacuum operated system. • Down draught and horizontal/ Side draught carburetor. • Carburetor functions and working under various Engine operating conditions like – Idling, Starting, accelerating, normal running. • Advantages of electronic fuel injection system. <p>Exhaust system</p> <ul style="list-style-type: none"> • Construction and function of Exhaust system: Header pipe, Muffler Types and their application, Tail Pipe arrangement and location. <p>2.2 Lubrication and Emission Control Systems 10 Marks</p> <p>Lubrication system.</p>	13	28

<ul style="list-style-type: none"> Petroil Lubrication with Separate Oil Pump for Two stroke engines. Wet sump Pressurized Lubrication in four stroke engines. <p>Block diagram and working of pollution control measures</p> <ul style="list-style-type: none"> Catalytic convertor, Exhaust Gas Recirculation, Positive Crankcase Ventilation. 		
<p>3: Steering and Suspension System</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> Know types of front and rear suspension system and steering System. <p>Contents:</p> <ul style="list-style-type: none"> Handle Bar arrangement, Steering fork, Purpose of providing Caster angle. Use of Dampers/ Double acting type of shock absorbers. Use of Variable Rate coil spring, Coil in coil spring arrangement. Advantages of Mono-shock suspension system. Advantage of Gas filled shock absorber for rear end suspension. 	04	08
<p>4: Brakes, Wheels and Tyres.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> Understand types of braking system, types of wheels and modern tyres. <p>Content :</p> <ul style="list-style-type: none"> Drum (Mechanical Expanding Shoe type) and disc Brakes (Fixed Caliper and Floating Caliper types.) Mechanical and Hydraulic brakes. Lever operated and pedal operated brakes. Application and criteria for selection of wheels and tyres, their specification for motorcycles, scooters, sports bike. 	04	08
<p>5: Electrical System</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> Know types of ignition and other electrical systems. <p>Contests :</p> <p>5.1 Ignition System 08 Marks</p> <ul style="list-style-type: none"> Working of Condenser Discharge Ignition (CDI) system. Microprocessor controlled Ignition system block diagram and working. Benefits of Twin Spark Ignition system <p>5.2 Starting system and Charging System 08 Marks</p> <ul style="list-style-type: none"> Kick Start and Button Start arrangements. Components of starting system and their functions: D C motor, Battery, Battery Rating for use in Button start vehicles. Schematic circuit and working of charging system. Schematic diagram showing AC and DC circuits. <p>5.3 Lighting System and accessories- 08 Marks Specifications and Application of</p> <ul style="list-style-type: none"> Head Lamp, Tail and number plate Lamp, Purpose of using LED lights in tail lamp, Turn Signal Lamp, Side Stand Indicator Lamp, High Beam Indicator Lamp, Neutral Indicator Lamp, Speedometer Lamp, 	12	24

<ul style="list-style-type: none"> Horn, Mobile Charger point, Head lamp and tail lamp Reflectors used in two wheelers. Dash units <ul style="list-style-type: none"> Use of Speedometer (Analog and digital), Trip meter. Use of Engine Speed indicator/ Tachometer. 		
<p>6: Aerodynamics, Ergonomics, Aesthetics and Safety Aspects.</p> <p>Specific Objectives :</p> <ul style="list-style-type: none"> ➤ Understand Aerodynamics, Aesthetics and Ergonomic aspects of a two wheeler. <p>Contents :</p> <p>6.1 Aerodynamic Aspects 04 Marks</p> <ul style="list-style-type: none"> Head lamp shape (Sealed beam and conventional). Tail lamp and indicator light arrangements- body enclosed and separate. Shape of Fuel Tank in Motorcycles <p>6.2 Ergonomic and Aesthetic Aspects 12 Marks</p> <p>Ergonomic Aspects</p> <ul style="list-style-type: none"> Seat Arrangement for rider and pillion rider Handle bar position. Floor/ Foot rest for driver and pillion rider, <p>Aesthetic Aspects</p> <ul style="list-style-type: none"> Headlamp fairing of motorcycles. Side panels for scooter/ scootercycle and motorcycle. Ground clearance. Mud guard shape and position. <p>6.4 Safety Aspects 04 Marks</p> <ul style="list-style-type: none"> Crash bar, Saree guard Driving Habits. Drive gear – Jacket, Helmet, Day night goggle. 	10	20
Total	48	100

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

- Observe, compare and describe two wheelers on basis of Aerodynamics, Aesthetics and Ergonomic considerations for their merits and demerits.
- Understand the functions of various parts of a two wheeler body.
- Understand various systems of a two wheeler. Use various facilities available in an advanced two wheeler

Motor Skills:

- Adjust the idling speed of two wheeler engine. Perform clutch and brake adjustment.
- Check parameters like tyre inflation, battery voltage, charging voltage of a two wheeler.

List of Practicals:

1. Observe and sketch the layout of a two wheeler transmission system.
2. Check the following electrical / electronic components, parameters of a two wheeler.
 - CDI system components,
 - Charging System components,
 - Voltage at battery, specific gravity and high discharge test
 Use service/ operators manual for specifications.
3. Adjust idle speed of a two wheeler engine using the specified procedure. Check the Idling Emission using Exhaust Gas Analyzer and do necessary carburetor adjustments for better performance.
4. Check the Ignition Timing of a two-wheeler and compare it with the Workshop/ Operators Manual Specification. Remove, observe, clean the Spark plug and adjust the gap and refit.
5. Remove and refit rear wheel of a two wheeler - check the conditions of brake shoes, brake drum, bearings etc. Perform brake adjustment. Replace brake cables, brake shoes/ pads.
6. Visit a Two wheeler Dealer Showroom/ Company showroom to obtain Chassis specification of a Scooter/ Motorcycle or scooterate. Share and Compare the data collected for two vehicles in the same category of vehicles (on the basis of Ground clearance, wheel base, engine power, spare wheel, claimed fuel efficiency, load carrying capacity). Prepare a report to identify the better one in the category.
7. Dismantle and assemble a motorcycle clutch and perform clutch adjustments. Replace clutch cable, if required.
8. Carry out lubrication and greasing of a vehicle.
 - Engine, brake linkage, clutch linkage, fork, axle, chain and levers.

Notes:

1. Practicals to be conducted in a group of 4 to 6 students.
2. Number of practicals shall be conducted simultaneously.

List of Assignments:

1. Report all the salient features of a latest two wheeler. Describe the technical and ergonomic features, if information is available. Comment on the aesthetics of the vehicle. Separate models should be considered by a group of four students.
2. Prepare troubleshooting chart for failure of a two wheeler system. (Symptoms, Causes and remedies)

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher, Edition
1	--	Service Manuals of Popular Indian Two Wheeled Vehicles.	--
2	K.K. Ramalingam	Two wheelers.	SCITECH-I
3	R.B. Gupta	Automobile Engineering	--
4	K.K. Ramalingam	Automobile Engineering.	SCITECH-II

2. Websites: Wikipedia, How Stuff Works,

Course Name : Diploma in Automobile Engineering

Course Code : AE

Semester : Fifth

Subject Title : Hydraulics and Pneumatics

Subject Code : 17522

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:

There is hardly any automobile as well as manufacturing industry and automobile service station without Hydraulics and Pneumatics system. The diploma holders are required to work with those systems, their components and troubleshooting. This is core technology subject which provides knowledge of constructing Hydraulics and Pneumatics circuits and its applications to industrial and mobile hydraulics and pneumatics. The subject requires the knowledge of Basic Engineering Science, Applied mechanics, Automobile Manufacturing Systems etc. This subject will be directly useful to the student in the industrial environment.

