



BANGLADESH TECHNICAL EDUCATION BOARD
Agargaon, Dhaka-1207

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)

POWER TECHNOLOGY

TECHNOLOGY CODE: **671**

7th SEMESTER

DIPLOMA IN ENGINEERING
PROBIDHAN-2016

POWER TECHNOLOGY(671)
7th SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total
						Theory		Practical		
						Cont. assess	Final exam	Cont. assess	Final exam	
1	67171	Auto Electricity & Electronic	2	6	4	40	60	50	50	200
2	67172	Automobile Trouble Shooting & Driving	2	6	4	40	60	50	50	200
3	67173	Power Engineering Project	0	6	2	0	0	50	50	100
4	66253	Automobile Air-conditioning	2	3	3	40	60	25	25	150
5	66773	Switch Gear & Protection	3	3	4	60	90	25	25	200
6	65853	Innovation & Entrepreneurship	2	0	2	40	60	0	0	100
Total			11	24	19	220	330	200	200	950

AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of automobile, electrical and electronic system with special emphasis on-

- Function, construction and operation of electrical devices used in automobile
- Troubleshooting and diagnosis of electrical devices used in automobile
- Wiring of automobiles
- Color coding and a selection of wire for wiring of automobiles.
- Fundamentals of hybrid car.
- Electronic dashboard instruments.

SHORT DESCRIPTION

Features of storage battery; Battery testing; Battery charging; Battery, maintenance; Conventional ignition system, Spark plug; starting system; Charging system; Vehicle wiring; Lighting system; Horn and horn relay; Windshield wiper, Diesel electronic fuel injection, Electronic fuel injection, Sensor, Actuator, Electronic component, Hybrid car, Electronic dashboard instruments.

DETAIL DESCRIPTION**Theory:****1. Understand the features of storage battery.**

- 1.1 Define lead acid battery.
- 1.2 Explain the construction and operation of lead acid battery.
- 1.3 State the low maintenance, maintenance free and hybrid battery.
- 1.4 Outline alkaline batteries constructed of Nickel-Iron battery, Nickel-cadmium battery and Silver-zinc battery.
- 1.5 State the battery voltage, battery rating and battery specification.
- 1.6 Explain the chemical reaction happens in battery cell during charging and discharging period.
- 1.7 Analyze the battery terminal test, leakage test, Specific gravity test, Open circuit voltage test, High discharge test & Capacity test.
- 1.8 Predict the factors affecting battery life.

2 Understand the features of battery Charging, Testing and Maintenance.

- 2.1 Outline the battery testing procedures.
- 2.2 Explain the different testing procedures of storage battery.
- 2.3 Describe the different types of battery charging system.
- 2.4 List the causes of battery faulty and failure.
- 2.5 Describe the process of storing of dry, wet and uncharged battery.

3 Understand the features of ignition system.

- 3.1 Outline the purpose of ignition system.
- 3.2 State different types of ignition system.
- 3.3 Describe the operation of magneto, CDI (Capacity Discharge Ignition), DLI (Distributor less Ignition) & DIS (Direct Ignition System) ignition system.
- 3.4 Outline the advantages & disadvantages of ignition system.
- 3.5 Describe the procedure of ignition timing setting.
- 3.6 Outline advantage and disadvantage of magneto, CDI, DLI&DIS ignition System.

4 Understand the features of spark plug.

- 4.1 State the purpose of spark plug.
- 4.2 Outline the classification of the spark plug.
- 4.3 Illustrate the construction of the spark plug.
- 4.4 Identify the spark plug defects.
- 4.5 Describe the procedure of spark plug servicing.

- 5 Understand the electric motor starting system.**
- 5.1 List the components of an electric motor starting system.
 - 5.2 Outline the classification of starter motor.
 - 5.3 Describe the operation of electric motor starting system component with circuit diagrams.
 - 5.4 Discuss the operation of different type of starter.
 - 5.5 Explain the starter motor drive mechanism.
- 6 Understand the features of charging system.**
- 6.1 Describe the operation of the automotive charging system with circuit diagrams.
 - 6.2 Describe the construction & operation of the alternator.
 - 6.3 Outline the functions of the alternator, rectifier, heat sink, rotor, stator, slip ring, carbon brush.
 - 6.4 Describe the operation of the electronic type alternator regulator.
 - 6.5 Explain the self excitation and battery excitation type alternator.
 - 6.6 Describe the procedure of testing, servicing and repairing of alternator with components.
- 7 Understand the wiring and light system of vehicle.**
- 7.1 Define the automobile wiring.
 - 7.2 List the typical cable and equipment used in vehicles.
 - 7.3 Describe cable size and color code used in vehicles.
 - 7.4 Illustrate the wiring diagram of a modern vehicle.
 - 7.5 Outline the purpose of lighting system of vehicle.
 - 7.6 List the components of the head light.
 - 7.7 Outline the functions of head light relay and dimmer switch.
 - 7.8 Describe the method of head light adjustment aiming.
 - 7.9 Describe the simplified side indicating light circuit of automobile.
 - 7.10 Explain the different types of flasher used in automobile.
- 8 Understand the features of horn and windshield wiper.**
- 8.1 Outline the different types of horn used in automobile.
 - 8.2 Outline the purposes of horn relay.
 - 8.3 Illustrate the horn circuit diagram of the vehicle.
 - 8.4 Describe the operation of the electric horn circuit with relay.
 - 8.5 Describe the procedure of adjusting horn.
 - 8.6 State the purposes of windshield wiper, wiper motor and windshield washer.
 - 8.7 Name the different types of windshield wiper mechanism.
 - 8.8 Describe the operation of windshield wiper and washer mechanism.
 - 8.9 Explain the intermittent wiping principles.
- 9 Understand the Diesel electronic fuel injection /Common Rail Diesel Injection (CDI)**
- 9.1 Define the electronic fuel injection CDI system of a diesel engine.
 - 9.2 Outline the purpose of CDI system.
 - 9.3 Outline the name of different types of diesel CDI system.
 - 9.4 Explain the principle of operation of the CDI system with diagram.
 - 9.5 Explain the advantages of the CDI system over conventional systems.
- 10 Understand the electronic fuel injection (EFI) system.**
- 10.1 Define electronic fuel injection (EFI) system.
 - 10.2 State the purpose of EFI system.
 - 10.3 Outline the name of the different types of EFI system.
 - 10.4 List the components of the EFI system.
 - 10.5 Describe the principle of operation of EFI system with diagram.
 - 10.6 State advantages and disadvantage of EFI system over carburetor system.
 - 10.7 Explain the D-Jetronic, L-Jetronic and K-Jetronic system.
- 11 Understand the features of sensors & actuators.**
- 11.1 Define sensor.
 - 11.2 Outline the purpose of the sensor used in diesel & gasoline-EFI system.
 - 11.3 Name different types of sensors used in automobile.
 - 11.4 Describe the operation of lambda (oxygen) sensor, air flow sensor, engine temperature sensor throttle position sensor, manifold absolute pressure (MAP) sensor, knock sensor, intake air temperature sensor.
 - 11.5 Outline the uses of brake pad wear sensor and fluid level sensor.
 - 11.6 Define actuator.
 - 11.7 Identify different types of actuators used in automobile.
 - 11.8 Describe the operation of different types of actuators such as an idle speed control (ISC) valve, gasoline & diesel fuel injection, igniter, circuit opening relay & EFI main relay.

- 12 Understand the feature of electronic components & systems.**
- 12.1 Define the Sensor testing Oxygen sensor, Engine coolant sensor, Intake air temperature sensor, Throttle position sensor, Manifold absolute pressure sensor.
 - 12.2 State the purpose of OBD-II Terminology Drive cycle, Trip, Warm up cycle.
 - 12.3 Explain the (on-board diagnostic) OBD-II system, flash codes of malfunction indicator light.
 - 12.4 Describe the working principle of the electronic control module.
 - 12.5 Describe the procedure of Electronic fuel injector test by diagnostic tool.
 - 12.6 Explain the SAE J2012 standards Diagnostic trouble code (DTC): 5 (five) digits only.
- 13 Understand the automotive, Hybrid Car.**
- 13.1 Define Hybrid Car.
 - 13.2 Discuss Hybrid Vehicles by Engine Arrangement. a) Series Hybrid b) Parallel Hybrid c) Series Parallel Hybrid d) Plug-In Hybrid Vehicles (PHVs) e) Split-Axle Hybrid Vehicle.
 - 13.3 Describe Hybrid Vehicles by Power Source a) Mild Hybrid b) Full Hybrid c) Plug-In d) Performance.
 - 13.4 Outline the advantages & disadvantages of Hybrid Vehicles.
 - 13.5 Outline the safety in High Voltage Vehicles.
 - 13.6 Describe major components & operation of the Hybrid car.
- 14 To understand the electronic dash board instruments.**
- 14.1 List the electronic dash board instruments.
 - 14.2 Identify the electronic instruments on the dashboard with the figure.
 - 14.3 Describe the operation of electronic tachometer, temperature gauge, fuel gauge, pressure gauge, oil pressure gauge, speedometer, odometer, trip Odometer.
 - 14.4 Explain the operation of trip computer with block diagram.

