



**BANGLADESH TECHNICAL EDUCATION BOARD**

Agargoon, Dhaka-1207.

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

**AUTOMOBILE TECHNOLOGY**

TECHNOLOGY CODE: **662**

**4th SEMESTER**

DIPLOMA IN ENGINEERING  
PROBIDHAN-2016

**AUTOMOBILE TECHNOLOGY (662)**

**4<sup>th</sup> 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	66241	Automotive Body Building	2	3	3	40	60	25	25	150
2	66242	Automotive Engine System -3	2	3	3	40	60	25	25	150
3	67041	Engineering Mechanics	3	3	4	60	90	25	25	200
4	66243	Automotive Shop Equipment & Workshop Practice	3	3	4	60	90	25	25	200
5	67131	Engineering Thermodynamics	3	3	4	60	90	25	25	200
6	65841	Business Organization & Communication	2	0	2	40	60	0	0	100
7	69054	Environmental Studies	2	0	2	40	60	0	0	100
Total			17	15	22	340	510	125	125	1100

**AIMS**

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of automobile body building and repair with special emphasis on:

- Automobile body construction and effect of collision on automobile body
- Tools and equipment required for collision damage works and repairing
- Welding and soldering process
- Automobile body painting.

**SHORT DESCRIPTION**

Automobile body; Construction of automobile body; Manufacturing process; Effect of collision; Tools and equipment required for auto-body repair; Fasteners; Sheet metal damage repair; Welding process; Fitting methods; Materials for automobile body; Surface preparation; Features of primer; Plastic fillers; Fiber glass repair; Refinishing methods and spray painting equipment.

**DETAIL DESCRIPTION****Theory:****1. Understand the features of automobile body.**

- 1.1 Define the automobile body.
- 1.2 Mention the function of automobile body.
- 1.3 Name the various designs of automobile body with sketch.
- 1.4 Identify the major body panels of a car with net sketch.

**2. Understand the construction of automobile body.**

- 2.1 Explain the automobile body construction viz. Body & frame construction and unibody construction.
- 2.2 Describe the method of manufacturing automobile body.
- 2.3 Explain the effects of overhangs.
- 2.4 List the materials required for automobile body making.
- 2.5 Describe the process of rust protection of automobile body.

**3. Understand the feature of automobile frame.**

- 3.1 Define automobile frame.
- 3.2 List the different type of frame used in automobile.
- 3.3 Explain the forming of metal frame to provide strength crown, angles and flanges, u-channels and box section rail pillars.
- 3.4 Explain stamping body parts.

**4. Understand the feature of collision of the automobile body.**

- 4.1 Mention the effects of collision of the automobile body.
- 4.2 Define metal bumping & dinging, buckle & roll of sheet metal.
- 4.3 Explain the low and high spot damage of body.
- 4.4 Mention the uses of fittings, denting, straightening and alignment of automobile body.

**5. Understand the tools and equipment required for collision damage work.**

- 5.1 Identify the hand tools for collision work.
- 5.2 List some necessary hand bumping tools for the automobile body repair.
- 5.3 Mention the function of
  - a. Hammer
  - b. Dolly blocks
  - c. Spoons
  - d. Files and Files holders
  - e. Mechanical and hydraulic jacks

**Understand the fasteners used in the assembly of the automobile body.**

- 5.4 Mention the uses of various types of bolts, viz cap screw, carriage bolt, bumper bolt, studs and machine bolt and stove bolt.
- 5.5 Mention the uses of different types of nuts used with the various fasteners.
- 5.6 Mention the use of different types of clips and washers.
- 5.7 Mention the uses of other mechanical fasteners.

**6. Understand the procedure of sheet metal damage repairing.**

- 6.1 Mention the factors to be considered to determine the types of damage.
- 6.2 Explain the methods of choosing the right type of hammer.
- 6.3 Explain the principle of using the hammer of dolly method.
- 6.4 Describe the method of detecting high and low spots.
- 6.5 Describe the process of picking up the low spots.
- 6.6 Mention basic use of the disc grinder.
- 6.7 Describe the repairing procedure of the damage by using mechanical and hydraulic body jacks.
- 6.8 Describe the repairing procedure of crowned panel.