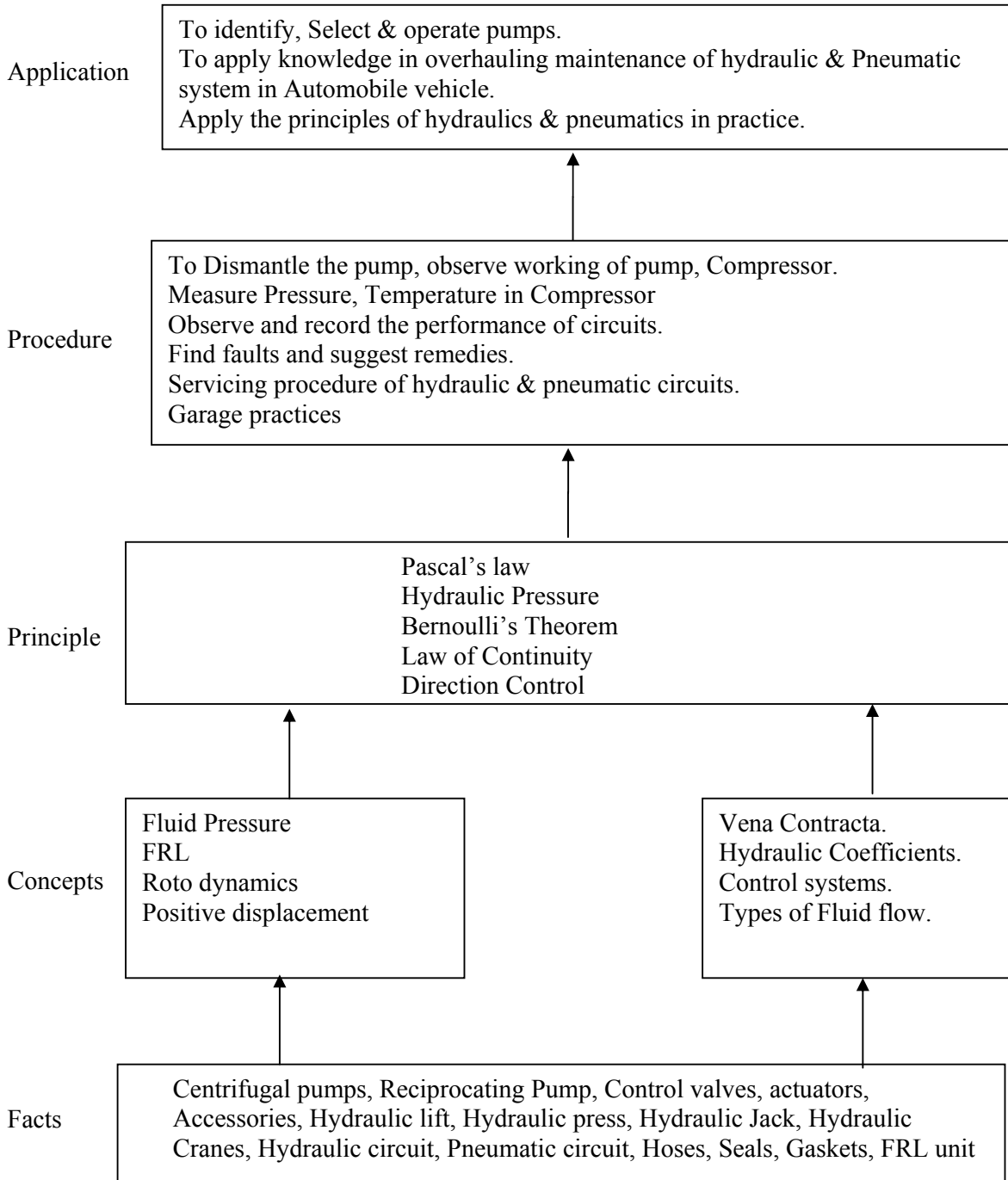
General Objectives:

Student will be able to

1. Understand the basic properties of fluid, pressure measurement techniques, important principles of hydraulics / Pneumatics with their applications and hydraulic/Pneumatic devices used in practice.
2. Identify fluid power system components like Pumps, actuators, valve, filters, and to construct the Hydraulic and Pneumatic circuits for various applications.
3. Preparation of maintenance schedule and select appropriate tools to dismantle and assemble the components.
4. Diagnose probable causes of failure of components of hydraulic and pneumatic circuits. Including power pack.

5. Analysis of the conditions of fittings, oil, pipes, seals and packing of hydraulic systems in automobile vehicles.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
<p>1. Overview of Fluid Mechanics.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know the types of fluids used and their properties ➤ Understand types of fluid flows ➤ know fluid pressure measurement and measuring gauges ➤ Understand principle used in hydrodynamics <p>Contents:</p> <p>1.1 Fluid Fundamentals. 08 Marks</p> <ul style="list-style-type: none"> • Classification of Fluid, Properties of fluids like Specific Weight, Specific gravity, Surface tension, Capillarity, Viscosity. Specification of hydraulic oil • Pascal's law. • Types of fluid flow- Steady, unsteady, rotational, irrotational, laminar, turbulent, one, two and three dimensional flow, Uniform and non uniform flow. (Definitions and applications only) <p>Pressure Measurement.</p> <ul style="list-style-type: none"> • Concept of atmospheric pressure, gauge pressure, vacuum pressure, absolute Pressure. • Pressure Gauges - Piezometer tube, simple and differential manometer, micro – manometer. (Theoretical Treatment only, No Analytical treatment / Problems on Manometers.) Bourdon tube pressure gauge. <p>1.2 Hydrodynamics. 14 Marks</p> <ul style="list-style-type: none"> • Basic principles of fluid flow • Law of continuity and its applications. • Energy possessed by the liquid in motion. • Bernoulli's theorem and its applications such as Venturimeter, Orifice meter and pitot tube. (Analytical treatment with derivation for measurement of discharge is expected). <p>Hydraulic coefficients</p> <ul style="list-style-type: none"> • Concept of Vena Contracta. • Coefficient of contraction, coefficient of velocity, coefficient of discharge, Coefficient of resistance. Relation between the hydraulic coefficient 	10	22
<p>2. Hydraulic Devices</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know working of pumps ➤ Select proper pumping devices ➤ Find faults in pumps ➤ Understand use of air vessel <p>Contents:</p> <p>2.1 Centrifugal Pumps. 08 Marks</p> <ul style="list-style-type: none"> • Types, Construction and working of centrifugal pump • Types of casing. Need of priming. • Heads, Losses and Efficiencies of Centrifugal Pump. (No Analytical Treatment.) • Net positive suction head • Fault findings and remedies. • Pump selection. 	08	16

<p>2.2 Reciprocating Pumps 08 Marks</p> <ul style="list-style-type: none"> • Construction and Working of single and Double Acting Reciprocating pump. • Positive and Negative slip. • Air vessels - their function and Advantage. • Power and Efficiencies of Reciprocation Pump. (No Analytical Treatment.) • Reasons of cavitations and separation. • Comparison between Reciprocating and Centrifugal Pump 		
<p>3. Miscellaneous Fluid Machines</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Apply Pascal's law in various hydraulic devices ➤ Know working of other types of pumps <p>Contents:</p> <p>3.1 Simple Hydraulic Devices.</p> <ul style="list-style-type: none"> • Working principles, construction and applications of Hydraulic jack, Hydraulic ram, Hydraulic lift, Hydraulic press. <p>3.2 Other Pumping Devices.</p> <ul style="list-style-type: none"> • Gear pumps used in hydraulic circuits, Vane type, Swash plate type pump. Comparison of above pumps for various characteristics and their applications. 	06	12
<p>4. Basic Components Of Hydraulic and Pneumatic Systems</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Make them familiar with various hydraulic and pneumatic symbols ➤ Understand working of actuators and valves <p>Contents:</p> <p>4.1 Hydraulic and Pneumatic actuators. 10 Marks</p> <ul style="list-style-type: none"> • Hydraulic Actuators - Hydraulic cylinders (single, double acting and telescopic) –construction and working, Hydraulic motors(gear and piston type) –construction and working • Pneumatic Actuators - Pneumatic cylinders (single and double acting) - construction and working, Air motors (gear and piston type) - construction and working <p>4.2 Valves for Hydraulic and Pneumatic systems. 08 Marks</p> <ul style="list-style-type: none"> • Classifications of valves, poppet, ball, needle, throttle, pressure control directional control, sequencing synchronizing ,rotary spool, sliding spool two position, multi position. Non-return valves. Proportionating valve • Construction and operation of above valves. 	08	18
<p>5. Accessories of Hydraulic and Pneumatic Systems</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand function of filters, hoses and gaskets ➤ Know use of gaskets and filters for specific applications <p>Contents:</p> <p>5.1 Filters</p> <ul style="list-style-type: none"> • Hydraulic filters and strainers – full flow and proportional types, function and working, difference between filters and strainers. • Pneumatic filters –screen type and mechanical type, function and working, FRL unit <p>5.2 Hoses and Connectors for hydraulic and pneumatic systems - Types, construction and applications.</p> <p>5.3 Seals and Gaskets for hydraulic and pneumatic systems-Types, function,</p>	06	12

construction, commonly used seals and gasket materials.		
6. Hydraulic and Pneumatic Circuits Specific Objectives: ➤ Compare hydraulic and pneumatic circuits ➤ Understand various hydraulic and pneumatic circuits Contents: 6.1 Hydraulic Circuits 10 Marks • Hydraulic symbols • Meter in, Meter out. Bleed off, Sequencing. • Introduction to electro-hydraulics – concept, principles and applications • Applications of hydraulic circuits – Hydraulic power steering, Hydraulic brakes, milling machine, hydraulic press, 6.2 Simple Pneumatic Circuits. 10 Marks • Pneumatic symbols • Speed control circuit (Meter in, Meter out), Sequencing. • Applications of pneumatic circuits – Air brake, Low cost Automation in industries, Pneumatic power tools (drill, hammer, and grinder). • Comparison of Hydraulic and pneumatic circuits.	10	20
Total	48	100

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

1. Understand the basic principles of Hydraulics and their applications.
2. Measure discharge, pressure head and velocity of flow.
3. Ability of observation in working of hydraulic and pneumatic system.
4. Identify the component used in Hydraulic and Pneumatic Circuit. Design small circuits using these components.
5. Ability to Co-relate the performance hydraulic and pneumatic system.
6. Ability to identify the faults and suggest remedies.

Motor Skills:

1. Ability to join various hydraulic and pneumatic components to operate circuit
2. Maintain pumps
3. Carryout measurement of various parameters.

List of Practicals:

1. Understand and Verify Bernoulli's theorem by using Bernoulli's Apparatus.
2. Calculate the coefficient of discharge (C_d) of Venturimeter by using setup of convergent - divergent section.
3. Determine overall efficiency of Centrifugal Pump & plot its operating characteristics by using Centrifugal pump test rig.
4. Dismantling and assembly of reciprocating pump to identify components, functions of each component and prepare trouble shooting chart.
5. Understand operation of Hydraulic trainer having simple circuit actuation with single acting cylinder.
6. Understand functions of various components in pneumatic trainer with simple circuit actuation of double acting cylinder.
7. Construct and operate speed control Hydraulic circuit for speed control of Double Acting Cylinder by following methods.