PRACTICAL:

- 1. Perform the test of storage battery.**
 - 1.1 Identify the components of a lead acid battery.
 - 1.2 Observe the lead acid battery by cutting an old (rejected) lead acid battery.
 - 1.3 Prepare the procedure of preparing electrolyte.
 - 1.4 Open the vent plugs.
 - 1.5 Topping up the battery.
 - 1.6 Measure specific gravity of all cells by hydrometer and record the readings.
 - 1.7 Write battery maintenance and safety precautions.
 - 1.8 Compare the reading and find out the problem of battery.
 - 1.9 Submit the report.
- 2. Perform charging of lead acid battery.**
 - 2.1 Clean the post terminals and topping up the battery.
 - 2.2 Connect the battery with charger.
 - 2.3 Set voltage and current for slow charging.
 - 2.4 Set voltage and current for quick charging.
 - 2.5 Set voltage and current for trickle charging.
 - 2.6 Set voltage and current for charging more than one battery at a time in series connection.
 - 2.7 Set voltage and current for charging more than one battery at a time in parallel connection.
 - 2.8 Check hydrometer test and high discharge load test.
 - 2.9 Compare the hydrometer reading.
 - 2.10 Submit the report.
- 3. Perform the Ignition coil test.**
 - 3.1 Identify the components of Ignition coil system.
 - 3.2 Connect the components and complete the wiring of Ignition system.
 - 3.3 Conduct open circuit Test of the ignition coil.
 - 3.4 Measure Primary and secondary coil resistance test.
 - 3.5 Conduct Short test of an ignition coil.
 - 3.6 Submit the report.

- 4. Perform the spark plug test.**
 - 4.1 Open the spark plug from the cylinder head.
 - 4.2 Clean the spark plug perfectly.
 - 4.3 Check the insulation for cracking.
 - 4.4 File the tip of center electrode.
 - 4.5 Adjust the gap accurately.
 - 4.6 Check the intensity of the spark.
 - 4.7 Fix or replace the spark plug.
 - 4.8 Submit the report.

- 5. Practice the starting motor.**
 - 5.1 Identify the components of starting motor circuit.
 - 5.2 Remove the starter motor from the engine.
 - 5.3 Open circuit, short circuit, ground test of starter motor.
 - 5.4 Pull in coil, hold in coil, terminal point check and test of solenoid switch.
 - 5.5 No load and load on test of starter motor.
 - 5.6 Assemble the starter motor.
 - 5.7 Submit the report.

- 6. Perform charging circuit of automobile.**
 - 6.1 Identify the components of charging circuit.
 - 6.2 Remove the alternator and alternator regulator from the engine.
 - 6.3 Clean the alternator and alternator regulator.
 - 6.4 Reinstall the alternator and alternator regulator.
 - 6.5 Complete the charging circuit.
 - 6.6 Test the operation of charging circuit.
 - 6.7 Submit the report.

- 7. Perform output test of the alternator.**
 - 7.1 Disassemble the alternator.
 - 7.2 Test each component for workability.
 - 7.3 Assemble the alternator.
 - 7.4 Run the engine and measure the output of the alternator.
 - 7.5 Submit the report.

- 8. Perform the automotive lighting system.**
 - 8.1 Identify the lighting circuit of automobile.
 - 8.2 Connect and complete the wiring of lighting circuit on a board or vehicle.
 - 8.3 Test the light, fuse, relay and circuit.
 - 8.4 Conduct the lighting circuit operation.
 - 8.5 Submit the report.

- 9. Perform the automotive horn circuit.**
 - 9.1 Identify the components of horn circuit.
 - 9.2 Connect the horn circuit on a circuit board.
 - 9.3 Test the operation of horn circuit.
 - 9.4 Adjust the perfect tone.
 - 9.5 Submit the report.

- 10. Perform the windshield wiper & washer circuit wiring.**
 - 10.1 Identify the components of windshield wiper & washer mechanism.
 - 10.2 Connect the windshield wiper & washer circuit.
 - 10.3 Test the operation of windshield wiper & washer circuit.
 - 10.4 Fix or replace of windshield wiper & washer circuit if required.
 - 10.5 Submit the report

- 11. Perform the test of electronic fuel injection (EFI) system.**
 - 11.1 Identify different component of EFI system.
 - 11.2 Test the work ability of injector & sensors.
 - 11.3 Reinstall or replace the injector & sensors if required.
 - 11.4 Submit the report.

- 12. Perform the sensor testing.**
 - 12.1 Identify the sensors used in automobile.
 - 12.2 Remove all sensors from the vehicle.
 - 12.3 Test the sensor for workability.
 - 12.4 Reinstall the sensor.
 - 12.5 Submit the report.

- 13. Perform the actuator testing.**
 - 13.1 Identify the actuators used in automobile.
 - 13.2 Remove the common actuators.
 - 13.3 Test the actuators for its workability.
 - 13.4 Reinstall the actuators.
 - 13.5 Submit the report.

- 14. Observe the dashboard instruments of automobile.**
 - 14.1 Identify the instruments of the dashboard.
 - 14.2 Test the operating condition of instruments of dashboard.
 - 14.3 Remove the dashboard faulty instruments.
 - 14.4 Repair or replace the instruments.
 - 14.5 Test the operating condition of dashboard.
 - 14.6 Submit the report.

REFERENCE BOOKS

1. Automotive Electrical Equipment - W H Crouse.
2. Automobile Electrical and Electronic System - A Tranter.
3. Automotive Electronic System - Trevor Mellard.
4. Automobile Electrical Equipment - P L Kohli.
5. Vehicle Operation and performance- Giles. J.G., Hiffie Books Ltd., London, 1989.
6. Motor Vehicle Inspection- Crouse. W.H. and Anglin. D.L., McGraw Hill Book Co., 1978.
7. Internal Combustion engines- Ganesan. V., Tata McGraw Hill Co., 1994.

AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of Vehicles driving and automotive troubleshooting & diagnosis with special emphasis on:

- Trouble-diagnosis of automotive engine and their system.
- Trouble-diagnosis of automotive power trains.
- Trouble-diagnosis of automotive chassis.
- Trouble-diagnosis of vehicle lighting systems.
- Driving technique moving vehicle.
- Traffic sign, signal and road marking vehicle acts.
- Emergency, Safety and first aid during driving.

SHORT DESCRIPTION:

Trouble diagnosis of automotive engine, ignition systems, fuel systems, lubricating system; cooling system; electric starting system; charging system; automotive of power trains; automotive lighting system and Process with fault code.

Fitness to drive a vehicle: Ideal position of driver; vehicle Takeoff/marching procedure; Technique of gear changing; safety and first aids; Motor vehicle Act, memorandum, law, rules and regulation. Traffic signals, sign, road marking & traffic signal gesture/acts; Procedure of Driving license; Vehicle registration; route permit, fitness certificate; tax-token, insurance certificate, ownership transfer, Endorsement, PSV badge; Instructor driving license and conductor license.

DETAIL DESCRIPTION**Theory:****1. Understand trouble diagnosis of automotive engine.**

- 1.1 Define the troubleshooting.
- 1.2 Outline the importance of troubleshooting and diagnosis in the automotive field.
- 1.3 Outline the advantages achieved by using a planned procedure for troubleshooting.
- 1.4 Outline the point that should be kept in mind when using the trouble shooting check lists.

2. Understand the trouble diagnosis of ignition system.

- 2.1 Outline the different types of trouble diagnosis ignition system.
- 2.2 List of the possible fault of conventional ignition system.
- 2.3 Explain the trouble diagnosis of CDI system.
- 2.4 Describe the trouble diagnosis of DLI, DSI ignition system.
- 2.5 Illustrate the trouble diagnosis chart of electronic ignition system.