**7. Understand the welding processes and their application.**

- 7.1 Define gas welding.
- 7.2 Mention the use of gas welding.
- 7.3 Explain the different types of gas flame and their uses.
- 7.4 Define the different types of welding position and various types of welding joints with sketches.
- 7.5 Describe the process of sheet metal welding.
- 7.6 Mention the uses of arc welding.
- 7.7 Describe the process of striking the arc.
- 7.8 Describe the process of running beat.
- 7.9 State the safety Precautions when using welding equipment around automobile.
- 7.10 Define spot welding.
- 7.11 Mention the use of spot welding.
- 7.12 Compare soldering, brazing & welding.

**8. Understand the fitting methods of deck lid, hood and door.**

- 8.1 Describe the process of bending or straightening of metallic steel.
- 8.2 Describe the process of deck lid fitting.
- 8.3 Describe the process of hood fitting.
- 8.4 Describe the process of door fitting.
- 8.5 Describe the process of correcting missaligned door.
- 8.6 Describe the frame straightening methods.

**9. Understand the plastic fillers and fiberglass repair.**

- 9.1 Mention the purposes of filler.
- 9.2 Mention the use of plastic filler.
- 9.3 Name the types of filler.
- 9.4 Describe the procedure of preparing plastic filler.
- 9.5 Describe the application procedure of filler.
- 9.6 Describe the method of fiber glass repairing.

**10. Understand the surface preparation.**

- 10.1 Mention the meaning of surface preparation.
- 10.2 Mention the purpose of surface preparation.
- 10.3 Describe the steps of surface preparation.
- 10.4 Mention the use of putties and sealers.
- 10.5 Describe the methods of surface preparation using abrasive papers (wet & dry type) sanding operation.

**11. Understand the features of primer.**

- 11.1 State the meaning of term primer.
- 11.2 Mention the use of primer.
- 11.3 Name the different types of primer.
- 11.4 Mention the uses of primer-sealer.
- 11.5 Describe the process of primer application.

**12. Understand the refinishing method of automobile body.**

- 12.1 Mention the importance of painting.
- 12.2 List the basic ingredients of painting.
- 12.3 Mention the uses of pigment, binder & solvent.
- 12.4 Mention the uses of top coat, under coat and guide coat.
- 12.5 Describe the method of application of synthetic enamel and lacquers.
- 12.6 Explain the uses of thinners and reducers. .
- 12.7 Describe manual painting process.
- 12.8 List the steps of painting a automobile body.
- 12.9 List the safety steps in the paint shop.

**13. Understand the spray painting equipment.**

- 13.1 List the name of principle parts of a spray gun.
- 13.2 Name the different types of spray gun.
- 13.3 Describe the process of spray gun adjustment.
- 13.4 State the operating principle of spray gun.
- 13.5 Describe the process of painting by using the spray gun.
- 13.6 Describe the method of refinishing the complete automobile.

**PRACTICAL: (Field trip should be included to relevant workshop).**

**1. Familiar with the automobile body parts.**

- 1.1 Identify the panels and crown.
- 1.2 Identify the floor panel assembly and front cowl assembly.
- 1.3 Identify the quarter panel, roof assembly and front end assembly.
- 1.4 Identify the radiator, bumper and hood.

- 1.5 Identify door glass, interior hardware and trim.
- 1.6 Identify different types of seats of automobile.
- 1.7 Identify glass and wind shield and rear window glass mountings.

**2. Familiar with the hand tools of body bumping of automobile.**

- 2.1 Identify the bumping, dinging and pick hammers.
- 2.2 Identify dollies, spoons, pry bars, body files, file holders and reveal file handle and file blade set.

**3. Familiar with the fasteners of automobile.**

- 3.1 Identify bolts and their types: such as cap screw, carriage bolts, bumper bolts, studs machine bolts and stove bolts.
- 3.2 Identify the common types of nuts used with the various fasteners viz: castle, acorn, squire, hex, slotted hex, retainer nuts, flanged hex nuts, etc.
- 3.3 Identify the labeler types speed clips and metal screws.
- 3.4 Practice the selecting bolt and screw sizes, head and nut sizes.
- 3.5 Identify the washers and hollow rivets.
- 3.6 Identify the different types of rivets.
- 3.7 Practice riveting to build up an automobile body.

**4. Practice the oxy-acetylene welding.**

- 4.1 Identify the components of oxy-acetylene welding equipment.
- 4.2 Turn the welding units.
- 4.3 Light the welding torch and prepare the three types of flame.
- 4.4 Shut off the flame.
- 4.5 Practice the welding work on various welding positions; viz; flat; vertical; overheat and horizontal.
- 4.6 Practice welding a sheet metal.
- 4.7 Practice brazes welding in vertical and horizontal position.
- 4.8 Practice oxygen cutting by cutting attachments.
- 4.9 Practice cutting plate and cutting sheet metal.