- Meter in,
 - Meter out
 - By pass
8. Understand working of pneumatic travel dependent sequence circuit to operate single acting and double acting cylinder sequentially.
 9. Understand faults, probable causes and remedial action that can be taken to trouble shoot problems in hydraulic circuits
 10. Perform mini project on practical application of hydraulic and pneumatics

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1	Dr. P. N. Modi Dr. S.M. Seth	Hydraulic and Fluid Mechanics	Standard Book House, Delhi
2	Pippengen and Hicks	Industrial Hydraulics	Tata McGraw Hill Int.
3	S. Ilango and V. Soundararajan	Introduction To Hydraulics And Pneumatics	PHI Learning Private Limited, New Delhi.
4	Anthony Esposito	Fluid Power	PEARSON Education Noida
5	R.J. Garde and A.G. Mirajgaoker	Engineering Fluid Mechanics	SITECH Publications (India) PVT. LTD.
6	K. Shanmuga Sundaram	Hydraulic and Pneumatic Controls	S. Chand
7	-----	Vicker's Industrial Hydraulic Manual	Vicker's system international Ltd. Pimpri, Pune – 411018

2. CDs, PPTs Etc.:

- Introduction to Pneumatics
- Compressor and compressed air system-presentation from the “Energy Efficient guide for industry in Asia”

3. IS, BIS and International Codes:

- BS2917/ISO 1219-1

4. Websites:

www.mechanisms101.com
www.bimba.com/products/prod7.htm
www.teamdavinci.com/understanting_pneumatics.htm
www.PneumaticsFIRST.org
www.energyefficiencyasia.org

Course Name : Diploma in Automobile Engineering

Course Code : AE

Semester : Fifth

Subject Title : Advanced Automobile Engines

Subject Code : 17523

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:

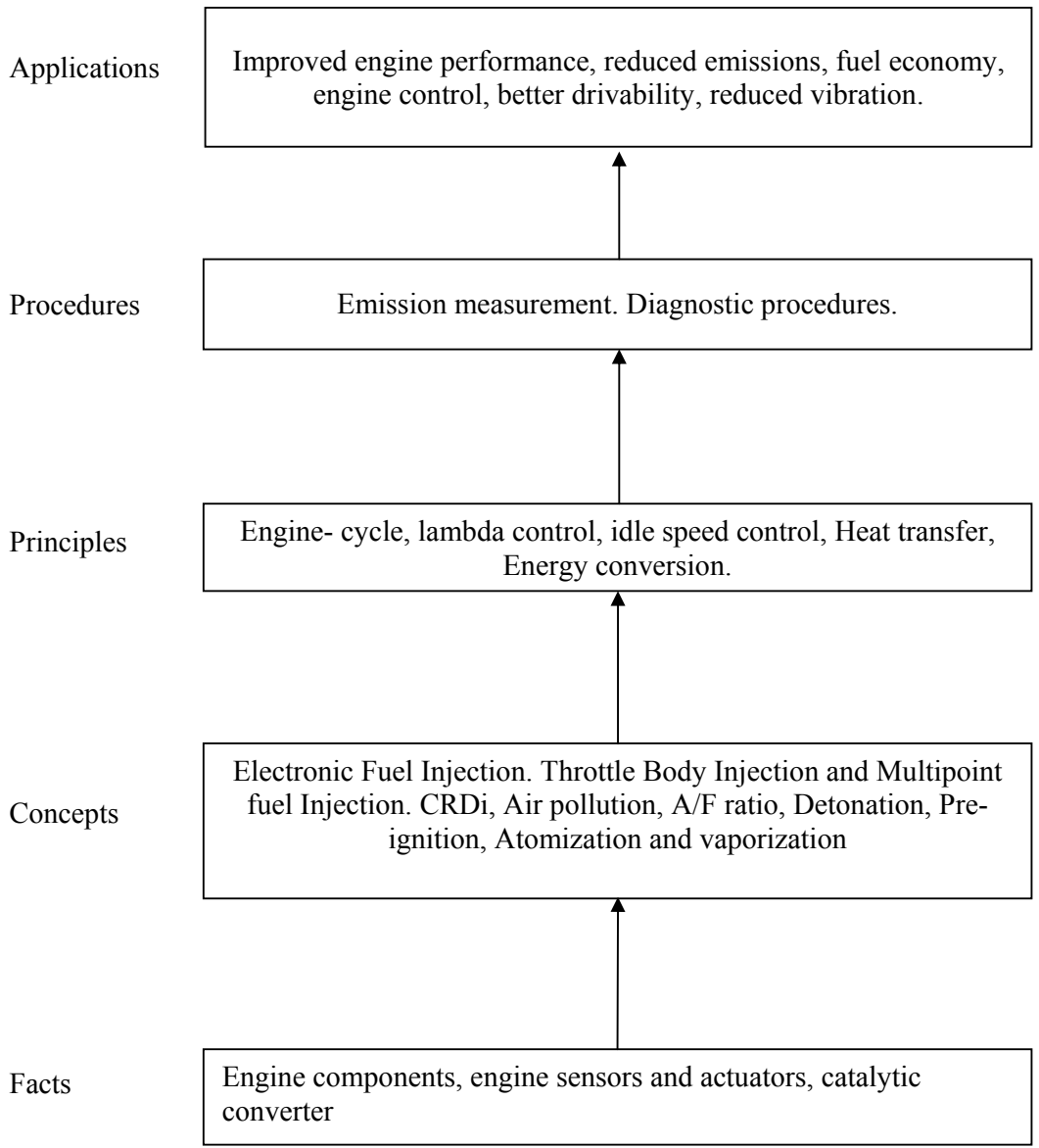
Day by day vehicle manufacturers are adapting advanced technology. They are taking care of pollution norms as a social responsibility and at the same time fuel economy, best driving responses, noise controls, and maintenance free technology in vehicles. The use of electrical, electronics and software engineering is used to achieve the above mentioned tasks. From manufacturing and service point of view it is necessary to study, practically observe and gain necessary intellectual and motor skills. The contents in this subject will help students to cope up requirements of manufacturer and society.

General Objectives:

The students will be able to

- Compare old technology and new technology used in engines.
- Understand combustion phenomena in SI and CI engines.
- Know new technologies like Electronic Fuel Injection, Common Rail Direct Injection, Turbo charging, and Emission control systems.
- Compare alternative fuels like Liquefied Petroleum Gas, Compressed Natural Gas.

Learning Structure:



Contents: Theory

Topic and Contents	Hours	Marks
<p>1: Theory of Combustion</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand combustion process and compare SI and CI engines. ➤ Know various types of combustion chambers. <p>Contents:</p> <p>1.1 Combustion in S.I. Engines 06 Marks</p> <ul style="list-style-type: none"> • Ignition limits • Stages of combustion in SI engine • Effect of engine variables on Ignition lag and flame propagation. <p>1.2 Abnormal combustion- 06 Marks</p> <ul style="list-style-type: none"> • Detonation, pre-ignition, • Surface ignition. • Effects of detonation, • Control of detonation. <p>1.3 SI engine combustion Chambers 04 Marks</p> <p>1.4 Combustion in CI engine 08 Marks</p> <ul style="list-style-type: none"> • Air Fuel ratio in Diesel engines • Delay period and variables affecting delay period. • Diesel knock and its control. • CI engine combustion chambers. • Comparison of SI and CI engines on the basis of thermodynamic and operating variables, performance characteristics. 	11	24
<p>2. Computer Controlled Petrol Engines.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Compare carbureted and advance engines. ➤ Know the functions and location of sensors, ECM and actuators in advance engines. ➤ Understand control functions of EFI system. <p>Contents:</p> <p>2.1 Introduction - 04 Marks</p> <ul style="list-style-type: none"> • Drawbacks of carbureted (SI) engines: Fuel distribution, Emission, Drivability, Power out- put, Fuel consumption, Air fuel ratio. <p>2.2 Throttle body injection (TBI) and Port fuel injection (PFI) systems 10 Marks</p> <ul style="list-style-type: none"> • Construction and working of TBI and PFI systems • Methods of fuel Injection: Sequential, Continuous, grouped, simultaneous injection. • Comparison of carbureted engine fuel supply system with TBI and MPFI System. <p>2.3 Sensors and Actuators of MPFI engine 10 Marks</p> <ul style="list-style-type: none"> • List, Function and Location of sensors and actuators of MPFI engine • Construction and working of pressure regulators, fuel injector, and fuel pump. • Electronic Control Module: Input and output control functions as fuel injection, idle speed control, EGR, canister purge. 	11	24