3. Understand the trouble diagnosis of fuel system.

- 3.1 Identify the possible causes of EFI fuel system.
- 3.2 Analyze the problem for remedies of EFI fuel system.
- 3.3 Select the possible cause of diesel fuel system.
- 3.4 Discuss the remedies for finding the problem of diesel fuel system.
- 3.5 Describe the trouble diagnosis chart of the EFI system.
- 3.6 Describe the trouble diagnosis chart of the diesel injection fuel system.

4. Understand the trouble diagnosis of lubricating and cooling system.

- 4.1 Identify the possible causes of lubricating system.
- 4.2 Analyze the problem for remedies of lubricating system.
- 4.3 Outline the possible causes and remedies of main bearing noise.
- 4.4 Identify the possible causes and remedies of connecting rod noise.
- 4.5 Describe the possible causes and remedies of oil pressure drop.
- 4.6 Select the possible cause of cooling system.
- 4.7 Outline the failure of thermostat valve.
- 4.8 Point out the function and failure of radiator pressure cap.
- 4.9 Analyze the funding problem for remedies of cooling system (VIZ over heating, radiator overflow, corrosion, lower engine temperature, noisy water pump).

5. Understand the trouble diagnosis of electric starting, charging, and Lighting system

- 5.1 Find out the possible causes and remedies of the Starter fails to operate and Starter turns but pinions do not engage.
- 5.2 State the problem and remedies of solenoid failure.
- 5.3 Outline the possible causes and remedies of failure alternator output.
- 5.4 List the possible causes and remedies of excessive charge on the battery.
- 5.5 Outline the possible causes and remedies of diode failure.
- 5.6 Describe the symptom, possible causes and remedies of the turn signal lighting system.
- 5.7 Outline the possible causes and remedies of lighting troubles viz: Light does not glow / burn, light flicker, the bulb burns out frequently.

6. Understand the trouble diagnosis of automotive Power transmission.

- 6.1 Outline the fault of automotive power transmission.
- 6.2 Identify the symptom of failure of CVT (continuous variable transmission) gear.
- 6.3 Find out the failure of quality of automatic transmission fluid (ATF).
- 6.4 Outline the symptoms and remedy of auto gear transmission.
- 6.5 Discuss the trouble diagnosis of auto gear transmission.

7. Understand the trouble diagnosis with fault code.

- 7.1 Check the engine lamp or malfunction indicator lamp.
- 7.2 Identify the fault code of vehicle.
- 7.3 Find the OBD-II diagnostic system.
- 7.4 Describe the fault diagnosis process with a scanner.
- 7.5 Analyze the fault code as per the service manual.

8. Understand the fitness to drive a vehicle.

- 8.1 Identify the body language of vehicles in traffic and of pedestrians.
- 8.2 Outline the mental fitness of a driver.
- 8.3 Explain color blind, vision error and car sickness.
- 8.4 Identify the causes of fatigue of a driver.
- 8.5 Describe the safe and defensive driving techniques.

9. Understand the vehicle Takeoff/ marching, technique of gear changing procedure.

- 9.1 Name the different types of controlling devices.
- 9.2 Outline the driver's duties & responsibilities before moving.
- 9.3 State the double de-clutching, gears and speed ratio.
- 9.4 Explain the function of controlling devices during driving.
- 9.5 Describe the safety technique of driving the vehicle.
- 9.6 Explain the necessity of a clutch pedal and accelerator pedal operation during gear change.

10. Understand the braking, stopping, parking, turning, overtaking, and maneuvering.

- 10.1 Define brake stopping distance of the vehicle.
- 10.2 Ensure brake performance test before drives the vehicle.
- 10.3 Apply brakes action procedure of the vehicle.
- 10.4 Discuss the procedure of car parking.
- 10.5 Explain parallel parking, angular parking and dead-end parking.
- 10.6 Describe the turning procedure at right turn, left turn and blind corner.
- 10.7 List the causes of skidding off wheel.
- 10.8 Outline take the precaution during overtaking.
- 10.9 Discuss the safe distance between vehicle to vehicle.

11. Understand the emergencies, safety and first aid.

- 13.1 Outline the emergency duties are performed by a driver during brake failure, broken windshield, animal on the road, tire blow off, steering failure, wheel falling off, emergency stop and towing.
- 11.1 List the emergency aids in the first aid box.
- 11.2 Describe the common first aid procedure, such as: burning, cutting and breaking of bone.

12. Understand the feature of traffic sign, Rules and Regulation:

- 12.1 Define traffic signals.
- 12.2 Outline the type of traffic signals.

- 12.3 Refer different road signals recommended by BRTA.
- 12.4 Identify the different road markings.
- 12.5 Outline the road signals shown by the traffic police / signal light.
- 12.6 Describe the traffic Rules and Regulation of motor vehicle acts.

13. Understand the features of Vehicle related requirements:

- 13.1 Identify of vehicle related papers.
- 13.2 Types of driving license.
- 13.3 Outline the factor to be considered in issuing a fitness certificate.
- 13.4 Describe the process of transfer of ownership of a vehicle.
- 13.5 Define road permit, fitness certificate, tax-token, insurance certificate, PSV badge and conductor license.
- 13.6 The process of driving license, registration, road permit, fitness Certificate, tax-token, insurance certificate, PSV (Personnel sign of the vehicle) badge and conductor license.

PRACTICAL:

1. Study the EFI fuel system.

- 1.1 Check the fuel pressure of the EFE fuel pump.
- 1.2 Check fuel leakage of EFI fuel system.
- 1.3 Remove the fuel pump from the fuel tank.
- 1.4 Repair / replace the fuel pump.
- 1.5 Assemble and fix the fuel pump.
- 1.6 Check the performance of the EFI fuel pump.
- 1.7 Check the fuel pressure regulator.
- 1.8 Diagnose the trouble of EFI system with built in electronic self-diagnostic system and rectify the troubles.

2. Study the trouble diagnosis of the diesel engine fuel system.

- 2.1 Clean / change fuel filter.
- 2.2 Remove high pressure fuel pump from the engine.
- 2.3 Remove the injectors from the engine.
- 2.4 Check the performance of high-pressure fuel pump by high pressure pump test bench.
- 2.5 Check the performance of injectors by injector tester.
- 2.6 Diagnose the diesel fuel system troubles and rectify.

3. Study the trouble diagnosis of cooling system.

- 3.1 Check the fan belt condition and coolant level.
- 3.2 Check the hosepipe the condition and cool the engine.
- 3.3 Remove the radiator pressure cap and check leakage test of cooling system.
- 3.4 Check the condition of radiator pressure cap.
- 3.5 Check the thermostat valve condition.
- 3.6 Check the water pump operation and condition.
- 3.7 Diagnose the troubles of cooling system and rectify.

4. Study the trouble diagnosis of Lubricating system.

- 4.1 Start the engine and check the oil pressure gauge reading measurements.
- 4.2 Check oil level by use deep-stick level.
- 4.3 Change/addlubeoil.
- 4.4 Change the oil filter.
- 4.5 Check the oil pressure switch.
- 4.6 Diagnose and rectify the troubles of lubricating system.

5. Study the trouble diagnosis of ignition system.

- 5.1 Check the performance of ignition system.
- 5.2 Remove the spark plug and check the condition of the spark plug by the spark plug tester.
- 5.3 Clean, check spark plug gap and adjustment if necessary.
- 5.4 Check the ignition coil resistance by multimeter and Replace the ignition coil if required.
- 5.5 Diagnose and rectify the ignition system troubles by diagnose tool (scanner).

6. Study the charging system.

- 6.1 Check the performance of the charging system.
- 6.2 Check the charge indicator lamp condition on the dashboard and check the charging fuse and relay.
- 6.3 Check alternator output and input voltage by multimeter.
- 6.4 Check the pulley belt tension or condition.
- 6.5 Check the performance of voltage regulator.
- 6.6 Remove the alternator from the engine and check the coil, diode, slip ring carbon of the alternator.
- 6.7 Diagnose and rectify the charging system troubles.

7. Study the starting system.

- 7.1 Check the performance of starting systems.
- 7.2 Check the fuse and relay of starting systems.
- 7.3 Check the solenoid contact, ignition switch and cable connection of starting system.
- 7.4 Check the battery performance test.
- 7.5 Remove the starting motor and dismount the motor and check the armature coil, field coil, carbon brush, solenoid pull in the coil and hold in the coil.
- 7.6 Assemble the motor and diagnose and rectify the charging system troubles.