**5. Perform electric welding.**

- 5.1 Identify the components of electric arc equipment.
- 5.2 Select the electrodes and their sizes.
- 5.3 Set the current of the machine.
- 5.4 Practice in striking the Arc.
- 5.5 Practice on running a bead.
- 5.6 Practice welding in various positions.

**6. Perform the sheet metal damage repair.**

- 6.1 Practice the hammering techniques.
- 6.2 Practice denting with hammer and dolly.
- 6.3 Apply basic hammer and dolly methods in straightening damage area.
- 6.4 Apply techniques of body filing cross and x filing.
- 6.5 Practice in picking up low spots.
- 6.6 Practice in using disc sander or grinder to remove paint and to provide scratch pattern.

**7. Perform straightening typical damage.**

- 7.1 Practice in selecting hinge buckle, roll buckle, direct damage and indirect damage.
- 7.2 Practice in straightening damage by using jacks.
- 7.3 Practice in straightening metal without damaging the point.

- 7.4 Practice repairing a double high crowned area.
- 7.5 Practice repairing a low crowned area.
- 7.6 Practice in straightening a reverse crowned area.

#### **8. Perform soldering.**

- 8.1 Identify the components of soldering unit.
- 8.2 Practice the process of using solder.
- 8.3 Apply the solder filling techniques.
- 8.4 Show tinning steps for using tinning flux.
- 8.5 Practice the application of soldering puddles.
- 8.6 Practice the soldering on the surface.

#### **9. Practice on fitting methods.**

- 9.1 Remove & Replace radiator.
- 9.2 Adjust front & rear bumper.
- 9.3 Remove & fit the wind shield and window glass.
- 9.4 Practice door fitting, raising and lowering the door, forward and back ward adjustment, missaligned door correction, adjustment of door locks.

#### **10. Perform refinishing.**

- 10.1 Identify the pigment binder and solvent.
- 10.2 Practice the top coats and under coats.
- 10.3 Apply synthetic enamel, lacquers, metallic top coats, primary putties, sealers and reducers.
- 10.4 Apply wax and grease removers.
- 10.5 Apply polisher application and metal conditioner.

#### **11. Practice surface preparation.**

- 11.1 Use abrasive papers.
- 11.2 Feather edging, block sanding and masking.
- 11.3 Perform the refinishing procedure.

#### **12. Use spray equipment.**

- 12.1 Identify the principal parts of a spray gun.
- 12.2 Adjust the spray gun.
- 12.3 Operate the spray gun.
- 12.4 Reduce the paint.
- 12.5 Requit the air pressure in using the spray gun.
- 12.6 Keep the proper distance from the work and the technique of the triggering gun.
- 12.7 Practice spraying.
- 12.8 Practice spot spraying.
- 12.9 Practice waxing, polishing and clearing of the exterior of the automobile.
- 12.10 Practice interior cleaning of the vehicle.

#### **REFERENCE BOOKS**

- |   |                                |
|---|--------------------------------|
| 1. Auto Body Repairing and Repainting     | - Bill Tobledt.                |
| 2. Automotive Body Repair and Refinishing | - W. H Crouse and D. L Anglin. |
| 3. Automobile Engineering                 | - J.B.S. Narang.               |

**AIMS**

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of automotive engine systems with special emphasis on:

- gasoline engine carbureted fuel system and fuel injected systems
- diesel engine fuel systems
- superchargers and turbochargers

**SHORT DESCRIPTION**

Gasoline engine fuel supply systems; Fuel pumps; Carburetors; Diesel engine fuel systems; Diesel engine fuel system components; Governing of diesel engine; CNG fuel systems; LPG fuel systems; Superchargers and turbochargers; Engine performance.

**DETAIL DESCRIPTION****Theory****1. Understand the features of gasoline engine fuel systems.**

- 1.1 Draw petrol fuel system with carburetor and describe operation.
- 1.2 Describe the construction of fuel tank.
- 1.3 Mention the function of gasoline engine fuel filter.
- 1.4 Mention the function of air cleaner.
- 1.5 Identify different types of air cleaner.
- 1.6 Describe the operation of air cleaners.
- 1.7 Explain the importance of vapor recovery system.
- 1.8 Describe the operation of vapor recovery system

**2. Understand features of fuel pumps.**

- 2.1 Mention the function & location of fuel pump.
- 2.2 Describe the construction & operation of mechanically operated fuel pump.
- 2.3 Explain the automatic control mechanism of fuel pump.
- 2.4 Mention the construction & operation of electrically operated fuel pump including intake type fuel pump.
- 2.5 Describe the construction of electrically operated fuel pump including intake type fuel pump.
- 2.6 Mention the common troubles of fuel pumps and its remedies.
- 2.7 Mention the special troubles of electrical fuel pumps and its remedies.