<p>3. Computer controlled Diesel Engines.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know components and working of CRDI system. ➤ Understand benefits of CRDI system. <p>Contents:</p> <p>3.1 Electronically controlled Fuel injection system</p> <ul style="list-style-type: none"> • Block diagram of electronic control system • Electronically controlled diesel injection pump. <p>3.2 Common rail direct injection system(CRDI):</p> <ul style="list-style-type: none"> • Block diagram of CRDI system. • Features of CRDI system. • Major Components-Fuel injector, Block diagram of Electronic diesel control unit (EDC). High pressure fuel pump, High pressure accumulator. • CRDI System operation and advantages. • Diesel Engine Glow plugs: Construction and working. • Circuit diagram and operation of glow plug 	08	16
<p>4. Fuels and Alternative Energy Options for Auto Engines</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand properties of fuels. ➤ Know alternative fuel systems <p>Contents:</p> <p>4.1 Properties of various fuels used in IC engines-</p> <ul style="list-style-type: none"> • Gasoline, Diesel, LPG, CNG, Hydrogen, Alcohol, Bio diesel. • Fuels used in modern vehicles. <p>4.2 Alternative Fuels for SI and CI engines-</p> <ul style="list-style-type: none"> • LPG, CNG, Alcohol, Bio- diesel (Advantages and Limitations with respect to performance and emission) • LPG and CNG conversion kit block diagram <p>4.3 Electric cars and hybrid vehicles – need, advantages, limitations and working with block diagram</p>	06	12
<p>5. Advanced Features in Automobile engines</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know advanced features of automobile engines. <p>Contents:</p> <p>Concepts and Advantages of following features</p> <ul style="list-style-type: none"> • Variable Geometric Turbocharger (VGT) • Variable Valve Timing mechanism (VVT) • Digital Twin Spark Ignition (DTSI) • Gasoline Direct Ignition (GDI) • Variable Valve Timing and Electronic Lift Control (VTEC) 	04	08
<p>6. Fuel Economy, Air pollution and Emission Control</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know the different sources of pollutants in I.C. engine. ➤ Understand working of different pollution controlling devices. ➤ Know various emission norms. <p>Contents:</p> <p>6.1 Fuel economy and Air pollution 08 Marks</p> <ul style="list-style-type: none"> • Methods of improving fuel economy. • Pollutants from gasoline engines. 	08	16

<ul style="list-style-type: none"> • Gasoline engine emission control - engine design modification, treatment of exhaust gas, fuel modification. • Diesel emission, Diesel smoke and control 		
6.2 Emission control	08 Marks	
<ul style="list-style-type: none"> • Exhaust-Gas recirculation (EGR) – EGR valve and control system • Positive crankcase ventilation (PCV) system • Evaporation emission control system • Euro Norms and Bharat stage Norms for cars. 		
Total	48	100

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

1. Identify types of combustion chamber.
2. Identify components of electronic fuel injection system (EFI) and CRDi system
3. Diagnose EFI system.
4. Diagnose engine condition from exhaust gas analysis and interpret results.

Motor Skills:

1. Observe combustion chamber.
2. Observe EFI and CRDi system components and their locations.
3. Use diagnostic tester for Electronics fuel injection system diagnosis.
4. Adopt recommended service manual procedure for testing EFI system and exhaust Gas analyzer application.

List of Practical's:

1. Identify Combustion chamber of multi cylinder S.I. and C. I. Engine and single cylinder 2/4 stroke engine
2. Identify, observe various sensors, actuators and ECM of MPFI engine. Draw a layout and write a report.
3. Dismantle & observe various components of electrical fuel feed pump of MPFI System.
4. Perform engine diagnosis of electronic fuel injection system using scan tool.
5. Identify and observe the components of Common Rail Direct Injection (CRDi) System.
6. Observe and draw layout of LPG or CNG Fuel supply system.
7. Perform exhaust gas analysis of an engine exhaust using 4-gas analyzer. Diagnose engine condition from exhaust gas analysis.
8. Identify & observe the EGR & PCV system used in an engine and draw layout.

Notes:

1. Practicals to be conducted in a group of 4 students.
2. Number of practicals shall be conducted simultaneously.
3. Visit to authorized service station is recommended for conducting practical number 4 and 5.

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher / Edition
01	M.L Mathur R.P.Sharma	A Course in Internal Combustion engine	Dhanpat Rai Publication
02	V. Ganeshan	Internal Combustion engines	Tata McGraw - Hill
03	Haywood	Internal Combustion engines	Tata McGraw - Hill
04	Don Knowles	Automotive Principles Vol-I	Prentice Hall
05	H.N. Gupta	Fundamentals of I.C. Engines	PHI Learning Pvt. Ltd 2011
06	K.K. Ramalingam	Internal Combustion Engines	SCITECH 2 nd edition 2011

2. Websites:

www.howstuffworks.com,
www.autoshop101.com

Course Name : Diploma in Automobile Engineering

Course code : AE

Semester : Fifth

Subject Title : Basic Electrical and Electronics

Subject Code : 17524

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).**

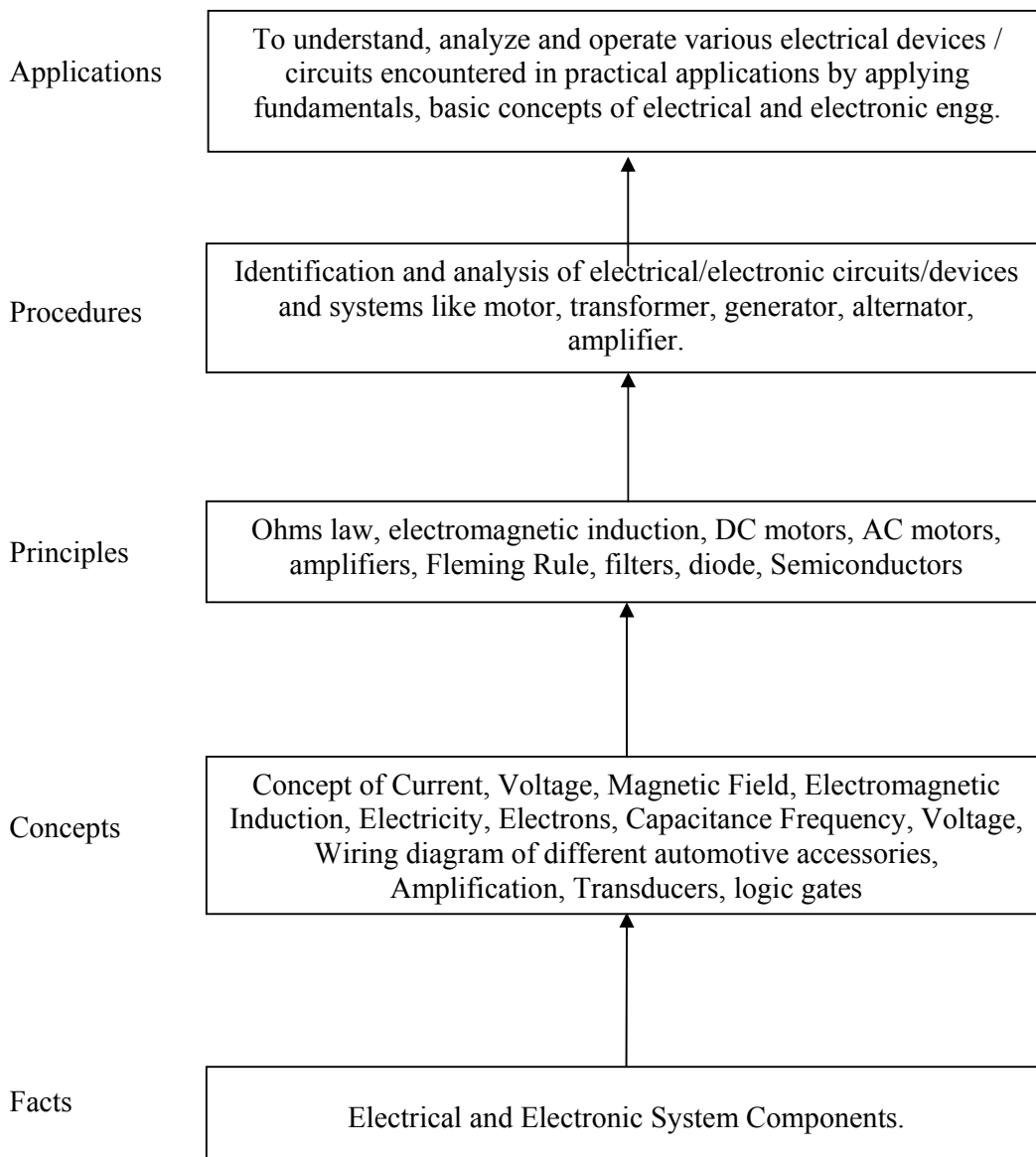
Rationale:

For effective maintenance and operation of Automobile electrical and electronic systems and circuits, automobile engineer must have basic knowledge of electrical technology and electronics. This subject forms the foundation for understanding and analyzing “Automotive Electrical and Electronic Systems”.

General Objectives:

Students will be able to:

1. Know the basic concepts of electricity, magnetism, transformer, measuring instruments that will be useful while analyzing different electrical systems.
2. Understand principle and working of electric motors.
3. Study various electrical symbols and concept of automotive wiring.
4. Know the concept of semiconductor, study the working of diodes, rectifiers, filters, regulators, transistors, amplifiers.
5. Describe the operation of transducers and state their applications in automobile.
6. Study basic concept of Digital electronics and Understand operation of logic gates, flip-flops, multiplexer and demultiplexer used in electronic circuits of an automobile.