8. Study the lighting system.

- 8.1 Check the performance of the lighting system.
- 8.2 Check the fuse and relay of the lighting system.
- 8.3 Check the cable connection and main light switch, upper and dipper switch and their lamps.
- 8.4 Assemble the connection and diagnose and rectify the lighting system troubles.

9. Understand the trouble diagnosis of clutch.

- 9.1 Check the performance of diagnosis of clutch.
- 9.2 Disassemble the clutch from the engine.
- 9.3 Check the clutch cylinder, linkage and clutch plate.
- 9.4 Check the pressure plate, clutch plate and release bearing, torsion spring and fork.
- 9.5 Assemble the clutch and fitting to the engine.

10. Study the brake system.

- 10.1 Check the performance of diagnosis of the brake system.
- 10.2 Check the component of master cylinder, wheel cylinder, brake line, brake paddle linkage, air gap, brake shoe retainer spring tension of the brake system.
- 10.3 Diagnosis of fault testing of brake system.
- 10.4 Assemble the brake system and add brake fluid fill in reservoir.
- 10.5 Remove air in the brake system like as air bleeding.
- 10.6 Performance check the brake system.

11. Understand the auto transmission system.

- 11.1 Check the performance of diagnosis of the auto transmission system.
- 11.2 Check the level gear fluid of auto transmission fluid (ATF) box.
- 11.3 Check the fuse and cable connection of the auto transmission box.
- 11.4 Check the fault code by diagnosis tool (scanner).
- 11.5 Performance check the auto transmission system and or replace gearbox if required.

12. Study the trouble diagnosis with fault code.

- 12.1 Insert diagnosis trouble code (DTC) connects with diagnosis tool (scanner).
- 12.2 Insert vehicle identification number (VIN) to the scanner.
- 12.3 Scan the diagnosis procedure.
- 12.4 Identify the trouble code and verify the code with manufacturing manual fault code.
- 12.5 Check the fault code following parameter: (As for Example)

SAE standards Diagnostic Trouble Code (DTC) 5 (Five) digit only.

P0203

B-Body (Including A/C & Air Bag).

C-Chassis (Includes ABS).

P-Powertrain (Engine, Transmission & Gear box).

U-User Network (Wiring BUS/UART)

0=Generic OBD Code or 1=Vehicle Manufacturer Specific Code.

1=Fuel & Air Metering. 2=Fuel & Air Metering (Injector circuit).

3=Ignition System or Misfire. 4=Auxiliary Emission Control.

5= Vehicle speed control & idle control system. 6=Computer output circuit.

7, 8 & 9=Transmission Gearbox. A, B & C=For Hybrid Propulsion.

03=Last two digits is Fault Description.

13. Study the pre-inspection of vehicle before starting the engine.

- 13.1 Inspect visual the wheel air pressure, wheel nut condition, any fluid drop under the floor to standing position of the car, radiator water.
- 13.2 Seat for driver and check the engine fuel condition, lube oil level, indicator lamp, charging condition, braking action during car moving.
- 13.3 Check the horn, headlight, indicator light, brake light, parking light, back-up light.

14. Practice the idle sitting before driving.

- 14.1 Adjust the seat.
- 14.2 Set the seat belt.
- 14.3 Set the eye, body, head, leg in ideal position.

15. Practice on takeoff/ marching, turning of the vehicle towards left or right.

- 15.1 Start the engine.
- 15.2 Press the clutch pedal.
- 15.3 Engage 1st gear.
- 15.4 Release the clutch pedal slowly.
- 15.5 Press the accelerator pedal slowly.
- 15.6 Press the clutch pedal for gear changing.
- 15.7 Follow the previous step from 15.4.
- 15.8 Decrease the speed of the vehicle.
- 15.9 Give the turning signals.
- 15.10 Observe the road condition and make turning.

16. Practice the parking of vehicle.

- 16.1 Select the parking area.
- 16.2 Set the back gear.
- 16.3 Follow the previous step from 15.4 to 15.5.
- 16.4 Look the rearview mirror/monitor
- 16.5 Control the steering wheel.
- 16.6 Complete the parking.

REFERENCE BOOKS

1. Automobile Guide - Frederick E. Bricker.
2. Automotive Mechanics - William H. Crouse Donald L. Anglin
3. Advanced electronics Diagnosis of Automobile - Don Khowles.
4. Automotive electrical equipment - W.H. Crouse
5. Automobile electrical and electronic system - TONY TRANTER
6. Engine Instrumentation and testing - Md. Roadrunner Rahman

AIMS

Project work allows students to use their creative and innovative ideas translating in working model, prototypes, and equipments and developing necessary hands on skills. This will allow the students to apply the previous knowledge and skills acquired during the course.

The student will be able to:

1. Analyze the given problem.
2. Generate alternative solutions to the problem.
3. Compare & select feasible solutions among the alternative generated.
4. Develop and manufacture new/modified equipments.
5. Acquire technical knowledge beyond the curriculum.

SHORT DESCRIPTION

Build up a storage battery; Build up a model of battery CDI system; Build up a model of electronic ignition system; Build up a model of automotive lighting system; Build up a model of automobile charging system; Build up a model of automobile electric starting system; Build up a model of automobile hydraulic brake system and Antilock brake system; Installation of a pump; EFI and VVTI system, Automobile power transmission system.

DETAIL DESCRIPTION**1. Build up a 12volt lead acid battery.**

- 1.1 Estimate the cost of material and making a charge of battery.
- 1.2 Collect the materials of the battery.
- 1.3 Make the cells of the battery.
- 1.4 Install the cells in the battery case.
- 1.5 Connect the battery cells.
- 1.6 Covered the top of the battery.
- 1.7 Pour electrolyte in the battery cells.
- 1.8 Charge the battery.
- 1.9 Submit the report.

2. Build up a model of CDI system.

- 2.1 Estimate the cost of material and making a charge of CDI model.
- 2.2 Collect the materials of CDI system.
- 2.3 Make a board with portable frame.
- 2.4 Install the components of the CDI system on the board.
- 2.5 Connect the components.
- 2.6 Test the work ability of the built unit.
- 2.7 Submit the report.

3. Build up a model of electronic ignition system.

- 3.1 Estimate the cost of material and making charge of electronic ignition model.
- 3.2 Collect the materials of an electronic ignition system.
- 3.3 Make a board with portable frame.
- 3.4 Install the components on the board.
- 3.5 Connect the components.
- 3.6 Test the work ability of the built unit.
- 3.7 Submit the report.

4. Build up a model of automobile lighting system.

- 4.1 Estimate the cost of material and making charge of lighting models.
- 4.2 Collect the materials of the automobile lighting system.
- 4.3 Make a board with portable frame.
- 4.4 Install the components of the automobile lighting system on the board.
- 4.5 Connect the components.
- 4.6 Test the work ability of the built unit.
- 4.7 Submit the report.

5. Build up an automobile battery charging system.

- 5.1 Estimate the cost of material and making a charge of battery charger.
- 5.2 Collect the materials for an automotive battery charging system.
- 5.3 Make a board with portable frame.
- 5.4 Install the components on the board.
- 5.5 Connect the components.
- 5.6 Test the work ability of the built unit.
- 5.7 Submit the report.

6. Build up a model of automobile electric starting system.

- 6.1 Estimate the cost of material and making charge of starting model.
- 6.2 Collect the materials of the automotive electric starting system.
- 6.3 Make a board with portable frame.
- 6.4 Install the components on the board.
- 6.5 Connect the components.
- 6.6 Submit the report.

7. Build up a model of Electronic Fuel Injection (EFI) system.

- 7.1 Estimate the cost of material and making a charge of EFI fuel model.
- 7.2 Collect the materials of the EFI system.
- 7.3 Make a board with portable frame.
- 7.4 Install the components of the EFI system.
- 7.5 Connect the components.
- 7.6 Test the work ability of the built unit.
- 7.7 Submit the report.

8. Build up a model of Automobile power transmission system with Automatic gearbox.

- 8.1 Estimate the cost of material and making a charge of the transmission gear box.
- 8.2 Collect the materials of power transmission system.
- 8.3 Make a portable frame.
- 8.4 Install the components of power transmission system.
- 8.5 Connect the components.
- 8.6 Test the work ability of the built unit.
- 8.7 Submit the report.