**3. Understand the features of carburetors used in gasoline engines.**

- 3.1 Explain the terms vaporization, Carburetion and venturi effect.
- 3.2 Describe the function of a carburetor.
- 3.3 Identify different types of carburetor.
- 3.4 Describe the operation of six circuits/systems of a carburetor with sketches.
- 3.5 Mention the working principle of a simple carburetor with neat sketch.
- 3.6 List the disadvantages of carbureted fuel system.

**4. Understand the servicing of carburetor.**



- 4.1 State the purpose of carburetor servicing.
- 4.2 Mention the steps of carburetor servicing.
- 4.3 List the common troubles of carburetor and its remedies.
- 4.4 Mention the procedure of carburetor idle adjustment.
- 4.5 List the causes of excessive fuel consumption of a gasoline engine with carburetor and its remedies.

**5. Understand the features of diesel engine fuel system.**

- 5.1 State the working principle of diesel fuel system.
- 5.2 Name the different methods of diesel engine fuel system.
- 5.3 Explain the air injection and solid injection systems.
- 5.4 Describe the individual pump, common rail and distributor systems.
- 5.5 Explain the design features of different types of combustion chamber used for automotive diesel engine with sketches.

**6. Understand the features of the components of diesel engine fuel system.**

- 6.1 Draw a neat sketch of diesel engine fuel system showing all the components.
- 6.2 Describe the construction & operation of primary and secondary filters.
- 6.3 Describe the operation of primary and secondary filters.
- 6.4 Mention the function of low and high pressure pumps used in diesel engine.
- 6.5 Describe the construction of low and high pressure pumps used in diesel engine.
- 6.6 Describe the operation of low and high pressure pumps of different type used in diesel engine.

**7. Understand the features of injectors.**

- 7.1 Mention the function of an injector with sketch.
- 7.2 Identify different types of injector nozzles.
- 7.3 Describe the construction & operation of an injector with sketch.
- 7.4 Describe the operation of an injector with sketch.
- 7.5 Mention the function of unit injector.
- 7.6 Describe the construction of unit injector.

**8. Understand the governing of diesel engine.**

- 8.1 Define governor and governing.
- 8.2 State the purpose of governors.
- 8.3 Mention the classification of governors.
- 8.4 Describe the operation of different types of governors with sketches.
- 8.5 Mention the common problems of governor and its remedies.

**9. Understand the servicing and trouble shooting of diesel engine fuel system.**

- 9.1 State the purpose of servicing of diesel engine fuel system.
- 9.2 Mention the servicing procedure of diesel engine fuel system.
- 9.3 Mention the common troubles of diesel engine fuel system.
- 9.4 Explain the air lock in diesel engine fuel system.
- 9.5 Describe the air removing procedure from fuel system.
- 9.6 Mention the procedure of speed limit adjustment of a diesel engine governor.
- 9.7 List the causes of excessive fuel consumption of a diesel engine.
- 9.8 Mention the procedure of calibration and phasing of high pressure pump unit.
- 9.9 Mention the injector test and adjustments procedure.

**10. Understand the features of CNG fuel system.**

- 10.1 Describe the construction & operation of CNG fuel system.

- 10.2 Mention the functions of high pressure regulator, low pressure regulator & Vaporizer.
- 10.3 Describe the construction & operation of high pressure regulator and low pressure regulator.
- 10.4 Mention the functions of each components of CNG fuel system.
- 10.5 List the advantages and disadvantages of CNG fuel system.

**11. Understand the features of LPG fuel system.**

- 11.1 State the purpose of LPG fuel system.
- 11.2 Identify different components of LPG fuel system.
- 11.3 Describe the operation of LPG fuel system with sketch.
- 11.4 Mention the advantages and disadvantages of LPG fuel system.

**12. Understand the features of superchargers and turbochargers.**

- 12.1 State the purpose of supercharger and turbocharger.
- 12.2 Mention the classification of the superchargers and turbochargers.
- 12.3 Describe the construction of superchargers and turbochargers.
- 12.4 Describe the operation of superchargers and turbochargers.
- 12.5 List the advantages and disadvantages of superchargers and turbochargers.