Learning Structure:

Contents: Theory

Topic and Content	Hours	Marks
1: Basic concepts and principles of Electrical Engineering Specific Objectives: <ul style="list-style-type: none"> ➤ Understand different concepts in electrical engineering. ➤ Understand concept of measuring instruments and transformer. Contents: <p>1.1 Introduction 08 Marks</p> <ul style="list-style-type: none"> • Definition, symbol and units of - E.M.F., Current, Resistance, concept of Potential difference. • Series and parallel circuit ,Ohms Law (Simple numerical only) • Connecting procedure for measuring instruments, Symbol of - Voltmeter, ammeter and Wattmeter. • Conductor and insulator. Comparison of Conductor and insulator. <p>1.2 Magnetism and Electromagnetism 04 Marks</p> <ul style="list-style-type: none"> • Fundamentals of magnetism. • Definition of Magnetic lines of force, magnetic flux, flux density, magnetic Potential, Field intensity, and Reluctance. • Electromagnetic Induction, Faraday Laws, Fleming Right hand and Left hand rules. • Self inductance and Mutual inductance. <p>1.3 A.C. Fundamentals 04 Marks</p> <ul style="list-style-type: none"> • Generation of alternating Voltage and Current. • Definition of Instantaneous value, Waveform, Phase and Phase difference, Cycle, Time period, Frequency, Amplitude , R.M.S. value, Average Value , Form factor and Peak factor. • Active Power, Reactive power, Apparent power and Power Triangle. <p>1.4 Transformer (Single Phase) 04 Marks</p> <ul style="list-style-type: none"> • Principle, Construction and Working. • Core and shell type transformer, Comparison. • EMF equation ,Turns ratio, Voltage Ratio, Transformation Ratio (Simple numerical problems) 	12	20

<p>2: Electric Motors and Generators</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand D.C. Motor and A.C. Motor ➤ Know the Concept of Stepper motor, Alternator and D.C. Generator. <p>Contents:</p> <p>2.1 D. C. Motor 04 Marks</p> <ul style="list-style-type: none"> • Principle, Construction, Symbols and types. <p>2.2 A.C. Motor (Single Phase) 06 Marks</p> <ul style="list-style-type: none"> • Starting of Single Phase Induction Motor. • Principle, Schematic, Working and application of Resistance Split Phase Motor, Capacitor Motor, Shaded Pole Motor. <p>2.3 Stepper Motor and Alternator 04 Marks</p> <ul style="list-style-type: none"> • Stepper Motor- Only Concept, Types of Stepper motors. • Alternator- Only Concept and Principle. 	05	14
<p>3: Automotive Wiring and Lighting Circuit</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know Different electrical Symbol and gauge of wire ➤ Understand Earthed and Insulated Return System. ➤ Know Wiring diagram of Automobile Electrical Accessories. <p>Contents:</p> <p>3.1 Symbols and Wire Colour Coding 04 Marks</p> <ul style="list-style-type: none"> • Symbols of electrical circuits and wiring colour code, gauge of wire. <p>3.2 Wiring Systems 04 Marks</p> <ul style="list-style-type: none"> • Insulated and ground return systems. • Positive and negative return systems, their comparison. ➤ Wiring Harness and Cable Connector. <p>3.3 Wiring Diagrams of accessories and electrical systems 04 Marks</p> <ul style="list-style-type: none"> ➤ Wiring diagram of: - Headlight, Turn indicator, Horn, Windshield wiper, Stop light. 	05	12

<p>4: Basic Electronics</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Define Intrinsic and Extrinsic Semiconductor. ➤ Draw symbols and understand working of various Electronic components. <p>Contents:</p> <p>4.1 Semiconductor 08 Marks</p> <ul style="list-style-type: none"> • Intrinsic and Extrinsic Semiconductor. • Doping , Energy Band • P-N junction and Zener Diode -- Symbol, Construction, Working, Forward and Reverse Biasing, V-I characteristics, Applications. • Rectifier : Working, Circuit diagram, Waveform of HWR and FWR, Necessity of Filter, Types (C, L and π) <p>4.2 Transistor and Amplifier 04 Marks</p> <ul style="list-style-type: none"> • Symbol, Construction, Working of PNP and NPN transistor. • Transistor as an amplifier. <p>4.3 SCR 04 Marks</p> <ul style="list-style-type: none"> • Symbol, Construction, Working of SCR • V-I Characteristics of SCR. <p>4.4 Photo Devices 04 Marks</p> <ul style="list-style-type: none"> • Working, Symbols, Applications of photodiode and LED. 	10	20
<p>5: Transducers and Measurement of Parameters</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Define Transducer ➤ Know Principle and Working of different Transducer. ➤ Understand Static and Dynamic Characteristics. ➤ Know measurement of different parameters <p>Contents:</p> <p>5.1 Introduction to measurement systems 08 Marks</p> <ul style="list-style-type: none"> • Concept of General Measurement System-Block Diagram • Electrical and Mechanical Instruments, Comparison. • Static Characteristics -Accuracy and Precision, Sensitivity, Reliability, Linearity, resolution, Repeatability and Reproducibility. • Dynamic Characteristics –Speed of Response, Lag, Fidelity, Dynamic Error. <p>5.2 Transducer (Working and Principle), Characteristics 12 Marks</p> <ul style="list-style-type: none"> • Potentiometer, Inductive (LVDT), Capacitive, Piezoelectric. <p>Measurement of pressure and Temperature</p> <ul style="list-style-type: none"> • Electrical Resistance Pressure Gauge • Pirani Vacuum Gauge (Thermal conductivity). • Thermistor, RTD. <p>Measurement of Speed, force, flow.</p>	11	20

<ul style="list-style-type: none"> • AC Tachogenerator, Contactless type tachometer-Inductive Pick Up, Capacitive Pick up, Stroboscope. • Strain Gauge load cell. • Ultrasonic flow meter. 		
<p>6: Digital Electronics.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Draw Symbol and truth table of Different logic Gates. ➤ Understand Flip flop, Shift register, MUX, DEMUX. ➤ Understand 7 Segment LED. <p>Contents:</p> <p>6.1 Logic Gates and flip-flops 08 Marks</p> <ul style="list-style-type: none"> • Analog signal and Digital signal • Study of logic gates (AND, OR, NOT, NAND, NOR) symbols and truth tables. • Flip Flop - Study of flip flops : only RS (using NAND gate) and D Flip flop , symbols and truth table <p>6.2 Shift Register, MUX , DEMUX 06 Marks</p> <ul style="list-style-type: none"> • Working principle with General block diagram of shift register. • Working principle with block/logic diagram of Multiplexer (4:1) and demultiplexer (1:4) • Working of seven segment LED display. 	05	14
Total	48	100

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

Students will be able to:

1. Understand the operations of Basic Electrical and Electronic Components.
2. Understand working of electrical equipments.
3. Identify electrical symbols, study colour code used in automotive wiring.
4. Describe wiring diagram of electrical accessories in an automobile.
5. Understand the operation of measurement systems.
6. Understand the concept of digital electronics.

Motor Skills:

Students will be able to:

1. Test simple electrical and electronic circuit.
2. Draw the circuit diagram for electric motors and perform the test.
3. Draw wiring diagram of different electrical accessories.
4. Perform experiment for electronic devices.

List of Practicals:

1. Measure the current, voltage and power drawn by the circuit in
 - Series connection of two resistors.
 - Parallel connection of two resistors.
2. Reverse the direction of rotation of DC shunt motor by
 - Reversing supply to the field winding.
 - Reversing supply to the armature winding.
3. Prepare wiring circuit of any one of the following. Head light, Turn indicator, Horn
4. Determine transformation ratio of a single phase transformer.
5. Determine values using colour code of Resistors, Capacitors.
6. Verify the truth tables of following gates AND,OR,NOT,NAND,NOR
7. Observe and draw output waveforms of
 - Half wave rectifier without filter and with filters.
 - Full wave rectifier without filter and with filters.
8. Determine line and load regulation using Zener diode.
9. Measurement of the displacement by using linear variable differential transformer (LVDT).
10. Measurement of pressure using strain gauge.