9. Build up a model of automobile hydraulic brake system / Antilock brake system (ABS)

- 9.1 Estimate the cost of material and making a charge of hydraulic/antilock bread.
- 9.2 Collect the materials of an automobile hydraulic brake system /Antilock brake system (ABS).
- 9.3 Make a board with portable frame.
- 9.4 Install the components of the brake system.
- 9.5 Connect the components.
- 9.6 Test the work ability of the built unit.
- 9.7 Submit the report.

10. Build up a model automotive power steering system.

- 10.1 Estimate the cost of material and setup charge of power steering model.
- 10.2 Collect the materials.
- 10.3 Make a board with portable frame.
- 10.4 Install the power steering pump, steering column, steering rack & electric motor set on the portable frame.
- 10.5 Arrange and align the pump & motor set.
- 10.6 Connect the hoses to pump and rack and using necessary protective device for electric connection.
- 10.7 Test the work ability of the installed power steering model.
- 10.8 Submit the report.

11. Build up automobile air-conditioning system.

- 11.1 Estimate the cost of material and making a charge of air-condition.
- 11.2 Collect the materials and components.
- 11.3 Make a board with portable frame.
- 11.4 Install the component on the portable frame.
- 11.5 Charge the refrigerant.
- 11.6 Test the work ability of the built-up units.
- 11.7 Submit the report.

12. Build up an electric car include solar power.

- 12.1 Estimate the cost of material and making a charge of electric cars.
- 12.2 Collect the materials and components.
- 12.3 Make a proto-type car as per required design.
- 12.4 Connect the solar panel to the car battery.
- 12.5 Connect the battery and motor through the controller.
- 12.6 Test the work ability of the built-up units.
- 12.7 Submit the report.

13. Build up a small car of one-cylinder, four stroke petrol/diesel engine.

- 13.1 Estimate the cost of material and making a charge of a small car.
- 13.2 Collect the four-stroke petrol/diesel engine.
- 13.3 Collect and Make a chassis and body frame of a car.
- 13.4 Install the engine on a chassis.
- 13.5 Make a body with the mat-sheet.
- 13.6 Make a window and door of a car.
- 13.7 Fit power train, Exel, differential box, wheel, steering and others.
- 13.8 Set head light, electric wiring, horn and others.
- 13.9 Paint the body of a car.
- 13.10 Test the work ability of new built up a car.
- 13.11 Submit the report.

RATIONALE

The practical training cum project work is intended to place students for project oriented, practical training in actual work situations for the stipulated period with a view to:

- i) Develop understanding regarding the size and scale of operations and nature of field work in which students are going to play their role after completing the courses of study.
- ii) Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- iii) Develop first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute-based knowledge and skills to solve practical problems in the world of work.
- iv) Develop special skills and abilities like interpersonal skills, communication skills, attitudes and values.

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at workplaces with minimal supervision. This experience is required to be planned and supervised on a regular basis by the polytechnic faculty. For the fulfillment of the above objectives, polytechnic may establish close links with 8-10 relevant organization for providing such an experience. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such which are of curricular interest to students and of professional value to industrial/field organizations.

Each teacher is expected to supervise and guide 5-6 students. Effort should be made to identify actual field problems as project work for the students. The project selected should not be too complex, which is beyond the level of the students. The placement of the students for such a practical cum project work should match with the competency profile of students and the project work assigned to them. Students may be assessed both by industry and polytechnic faculty. The suggested performance criteria are given below:

- (1) Punctuality and regularity
- (2) Initiative in learning/working on the site
- (3) Level/proficiency of practical skills acquired
- (4) Ability of solving live practical problems
- (5) Sense of responsibility
- (6) Self expression/communication skills
- (7) Interpersonal skills/Human Relation
- (8) Report Writing Skills
- (9) Viva Voce

The projects given to students should be such for which someone is waiting for a solution. Some of the suggested project activities are given below:

1. Projects connected with repair and maintenance of machine parts.
2. Estimating and costing projects
3. Design of components/parts/jigs/fixtures.
4. Projects related to quality control.

5. Project work related to increasing productivity.
6. The project connected with work study.
7. Projects relating to erection, installation, calibration and testing.
8. Projects related to wastage reduction.
9. Problem related to value analysis/value engineering
10. Project related to mistake proofing.

AIMS

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of basic refrigeration and auto air-conditioning with special emphasis on:

- Refrigeration science.
- Different methods of refrigeration.
- Components and accessories of refrigeration cycle.
- Refrigerants.
- Air-conditioning fundamentals
- Automobile bus air conditioning system
- Van & Trailer refrigeration system
- Automobile air-conditioning system and servicing.

SHORT DESCRIPTION

Refrigeration science; Different methods of refrigeration; Vapor compression cycle components and accessories; Refrigerants; Air-conditioning fundamentals; Automobile air conditioner; Automobile air conditioner control system; Automobile bus air conditioning system; Van & Trailer refrigeration system, Automobile air conditioner servicing.

DETAIL DESCRIPTION**Theory:****1. Understand the science of refrigeration.**

- 1.1. Define refrigeration, refrigerant and refrigerator.
- 1.2. Mention the laws of refrigeration.
- 1.3. Mention the application of refrigeration in our daily life.
- 1.4. Define the heat, temperature & pressure.
- 1.5. Mention the units of heat, temperature and pressure.
- 1.6. Describe the methods of heat transfer in the field of refrigeration.

2. Understand different methods of refrigeration.

- 2.1. List different methods of refrigeration.
- 2.2. Identify the refrigeration systems used in automobile air-conditioning.
- 2.3. Mention the principle of evaporative refrigeration.
- 2.4. Describe operation of vapor compression refrigeration system.

3. Understand the features of vapor compression system components.

- 3.1. Mention the function of compressor, condenser, expansion device and evaporator.
- 3.2. Mention the classification of compressors, condensers, expansion valves and evaporators used in automobile air conditioner
- 3.3. State the cycling and non cycling compressor.
- 3.4. Describe the operation of swash-plate compressors, scotch yoke compressors and scroll compressors.

- 3.5. Mention the advantages and disadvantages of different types of compressors used in automobile air conditioner.
- 3.6. Mention the advantages & disadvantages of plate, fin type, serpentine type and drawn cup type evaporators.
- 3.7. Describe the operation of thermostatic expansion valve, H-type expansion valve and orifice (expansion tube) used in automobile air conditioner.

4. Understand the features of the accessories used in auto air-conditioner refrigeration cycle.

- 4.1. List the accessories used in auto air-conditioner refrigeration cycle.
- 4.2. Mention the function of accessories used in automobile air-conditioner refrigeration cycle.
- 4.3. Describe the operation of receiver, dryer, sight glass and fusible plug.
- 4.4. Describe the operation of low side accumulator.
- 4.5. Mention the purpose of refrigeration lines used in automobile air conditioner application.
- 4.6. Explain the design features of refrigeration lines.
- 4.7. Identify the fittings used in refrigerant lines.

5. Understand the application of refrigerants.

- 5.1. Define refrigerant
- 5.2. Mention the classification of refrigerants
- 5.3. List the refrigerant of CFCs, HCFCs and HFCs groups.
- 5.4. State the desirable properties of an ideal refrigerant.
- 5.5. Identify the refrigerants by number.
- 5.6. List the applications of common refrigerants.
- 5.7. Mention the properties of most commonly used refrigerant viz. R-12 ,R-134a & R- 1234 YF
- 5.8. Describe the refrigerant cylinder handling.
- 5.9. Identify the color codes of refrigerant cylinder.
- 5.10. Mention the properties of refrigerant oil used with R-12 R –134a & R- 1234 YF system.

6. Understand the features of automobile air-conditioning system.

- 6.1. Define air conditioning system
- 6.2. State the purpose of auto air-conditioning.
- 6.3. Identify the components of automobile air-conditioning system.
- 6.4. Describe the operation of automobile air-conditioning system (cooling and heating).
- 6.5. Describe the ducting system of automobile air-conditioning system.
- 6.6. Describe the air distribution system of a car air conditioner (including ventilation system).
- 6.7. Describe the automotive vehicle body insulation system.
- 6.8. Describe the filtering system of automobile air-condition system.

7. Understand the features of automobile air-conditioner control system.

- 7.1. Identify the control panel switches and levers of automobile air-conditioner (heating and cooling system).
- 7.2. Describe the operation of control panel unit with sketch (heating and cooling)
- 7.3. Describe the anti icing control system of automobile air conditioner.
- 7.4. Draw the electric wiring diagram of auto air-conditioner including all safety and control devices.
- 7.5. Describe the construction & operation of manual control systems (including HVAC controller) of automotive air-conditioning system.
- 7.6. Describe the construction & operation of automatic control systems (including HVAC controller) of automotive air-conditioning system.

8. Understand the features of coupling & safety devices of automobile air-conditioner.

- 8.1. Mention the purpose of magnetic clutch.
- 8.2. Mention the classification of magnetic clutch.
- 8.3. Describe the construction & operation of magnetic clutch.
- 8.4. Identify the safety devices used in cycling compressors automobile air-conditioning systems.
- 8.5. Mention the function of various safety devices in automobile air conditioner.

9. Understand the concept of transport refrigeration.

- 9.1. Define transport refrigeration
- 9.2. Outline the importance of transport refrigeration
- 9.3. Mention the field of application of transport refrigeration.
- 9.4. List various non-mechanical transport refrigeration systems.
- 9.5. List various mechanical transport refrigeration
- 9.6. Mention the advantages and disadvantages of non-mechanical transport refrigeration system.
- 9.7. Mention the advantages and disadvantages of mechanical transport refrigeration system.

10. Understand features of refrigerated Covered Van and trailers.

- 10.1. Identify the various refrigeration system used in covered Van and trailers.
- 10.2. Describe the body insulation process of refrigerated Covered Van and trailers.
- 10.3. Describe the product sub-cooling in Covered Van refrigeration system.
- 10.4. Describe the operation of expendable refrigerant refrigeration system.
- 10.5. Describe the operation of eutectic solution in Covered Van refrigeration system.
- 10.6. Describe the servicing procedure of a conventional Covered Van refrigeration system.

11. Understand the concept of bus air-conditioning system.

- 11.1. Describe the dual compressor refrigeration cycle of a bus air-conditioning system.
- 11.2. Describe the different components of bus air conditioner refrigeration cycle.
- 11.3. Mention possible locations on bus air conditioner.
- 11.4. Describe air distribution systems of bus air-conditioner.
- 11.5. Describe the control system of bus air-conditioning system.
- 11.6. Identify the electric circuit of bus air-conditioning system.
- 11.7. Mention typical specification of bus air-conditioner.

12. Understand the automobile air-conditioning system servicing.

- 12.1. Identify the equipment and tools used in automobile air-conditioning servicing works.
- 12.2. Mention the cautions for air-conditioner service and special cautions for refrigerant 134a system.
- 12.3. List the various contaminants of air-conditioner.
- 12.4. Mention the effects of various contaminants of air-conditioner.
- 12.5. Describe the refrigerant system quick check and air-conditioner visual inspection.
- 12.6. Mention the sight glass indication for various conditions in the refrigeration system.
- 12.7. Describe the leak detection methods of automobile air-conditioning system.
- 12.8. Mention the evacuation, refrigerant charging and oil adding procedure of automobile air-conditioner unit.
- 12.9. Mention the performance test procedure of automobile air-conditioner.
- 12.10. Mention the fault diagnosis and remedies of automobile air-conditioner.

PRACTICAL:

1. Identify the equipment & tools and materials used in basic refrigeration and automobile air-conditioning works.

- 1.1 Identify the hand tools used in refrigeration & automobile air-conditioning works.
- 1.2 Identify the power tools/equipment used in refrigeration & automobile air-conditioning works.
- 1.3 Identify the materials used in refrigeration & automobile air-conditioning works.
- 1.4 Demonstrate the measures should be taken during the use of tools & equipment of auto air-conditioning.

2. Perform the tube cutting, bending and swaging of copper tube.

- 2.1 Select proper copper tube & tools.
- 2.2 Practice tube cutting.
- 2.3 Practice tube bending in different angle.
- 2.4 Practice tube swaging.

3. Perform the soldering and brazing of refrigeration & auto air-conditioning work.

- 3.1 Select proper tools & materials for soldering work.
- 3.2 Practice soldering in correct method.
- 3.3 Select proper tools & materials for brazing work.
- 3.4 Practice brazing in correct method.

4. Isolate the compressor from the system.

- 4.1 Recover gas from the system.
- 4.2 Disconnect the electrical line.
- 4.3 Disconnect inlet & outlet connection.
- 4.4 Remove mounting nut/bolt.
- 4.5 Isolate the compressor from the system.

5. Remove and replace clutch pulley bearing.

- 5.1 Disconnect clutch pulley belt.
- 5.2 Remove clutch centre bolt & snapping.
- 5.3 Remove clutch pulley with bearing.
- 5.4 Remove bearing from the pulley.
- 5.5 During replacing follow the reverse process of removing.

6. Perform servicing the magnetic clutch.

- 6.1 Remove magnetic clutch from vehicle.
- 6.2 Disassemble the clutch and clean each component.
- 6.3 Inspect each component for workability.
- 6.4 Change or repair if necessary.

7. Replace the refrigerant hose & filter.

- 7.1 Recover refrigerant.
- 7.2 Remove deactivate hose/filter.
- 7.3 Replace new/filter.
- 7.4 Evacuate the system.
- 7.5 Charge refrigerant in the system.

8. Evacuate the automobile air-conditioning system and charge refrigerant in the system.

8.1 Connect hose pipe, gauge & vacuum pump properly with charging port.

8.2 Evacuate properly.

8.3 Set gas cylinder properly.

8.4 Charge gas as per requirement.

9. Test the leaks in the automobile air-conditioning system.

9.1 Collect a leak detector

9.2 Place the sniffer of leak detector to possible leakage places.

9.3 Find out place of leakage.

10. Purge the air-conditioning system.

10.1 Disconnect inlet and outlet line from compressor.

10.2 Supply dry Nitrogen gas (N_2) through discharge side.

10.3 Connect discharge line and suction line to the compressor.

10.4 Last of all evacuate the whole system.

11. Test and adjust the thermostatic expansion valve.

11.1 Test the thermostatic expansion valve.

11.2 Adjust the thermostatic expansion valve by adjusting screw.

REFERENCE BOOKS

1. Modern Refrigeration and Air-conditioning – Althouse/Turnquist/ Bracciano.
2. Basic Refrigeration and Air-conditioning – Hazr & Chakravarty.
3. Automobile Mechanics – Crouse – Anglin.

AIMS

To provide the student with an opportunity to acquire knowledge, skill and attitude in the area of switchgear and protection with special emphasis on :

- Busbar and sub-station equipment.
- Circuit breakers and relays.
- Protection system for busbar, alternators, transformer, feeder and transmission line.
- Protection against over voltage.
- Sub station.

SHORT DESCRIPTION

Switch gear; Electrical faults; Busbar arrangements; Short circuit current calculation; power system stability; Current limiting reactors; Fuses; Circuit breakers; Relays; Protection of alternator & transformer; Protection of feeder & transmission line; Busbar protection; Over-voltage on transmission line; Protection against lightning; Sub-station.

DETAIL DESCRIPTION**Theory:****1. Understand the concepts of switch gear.**

- 1.1 Define switch gear.
- 1.2 Discuss the importance of switch gear protection of electrical system.
- 1.3 List different types of switch gear.
- 1.4 Mention the switch gear equipment.

2. Paraphrase the concepts of electrical faults.

- 2.1 Define electrical faults.
- 2.2 Name the different types of faults in electrical power system.
- 2.3 Discuss the causes of faults in electrical power system.
- 2.4 Describe different types of faults in electrical power system.

3. Perceive the concepts of busbar arrangements.

- 3.1 Define busbar.
- 3.2 Describe different types of busbar.
- 3.3 Mention different types of busbar arrangements.
- 3.4 Explain different types of busbar arrangements.
- 3.5 Mention different types of faults in busbar.

4. Interpret the short circuit current calculation.

- 4.1 Define short circuit faults.
- 4.2 Describe the causes of short circuit fault.
- 4.3 Name different types of short circuit fault.
- 4.4 Mention the steps for symmetrical fault calculations.
- 4.5 Distinguish between symmetrical and unsymmetrical fault.
- 4.6 Explain the method of calculation of short circuit current.
- 4.7 Distinguish between per unit method and percentage method.
- 4.8 Discuss the advantages of per unit methods of short circuit current calculation
- 4.9 Solve problems on short circuit current calculation.

5. Perceive the power system stability.

- 5.1 Define stability.
- 5.2 Describe transient, dynamic and steady state stability.
- 5.3 Explain swing equation
- 5.3 Define and mention the application of swing equation
- 5.4 Discuss the factors affecting transient stability.
- 5.5 Explain the method of improving transient stability.
- 5.6 Analyze the effect of sudden change in mechanical input.