Note: Practicals to be performed in group of 3-4 students

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1.	Theraja BL	Fundamentals of Electrical and Electronics Engineering	S. Chand and company LTD
2.	P L Kohli	Automotive Electrical Equipments	Tata McGraw hill Publishing Company Ltd
3.	Jack Erjavec, Robert Scharff	Automotive Technology-System Approach	Delmar Publisher
4.	A. K. Sawney	Electrical and Electronic Measuring Instruments	Dhanpat Rai and sons.
5	Thomas Malvino	Electronic Principles	Tata McGraw hill Publishing Company Ltd
6	V. K. Mehta	Principles of Electrical and Electronics Engineering	S. Chand and company Ltd.
7	Sedha R.S.	Applied Electronics	S. Chand and company Ltd
8.	Santiram Kal	Basic Electronics	PHI Pvt. Ltd.
9.	Debashis De	Basic Electronics	Pearson
10	R. Savan Kymar, K.V. Inoth Kumar, V. Jegathesan	Basic Electrical and Electronics	Wiley Precise publisher
11.	T. Thyagaran	Fundamental of Basic Electrical and Electronics	Scitech

- 2. Websites:**
- www.educyclopedia.be
 - www.howstuffworks.com
 - www.ee.iitm.ac.in
 - www.ee.iitb.ac.in
 - en.wikipedia.org

Course Name : Diploma in Automobile Engineering**Course Code : AE****Semester : Fifth****Subject Title : Design of Automobile Components****Subject Code : 17525****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	04	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).**

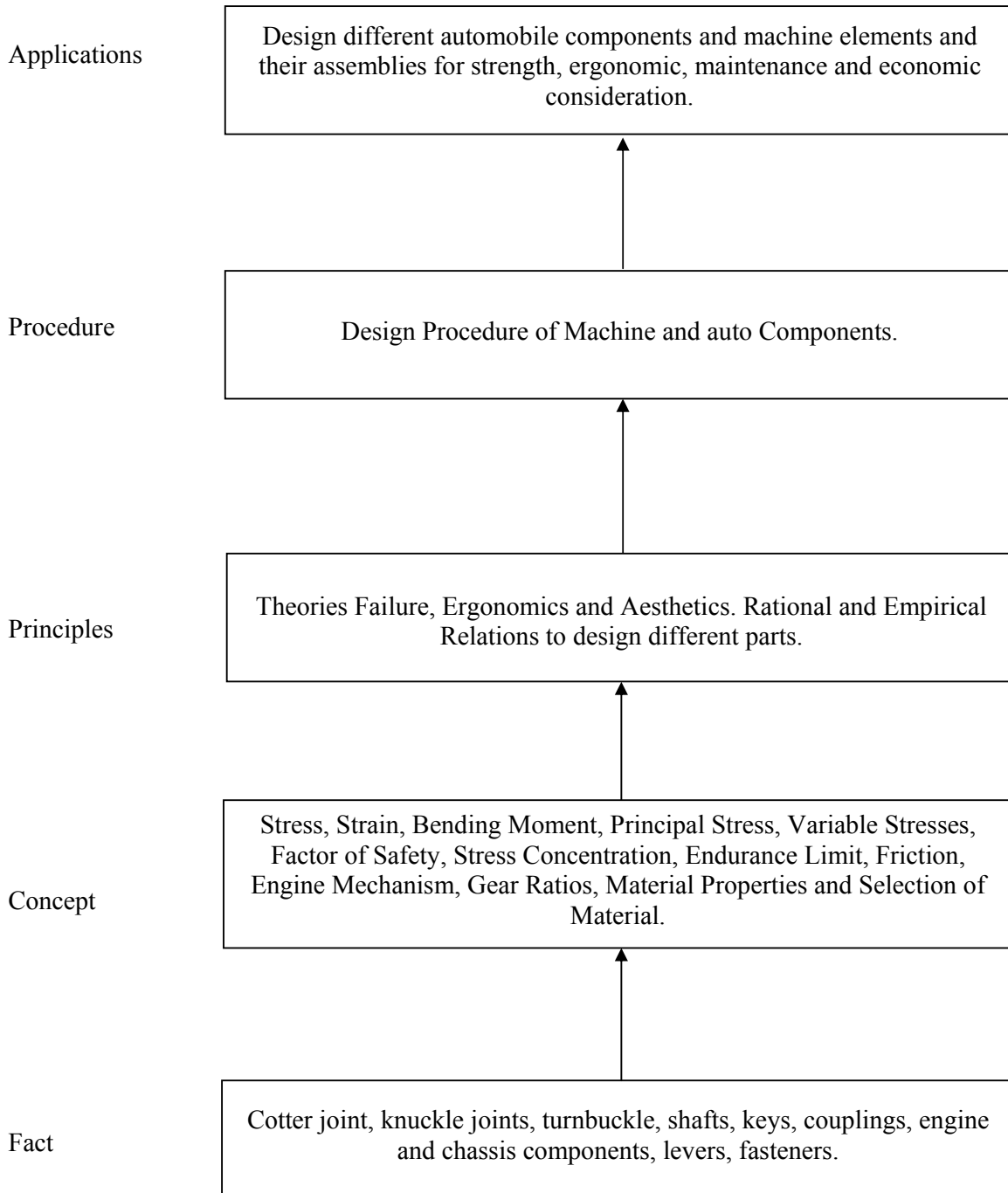
Rationale:

Automobile component design is applied technology subject, which requires knowledge of Mechanisms, Strength of materials, Material sciences- Manufacturing processes and Mechanical engineering drawing. This subject deals with fundamental principles of machine design applied to automobile components. It also gives exposure to standard codes of practices and Use of Design Data Book.

General Objectives:

Student will be able to

1. Analyze the loads, type of induced stresses, resisting areas and hence the modes of failure.
2. Identify and apply modes of failure and relevant theory of failure for problem solving.
3. Analyze practical problems and selection of materials, strength equations, factor of safety, stress concentration factors etc.
4. Know the design process.

Learning Structure:

Theory:

Topic and Content	Hours	Marks
<p>1: Fundamentals of Design.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know the concept and process of engineering design and concept of post design aspect. ➤ Use of design factors. ➤ Select materials for various automobile components. <p>Content:</p> <p>1.1 Introduction to design 4 Marks</p> <ul style="list-style-type: none"> • Classification of design (system design, component design, product design) • Design consideration (Mode of Failure- strength, deformation, fracture, corrosion and wear) • Design procedure • Types of Load- Actual and design loads. Factors to find design loads such as service factor, overload factor, velocity factor and factor of safety. Stress concentration - causes and remedies • Bolts of uniform strength <p>1.2 Stress analysis:(Revision only)</p> <ul style="list-style-type: none"> • Types of external loads • Types of induced stresses: tensile, compressive, shear, Crushing and bearing pressure, bending, torsion, thermal stresses, principal stresses. • Stress – strain diagram for ductile and brittle material and it's use <p>1.3 Variable stresses in machine parts. 4 Marks</p> <ul style="list-style-type: none"> • Fatigue and endurance limit, S-N diagrams for variable stresses • Working stresses for static load, variable or fatigue load. • Factor of safety and its selection. <p>1.4 Introduction to theories of failure. 4 Marks</p> <ul style="list-style-type: none"> • Maximum principal stress theory. • Maximum shear stress theory. • Distortion energy theory. (Simple numerical only) <p>1.5 Materials and other considerations in design. 8 Marks</p> <ul style="list-style-type: none"> • Selection of material for Automobile components and its justifications on the basis of mechanical, thermal properties, manufacturing, wear considerations, cost. • Concept of standardization, preferred numbers and interchangeability in design practice. • Principles of Ergonomics, Aesthetics in designing automobile components. 	10	20
<p>2: Design of Joints.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Find induced stress and resisting area for various cross sections. ➤ Find the dimensions of components of joints <p>Content:</p> <ul style="list-style-type: none"> • Design of socket and spigot type cotter joint. • Design of knuckle joint • Design of Turn buckle • Applications of above joints in the automobile. 	06	12

<p>3: Design of shafts, keys and Coupling.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Differentiate between shaft, axle and spindle ➤ Know design procedure of shaft, keys and couplings. ➤ Understand concept of critical speed and whirling of shaft. <p>Content:</p> <p>3.1 Shafts and Keys 10 Marks</p> <ul style="list-style-type: none"> • Types - Transmission, machine, axle, spindle. • Design considerations of shaft –strength, rigidity (lateral and torsional) • Design of propeller shaft, Rear axle. • Concept of whirling and critical speed of the shaft • Types of keys and their applications,, • Design of sunk key. • Effect of keyways on shaft strength. <p>3.2 Design of couplings- flange, and bush pin type flexible coupling 08 Marks</p>	08	18
<p>4: Design of levers.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Identify various types of levers. ➤ Find the dimensions of components of levers <p>Content:</p> <ul style="list-style-type: none"> • Types of levers – simple, compound, differential, acute and obtus angle lever, hand levers and foot pedals. • Design of rocker arm, bell crank lever. 	04	08
<p>5: Design of Chassis Component</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Calculate diameters of clutch plate ➤ Calculate number of teeth on each gear in the gear box. ➤ Calculate dimension of semielliptical leaf spring. <p>Content:</p> <p>5.1 Design of clutch 6 Marks</p> <ul style="list-style-type: none"> • Single plate and Multi plate, using uniform pressure and wear condition. <p>5.2 Gearbox 6 Marks</p> <ul style="list-style-type: none"> • Teeth calculation of gears for sliding mesh/constant mesh gear box • Concept of minimum number of teeth on spur pinion <p>5.3 Leaf Spring 6 Marks</p> <ul style="list-style-type: none"> • Concept of nipping. • Design of semi elliptical leaf spring. 	08	18
<p>6: Design of engine components</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Calculate various loads acting on different components of engine and find out their dimensions. <p>Content:</p> <p>6.1 Cylinder and cylinder head 6 Marks</p> <ul style="list-style-type: none"> • Data of engine specifications and calculations of cylinder dimensions for given power. • Design of cylinder head thickness <p>6.2 Piston 10 Marks</p> <ul style="list-style-type: none"> • Design of piston crown by bending strength and thermal considerations. • Design of piston rings and skirt length • Design of piston pin for bearing, bending and shear considerations <p>6.3 Connecting Rod 8 Marks</p>	12	24

<ul style="list-style-type: none"> • Design of connecting rod cross -section (I section). • Design of connecting rod small end • Design of big end, cap and bolts. 		
Total	48	100

Practical:

Skills to be developed:

Intellectual Skills:

1. Analyze the loads, resisting areas, types of induced stresses on automobile components
2. Identify the engine and chassis components which may fail due to stress concentration,
3. Calculate the dimensions of automobile components.
4. Identify different engine and chassis components.
5. Identify different fasteners used in automobiles.