6. Understand the principle of operation of current limiting reactors.

- 6.1 Define current limiting reactor.
- 6.2 Describe the principle of operation of current limiting reactor.
- 6.3 Discuss different types of current limiting reactors with diagram.
- 6.4 List the advantages and disadvantages of different types of current limiting reactor (CLR).
- 6.5 Solve problems related to the current limiting reactor (CLR).

7. Recognize the operation and construction of fuses.

- 7.1 Describe the principle of operation of fuses.
- 7.2 List different types of fuses.
- 7.3 Describe the current ratings of fusing element, fusing factor and breaking capacity.
- 7.4 Classify fuses according to the construction and current carrying capacity.
- 7.5 Describe the constructional features of the following fuses:
 - a. High Rupturing Capacity (HRC) fuse.
 - b. Carbon Tetrachloride (CTC) fuse.
 - c. Dropout fuse.
 - d. Horn gap fuse.

8. Perceive the concept of construction and operation of circuit breaker.

- 8.1 Define circuit breaker.
- 8.2 Describe the principle of operation of a circuit breaker and its function.
- 8.3 Describe arc and the process of its production & extinguishment.
- 8.4 Describe the construction and the principle of operation of the following circuit breakers:
 - a. Plain-break type circuit breaker.
 - b. Oil Circuit Breaker (OCB)
 - c. Low oil content circuit breaker.
 - d. Air Circuit Breaker (ACB).
 - e. Gas [Sulphur-Hexafluoride, SF₆] circuit breaker.
 - f. Vacuum Circuit Breaker (VCB).
 - g. Magnetic actuator type Circuit Breaker
- 8.5 Compare between Gas circuit breaker (GCB) and Vacuum Circuit Breaker (VCB).
- 8.6 Describe the mountings and ratings of a circuit breaker.
- 8.7 Explain miniature types of circuit breaker such as MCB, MCCB.
- 8.8 Describe the principle of operation of an automatic recloser(auto reclosr) and Isolator.
- 8.9 Compare among the circuit breaker, auto-recloser, fuse and isolator.
- 8.10 Solve problems on ratings of circuit breaker

9. Clarify the features of relay.

- 9.1 Define relay.
- 9.2 Classify the relays on the basis of construction, principle of operation, mode of use, qualities and the timing characteristics.

9.3 Describe the principle of operation and construction of the following protective and control relays:

- a. Solenoid and plunger type relay.
- b. Induction type over current relay.
- c. Reverse power relay.
- d. Directional over load relay.
- e. Thermal relay.
- f. Buchholz relay.
- g. Differential relay.
- h. Induction type impedance or distance relay.
- i. Numeric Relay
- j. Earth fault (EF) and Restricted Earth fault Relay (REF)

9.4 Describe control and relay panel.

9.5 List the factors to be considered for the maintenance of a relay.

10. Understand the principle of protection of alternator and transformer.

10.1 List the major features of good protective gears for alternators and transformers.

10.2 List the major faults that may occur in alternator and transformer.

10.3 Describe Merz-Price protection of alternator.

10.4 Describe Merz-Price protection of transformer.

10.5 Solve problems on transformer protection (Merz-Price system).

10.6 Describe the reverse power protection of alternators by reverse power relay.

10.7 Describe the internal fault protection of transformer by Buchholz relay.

11. Perceive the principle of protection of feeder and transmission line.

11.1 Describe the time graded protection of radial feeder.

11.2 Describe the reverse power and over load protection of parallel feeders by over current and reverse power relay.

11.3 Describe Merz-Price voltage balance system for protection of feeder for internal (in between the relay set) fault.

11.4 Explain Translay system of protection for internal (in between the relay set) fault of feeder.

11.5 Describe the over load protection of transmission lines by definite distance relay.

11.6 Discuss the over load protection of transmission line by time distance relay.

12. Understand the principle of static relays and protections.

12.1 Define static relay.

12.2 List the advantages of static relays.

12.3 Describe amplitude comparator.

12.4 Explain level detector.

12.5 Describe static-time-lag over current relay.

12.6 Analysis busbar protection by static relay.

12.7 Describe busbar protection by saturable reactor protection system

13. Paraphrase the causes and effects of over voltage on a transmission line.

13.1 Describe surge.

13.2 Explain the resonance in transmission line.

13.3 Explain the switching effect.

13.4 Describe the causes of insulation failure and its effect.

13.5 Discuss the arcing earth.

13.6 Describe the construction and function of Peterson coil.

13.7 Explain lightning and its effect.

13.8 Classify the lightning strokes.

13.9 Explain electrostatic induction.

14. Perceive the system of protection against lightning.

- 14.1 Describe the protective function and principle of operation of a lightning arrester.
- 14.2 Distinguish between lightning arrester, surge diverter and surge absorber.
- 14.3 Describe the construction and principle of operation of the following lightning arresters:
 - a. Rod gap
 - b. Horn gap
 - c. Expulsion type
 - d. Oxide film
 - e. Thyrite
- 14.4 Explain the protective function of a condenser or diverter.
- 14.5 Explain the function of Ferranti Surge Absorber.
- 14.6 Explain the function of ground wire.

15. Realize the utility and function of a sub-station.

- 15.1 Describe the function and importance of a sub station as a part of the power supply system.
- 15.2 Distinguish between indoor and outdoor sub-station.
- 15.3 List the factors to be considered in selecting the site of a sub- station.
- 15.4 Sketch the layout plan of an indoor sub-station.
- 15.5 List different components of an indoor sub station.
- 15.6 Mention the functions of the components of an indoor sub-station.
- 15.7 Sketch the layout plan of an indoor sub-station.
- 15.8 List different components of an outdoor sub-station and describe their function.

16. Understand the concept of Gas Insulated Sub Station(GIS)

- 16.1 Define Gas Insulated Sub Station (GIS)
- 16.2 Familiarize with different parts of a Gas Insulated Sub Station (GIS)
- 16.3 List the advantage of Gas Insulated Sub Station (GIS)
- 16.4 Compare between Air Insulated Sub Station & Gas Insulated Sub Station
- 16.5 Describe Gas monitoring system of a Gas Insulated Sub Station
- 16.6 Describe Gas handling process and precaution about quality of GAS.

Practical:

1. Categorize different types of fuses and measure the current carrying capacity of HRC fuse.

- 1.1 Identify and sort out different type of fuses from a given number of fuses.
- 1.2 Sketch different parts of HRC fuse.
- 1.3 Select a HRC fuse for a particular electrical circuit.
- 1.4 Connect the selected HRC fuse to the circuit.
- 1.5 Increase the load and measure the fusing current.

2. Perform the identification of different parts of an Air blast Circuit Breaker (ACB) with tripping their mechanism.

- 2.1 Identify different parts of an Air blast Circuit Breaker (ACB) with its moving and fixed contacts.
- 2.2 Sketch the main parts of the ACB.
- 2.3 Turn on and Turn off the ACB manually and observe its make and break mechanism.
- 2.4 Sketch the connection diagram of the ACB in a circuit and connect physically according to the diagram.
- 2.5 Read the name plate of the ACB and record its current rating.
- 2.6 Check the breaking operation during abnormal condition of the ACB by making a short circuit.

3. Perform the identification of different parts of an Vacuum Circuit Breaker (VCB) and observe the tripping mechanism.

- 3.1 Identify different parts of a VCB with special stress on its moving and fixed contacts.
- 3.2 Sketch the main parts of a VCB.
- 3.3 Turn-on and Turn-off the VCB manually and observe its make and break mechanism.
- 3.4 Check the oil level of the VCB.
- 3.5 Draw the connection diagram of the VCB in a circuit..
- 3.6 Connect the CB according to the diagram.
- 3.7 Read the name plate of the VCB and note down its current rating.
- 3.8 Check the breaking operation during abnormal condition of the VCB by making a short circuit

4. Perform the identification of different parts of a Sulphur- Hexafluorid (SF₆) Gas Circuit breaker and observe their tripping mechanism.

- 4.1 Identify different parts of a SF6 circuit breaker with its moving and fixed contacts.
- 4.2 Sketch the main parts of the SF6 circuit breaker.
- 4.3 Turn-on and Turn-off the GCB (Gas circuit Breaker) manually and observe its make and break mechanism.
- 4.4 Connect the GCB according to the diagram.
- 4.5 Read the name plate of the GCB and record its current rating.
- 4.6 Check the breaking operation during abnormal condition of the GCB by making a short circuit.