Motor Skills:

1. Draw various automobile components as per the designed dimensions.
2. Suggest materials for automobile components.
3. Use design data book to standardize component dimensions.

List of Practical:

1. Design any one joint and coupling for specified data. Select suitable materials and prepare assembly-detail drawings indicating overall dimensions, tolerances, hardness and surface finish. Prepare bill of material.
2. Design of Automobile components:
 - a) Engine components: - Piston and connecting rod.
 - b) Design of chassis components: - Clutch, Propeller shaft and rear axle, leaf spring for specified data.
For the above components select suitable materials, prepare drawing indicating overall dimensions, tolerances, hardness and surface finish.
3. Design any one of the following systems: Transmission system, Valve Mechanism, Suspension system.

List of Assignments:

1. Identify and classify the different engine and chassis components according to the type of load to which they are subjected. Also state the types of induced stresses in them.
2. Identify the different engine and chassis components which may fail due to stress concentration, observe and state remedy to reduce stress concentration
3. Suggest materials with justifications for components like gears, piston, piston rings, leaf springs, cylinder head and engine block, chassis, valves etc.
4. Identify different fasteners used in an automobile, justify their locations.

Learning Resources:**Books:**

Sr. No.	Author	Title	Publisher / Edition
01	P.Kannaiah	Machine Design.	Scitech
02	U.C. Jindal	Machine Design	Pearson Publication
03	PSG Coimbtore	Design data book	PSG Technical Institute
04	R. B Gupta	Auto design	Satya Prakashan
05	K.Ganesh Babu/K. Srithar	Design of machine elements.	Tata McGraw Hill
06	B.V.Bhandari	Design of machine elements.	Tata McGraw Hill
07	J. E. Shigley	Machine Design	Tata McGraw Hill

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.

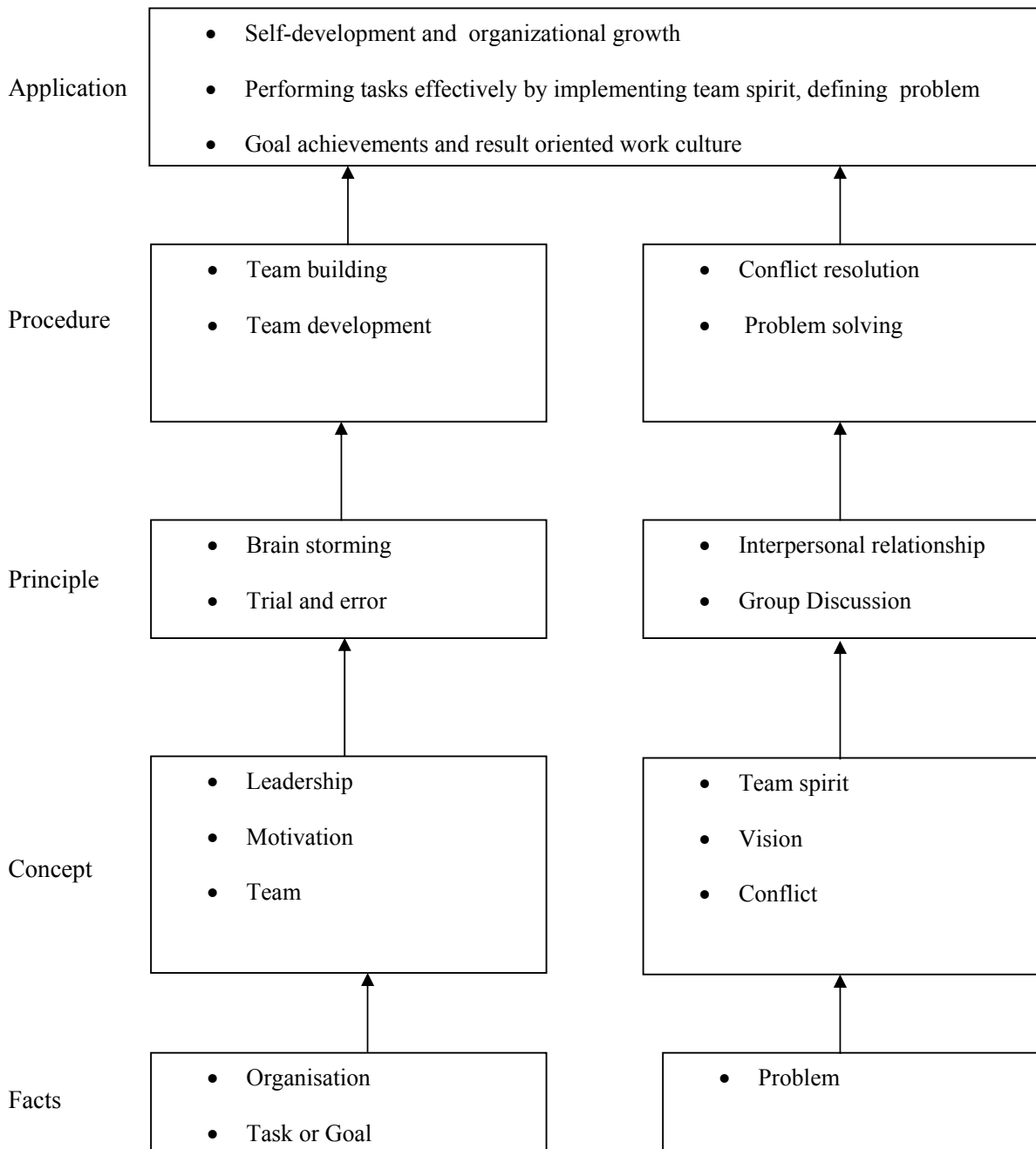
This subject of 'Behavioural Science' provides a broad base in which a technician can develop a successful career in the world of work.

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

6.4	Types of decisions- programmed, non programmed, strategic, tactical, impulsive	
6.5	Group decision making	
6.6	Steps of decision making	
Topic 7: Interview Techniques		
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	02
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	
Total		16

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:**

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 : AE/ME/PG/PT/MH/MI

Semester : Fifth

Subject Title : Solid Modeling

Subject Code : 17063

Teaching and Examination Scheme:

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

Rational:

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

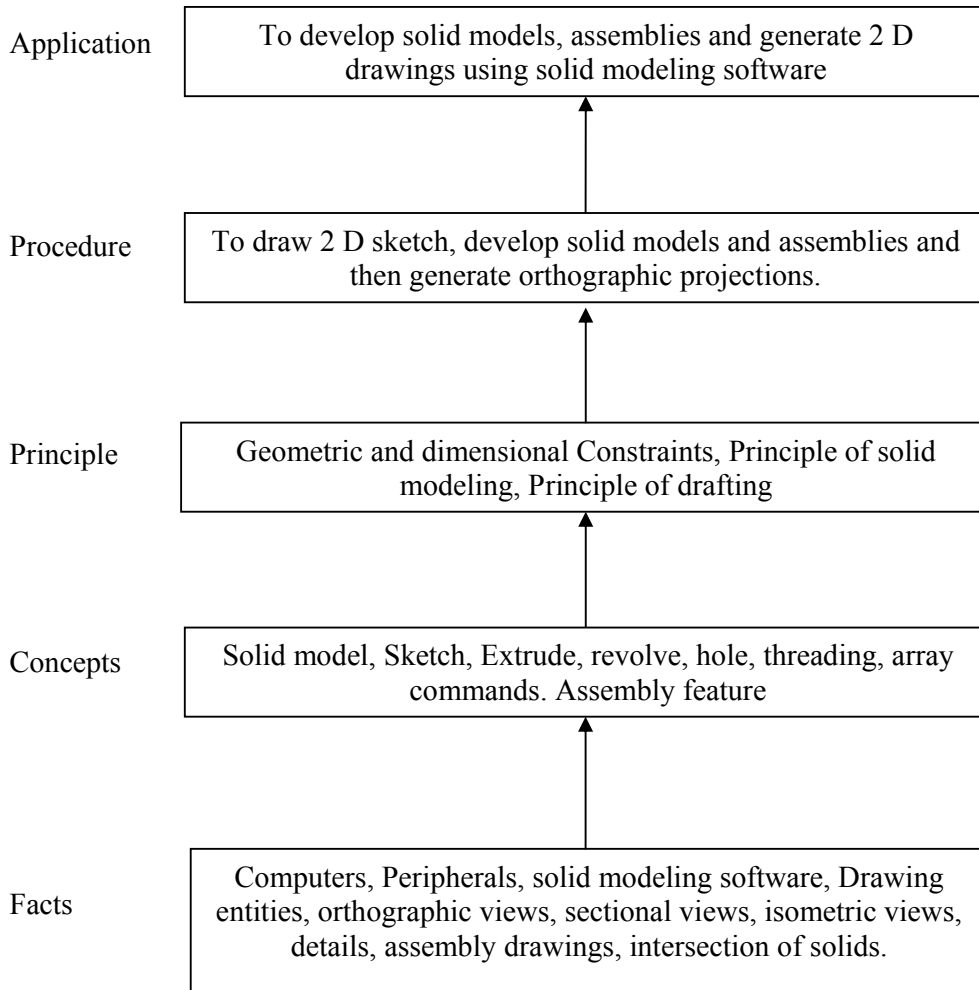
Today 3D models are used in wide variety of engineering fields. Three dimensional computer graphics are widely used for product design, assembly design etc. As a diploma engineer he should have the knowledge of solid modeling software to visualize the machine components & assembly like cars, machine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