5. Perform the operation and identification of different parts of an induction type over current relay (IOR).

- 5.1 Identify, sketch and level different parts of an induction type over current relay.
- 5.2 Draw the circuit diagram of the Induction type Over current Relay (IOR).
- 5.3 Sketch the diagram of the mimic trip circuit consists of a 1.5 V dry cell and small torch light bulb simulating the tripping arrangement.
- 5.4 Connect the relay (IOR) according to the circuit diagram and set the load current and allow it to work beyond the set value of load current.
- 5.5 Observe the operation of the relay and the simulation tripping.

6. Sketching the layout of the electrical sub-station situated in campus and understanding its operation.

- 6.1 Identify different protective devices, equipment and accessories of the sub station.
- 6.2 Note the rating of transformer, circuit breaker, isolator, CT & PT, HT & LT switch gear.
- 6.3 Sketch the front view of the panel board.
- 6.4 Draw the block diagram of the sub-station showing all the components.
- 6.5 Draw the single line diagram of the sub-station.
- 6.6 Sketch the layout diagram of the sub-station.

7. Visit an outdoor distribution sub-station situated near to the institute campus and prepare a report.

- 7.1 Identify the in-coming and out-going line of the sub-station.
- 7.2 Identify different equipments, their ratings and positions in the sub-station.
- 7.3 Read the name plate and record all the information including the feeder capacity.
- 7.4 Draw the front view of the control panel.
- 7.5 Sketch the layout of the sub-station showing the position of all the components by block diagram.
- 7.6 Draw the single line diagram of the outdoor sub-station.
- 7.7 Submit a complete technical report of the study visit.

8. Study a widely used lightning arrester.

- 8.1 Identify different components of thyrite lightning arrester or any type of given lightning arrester.
- 8.2 Sketch the cross sectional view of the given lightning arrester and label its different components.

9. Visit a nearest grid sub-station of the national grid system and submit a report.

- 9.1 Identify the incoming and outgoing lines.
- 9.2 Identify different equipment, their ratings and positions in the sub- station.
- 9.3 Read the name plate of the sub-station equipment and record all the information.
- 9.4 Draw the front view of the control panel.
- 9.5 Draw the layout of the sub-station showing the positions of all the components by block.
- 9.6 Draw the single line diagram of the grid sub-station.
- 9.7 Submit a complete technical report of the study visit.

10. Study the catalogue and write the report.

- 10.1 Collect commercial catalogue and price list of switch gear and protective devices from different local and foreign manufactures.
- 10.2 Study the collected literature.
- 10.3 Draw a standard specification for the required switch gear.
- 10.4 Submit a technical report based on the information of the collected papers.

REFERENCE BOOKS

- 1 Switch Gear & Protection - S. Rao.
- 2 Electrical Power - J. B. Gupta.
- 3 Principles of Power System - V. K. Mehta.
- 4 Modern Power System - Nagrath Kothari.
- 5. Fundamental of switchgear and Protection - J. B. Gupta

AIMS

- To be able to understand the concept of entrepreneurship & entrepreneur.
- To be able to understand the concept of environment for entrepreneurship.
- To be able to understand the sources of venture ideas in Bangladesh.
- To be able to understand the project selection.
- To be able to understand business planning.
- To be able to understand the insurance and premium.
- To be able to understand the MDG & SDG.

SHORT DESCRIPTION

Concepts of entrepreneurship & entrepreneur; Entrepreneurship & economic development; Environment for entrepreneurship; Entrepreneurship in the theories of economic growth; Sources of ventures ideas in Bangladesh; Evaluation of venture ideas; Financial planning; Project selection; Self employment; Entrepreneurial motivation; Business plan; Sources of assistance & industrial sanctioning procedure; Concept of SDG; SDG 4,8 .

DETAIL DESCRIPTIONTheory :**1. Understand the basic concept of entrepreneurship & entrepreneur.**

- 1.1 Define entrepreneurship & entrepreneur.
- 1.2 Discuss the characteristics and qualities of an entrepreneur.
- 1.3 Mention the classification of entrepreneur.
- 1.4 Discuss the necessity of entrepreneurship as a career.
- 1.5 Discuss the prospect of entrepreneurship development in Bangladesh.

2. Understand the concept of entrepreneurship and economic development.

- 2.1 Define economic development.
- 2.2 Discuss the economic development process.
- 2.3 Discuss the capital accumulation or rate of savings.
- 2.4 Discuss the role of entrepreneur in the technological development and their introduction into production Process.
- 2.5 Discuss the entrepreneur in the discovery of new product.
- 2.6 Discuss the discovery of new markets.

3. Environment for entrepreneurship development:

- 3.1 Define the micro environment.
- 3.2 Discuss individual income, savings and consumption.
- 3.3 Define macro environment.
- 3.4 Discuss political, socio-cultural, economical, legal and technological environment.
- 3.5 Difference between micro and macro environment .

4. Understand the concept of entrepreneurship in the theories of economic growth.

- 4.1 Define entrepreneurship in the theories of economic growth.
- 4.2 Discuss the Malthusian theory of population and economic growth.
- 4.3 Discuss the stage theory of growth.
- 4.4 Discuss the Schumpeterian theory of economic development.
- 4.5 Discuss the entrepreneurship motive in economic development.

5. Understand the sources and evaluation of venture ideas in Bangladesh.

- 5.1 Define sources of venture ideas in Bangladesh.
- 5.2 Discuss different types of sources of venture ideas in Bangladesh.
- 5.3 Define evaluation of venture ideas.
- 5.4 Discuss the factors that influence the selection of venture idea.

6. Understand the concept of project selection and financial planning.

- 6.1 Define project.
- 6.2 Discuss the idea of project.
- 6.3 Describe the guide lines for project ideas.
- 6.4 Discuss the sources of project ideas.
- 6.5 Discuss the evaluation of project ideas.
- 6.6 Describe the technical aspect of project.
- 6.7 Define financial planning.
- 6.8 Discuss the long term financial plan.
- 6.9 Discuss the short term financial plan.

7. Understand the concept of self employment.

- 7.1 Define self employment.
- 7.2 Describe different types of employment.
- 7.3 Describe the importance of business as a profession.
- 7.4 Discuss the reasons for success and failure in business.

8. Understand the business plan and the concept of the environment for entrepreneurship.

- 8.1 Define business plan.
- 8.2 Describe the importance of business plan.
- 8.3 Discuss the contents of business plan.
- 8.4 Define environment of business.
- 8.5 Describe the factors which effect environment on entrepreneurship

9. Understand the concept of sources of assistance & industrial sanctioning procedure.

- 9.1 Define sources of assistance.
- 9.2 Describe different types of sources of assistance.
- 9.3 Discuss the aid of sources.
- 9.4 Discuss the industrial policy.
- 9.5 Define foreign aid.

10. Understand the insurance and premium.

- 10.1 Define insurance and premium
- 10.2 Describe the essential conditions of insurance contract.
- 10.3 Discuss various types of insurance.
- 10.4 Distinguish between life insurance and general insurance.

11. Understand the concept of Sustainable Development Goals (SDG)

- 11.1 Define Sustainable development
- 11.2 State UN targets of MDG
- 11.3 State UN targets of SDG
- 11.4 Describe the importance of SDG
- 11.5 Explain the objectives of SDG
- 11.6 State the Challenges to achieve SDGs
- 11.7 Explain the actions to face the challenges of SDGs
- 11.8 State the of 7th 5 years plan
- 11.9 Mention the link of 7th 5 years plan with SDGs
- 11.10 Write down the 5 ps of sustainable development goals

12. Understand SDG 4,8 and 17

- 12.1 Describe SDG 4 and its targets
- 12.2 State the elements of Quality education for TVET
- 12.3 Describe the gender equality and equal access of TVET for economic growth
- 12.4 Describe SDG 8 and its targets
- 12.5 Explain Green development, Green Economy, Green TVET & Green Jobs
- 12.6 Explain the role an entrepreneur for achieving SDG

Reference book :

1. A hand book of new entrepreneur-by p.c jain.
- 2.A manual on business opportunity Identification and selection-by j.B patel and S S modi.
- 3.Uddokta unnoyan Nirdeshika -Md.Sabur khan.
- 4.Entrepreneurship- bashu and mollik.
- 5.Business Entrepreneurship-kage faruke.
6. Website, Youtube and Google