General Objectives:

Students will be able to

- 1) Develop solid models.
- 2) Prepare assembly using details.
- 3) Generate orthographic drawing from a solid models.
- 4) Apply dimensions, tolerances and geometrical tolerances.
- 5) Plot a drawing

Learning Structure:



Theory:

Topic and Content	Hours
<p>1: Introduction to Solid Modeling Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Know applications of solid modeling. ➤ Use of solid Modeling. ➤ Identify and select hardware and software for solid modeling. <p>Content: Introduction, Applications, Benefits, Need, Hardware Requirements, Different Software packages used for Solid Modeling.</p>	02
<p>2: Working in 2 D environment Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Draw 2 D sketch. <p>Content: 2.1 Working in Sketcher mode – Line, Profile, Circle, Arc, Rectangle and their sub options. 2.2 Constraints - Dimensioning constraint, Geometrical constraint.</p>	02
<p>3: Creation of solid models Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Develop solid model. ➤ Apply Boolean operations. <p>Content: 3.1 Working in 3 D environment -Creating 3D Solid Models of simple machine parts. 3.2 Intersection of solids – Intersect 2 solid components by inserting new body option, Boolean operations – Union, subtract, intersection.</p>	04
<p>4: Assembly Drawing Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Generate assembly drawing. <p>Content: 4.1 Assembly Drawing - Preparation of Assembly drawing by using assembly features. (Assembly of minimum 4-5 components) 4.2 Exploded view – Explode the assembly.</p>	04
<p>5: Working in Drafting Mode Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Generate orthographic projections. ➤ Apply dimensions, tolerances and geometric tolerances. ➤ Prepare part list. <p>Content: 5.1 Orthographic projections – Generate orthographic projections which will include all types of views – front view, top view, side view, sectional views, isometric views, auxiliary views. 5.2 Dimensioning Commands – Apply dimensions, dimensional and geometrical tolerances. 5.3 Bill of material – Prepare part list table and name plate</p>	03
<p>6: Plotting drawing Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Plot a drawing. <p>Content: Page set up, Plot command.</p>	01
Total	16

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

Practical:

List of practicals:

1. Draw 2 D sketch
2. Prepare solid component from 2 D sketch
3. Modify solid model Component
4. Prepare assembly drawing from machine components
5. Explode assembly drawing
6. Draw intersection of solids
7. Prepare orthographic & sectional views from solid model.
8. Plotting of drawings on A2/A3 size sheet.

Guideline for Practical: One student per computer terminal.

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

Practical Examination: (2 Hours for each student)

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

Skills to be developed

Intellectual skills:

- 1) Understand degrees of freedom.
- 2) Interpret a drawing to draw in solid Modeling software.
- 3) Know command dialogue box.

Motor Skills:

- 1) Use toolbars.
- 2) Draw 2 D sketch.
- 3) Create solid model.
- 4) Generate assembly.
- 5) Generate orthographic projections.
- 6) Use printers and plotters.

List of Assignments:

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

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher / Edition
1	Sham Tickoo	CATIA V5R17 for Designers	Softcover, Cadcim Technologies
2	Sham Tickoo	Pro/Engineer Wildfire for Designers	Softcover, Cadcim Technologies
3	Sham Tickoo	SolidWorks For Designers Release 2006	Softcover, Cadcim Technologies
4	Sham Tickoo	Autodesk Inventor for Designers: Release 10	Softcover, Cadcim Technologies
5	Sham Tickoo, Deepak Maini	NX 4 for Designers	Softcover, Cadcim Technologies
6	Sham Tickoo, Deepak Maini	Solid Edge V19 for Designers	Softcover, Cadcim Technologies
7	--	Various advance 3d modelling software manuals	--

2. CDs, PPTs Etc.:

- 1 Tutorials Catia V5 by CADENV website: www.cadenv.com
- 2 Pro/ENGINEER Multimedia Trainer DVD from CADCIM
 - a. website: www.cadcimtech.com
- 3 Solid Edge Training Videos by Edge Learn Interactive
- 4 NX4 DVD Video Training website: www.traing-classes.com
- 5 SolidWorks 2011 Traing Video by website: www.soloidworkstutorials.com
- 6 Video Bases Autodesk Inventor 2011 Tutorial website: www.softwaretraingtutorials.com

3. Websites:

1. <http://catiatutor.com/>
2. http://www.cadenv.com/Tutorials/catia_tutorials/Catia.htm
3. <http://www.frotime.com/>
4. <http://www.proetutorials.com/>
5. <http://www.solidworks.com/sw/resources/solidworks-tutorials.htm>
6. http://www.solidengineering.co.nz/solidworks_free_tutorials.htm
7. www.solidedgetutorials.com/
8. <http://appsci.queensu.ca/courses/APSC161/SETutorials.php>
9. http://homepages.cae.wisc.edu/~me232/ug_tutorials/ug_tutorials.htm
10. <http://www.jqoc.com/soft/Unigraphics-Tutorial/>

Equipment List:

- 1) Latest Configuration Computers which can be able to run latest any Solid Modeling Software. (One Computer per student in practical session.)
- 2) Any latest Authorised Solid Modeling Software.
- 3) Plotter of size A2/A3
- 4) LCD Projector

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.

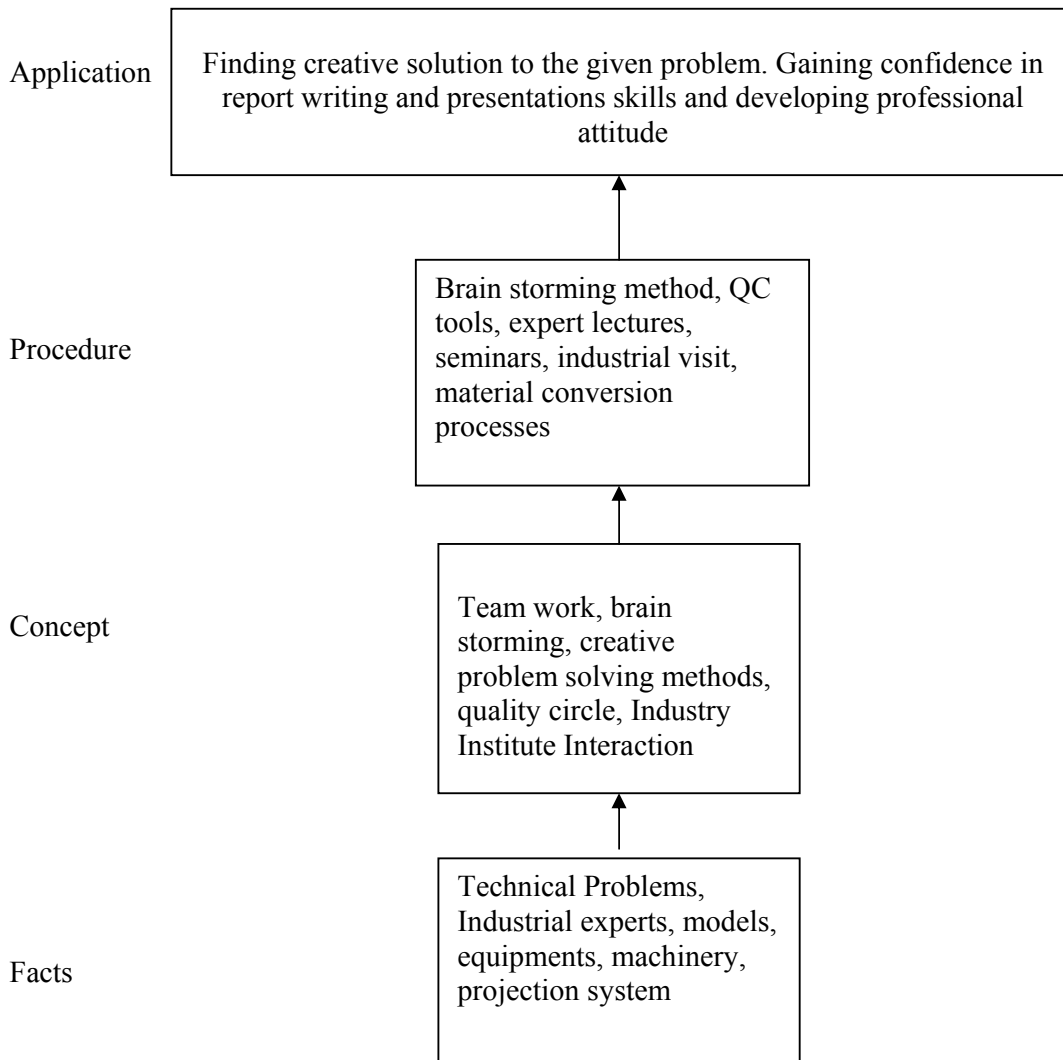
Professional development of Diploma engineering students is to be done by exposing them to various simulative situations in the industries. This can be achieved by inculcating attitude to face the problems, get alternative solutions and validation of the selected alternatives. This is achieved by involving 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

<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
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<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

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 IVth 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, 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