**13 . Understand the aspects of engine performance.**

- 13.1 State the meaning of engine performance.
- 13.2 Mention the parameters of engine performance.
- 13.3 Explain the basic measurements of evaluating the performance of an engine.
- 13.4 Compare the engine performance using various parameter with graphs.
- 13.5 Solve problems on engine performance.

**PRACTICAL:**

**1 Study the carbureted fuel system.**

- 1.1 Identify different components of a carbureted gasoline fuel system.
- 1.2 Clean or replace the fuel filter.
- 1.3 Remove and service the fuel tank.
- 1.4 Install the fuel tank.

**2 Study the mechanical fuel pump.**

- 2.1 Remove the mechanical fuel pump from the engine.
- 2.2 Disassemble a mechanical fuel pump.
- 2.3 Identify the parts of mechanical fuel pump.
- 2.4 Inspect and service the mechanical fuel pump.
- 2.5 Reassemble the mechanical fuel pump.

**3 Study the electric fuel pump.**

- 3.1 Remove the electric fuel pump from the engine/fuel tank.
- 3.2 Dismantle the electric fuel pump.
- 3.3 Identify the components of electric fuel pump.
- 3.4 Clean and inspect the electric fuel pump.
- 3.5 Reassemble the electric fuel pump.
- 3.6 Install the electric fuel pump.

**4 Study the different types of carburetor.**

- 4.1 Identify the different types of carburetor.
- 4.2 Remove a carburetor from the engine.
- 4.3 Disassemble the carburetor.

- 4.4 Identify the components of carburetor.
- 4.5 Identify the circuits of carburetor.
- 4.6 Clean, inspect and reassemble the carburetor.
- 4.7 Perform the carburetor adjustments (float level, idle system, accelerator pump system, main metering system, choke system, etc).
- 5 Study the diesel engine fuel systems.**
  - 5.1 Identify the components of the in-line diesel fuel injection system.
  - 5.2 Identify the components of distributor diesel fuel injection system.
  - 5.3 Identify the components of common rail fuel injection system.
  - 5.4 Remove fuel filter, clean or replace fuel filtering element.
  - 5.5 Install the filter.
  - 5.6 Perform air bleeding operation.
- 6 Study the high pressure pump.**
  - 6.1 Remove high pressure pump from the engine.
  - 6.2 Disassemble the pump.
  - 6.3 Identify the high pressure pump components.
  - 6.4 Clean, inspect and assemble the high pressure pump.
  - 6.5 Perform phasing and calibration operation of a high pressure pump.
  - 6.6 Install the high pressure pump.
- 7 Study the injector of diesel fuel system.**
  - 7.1 Disassemble an injector.
  - 7.2 Identify, clean and inspect the injector components.
  - 7.3 Assemble the injector.
  - 7.4 Test the injector by the injector tester.
  - 7.5 Diagnose and correct troubles of injector.
- 8 Study the CNG fuel systems.**
  - 8.1 Identify the components of CNG fuel system.
  - 8.2 Remove and service the CNG fuel system components.
  - 8.3 Install the CNG fuel system components.
- 9 Study the LPG fuel systems.**
  - 9.1 Identify the components of LPG fuel system.
  - 9.2 Remove and service the LPG fuel system components.
  - 9.3 Install the LPG fuel system components.
- 10 Study the turbochargers.**
  - 10.1 Identify the components of turbochargers.
  - 10.2 Diagnose the trouble of turbochargers.
  - 10.3 Check the boost pressure and wastage operation.
  - 10.4 Service and repair turbocharger.

## REFERENCE BOOKS

- |                               |                        |
|-------------------------------|------------------------|
| 1. Automotive mechanics       | - Crouse – Anglin      |
| 2. The Automobile             | - Harban singh Rayet   |
| 3. Aeromechanics Fundamentals | - W. Stokel & T.Stokel |
| 4. Automotive Technology      | - Jack Erjavec         |
| 5. Automotive Technology      | - Dr. N.K. Giri        |

**AIMS**

- To facilitate understanding the fundamental of units and their conversions.
- To provide the understanding of force, effect of the force, composition and resolution of forces and computing the resultant force & couple
- To provide the understanding of parallel forces, To provide understanding the centroid and enable to computing the center of gravity & the moment of inertia.
- To enable to understand the laws of friction and the coefficient of friction & the ability of computing frictional forces of reactions of surfaces.
- To provide to understanding of deriving support reactions and types of loading of beam and trusses.
- To facilitate the understanding of work, power, energy, projectile lifting machine and gear trains.

**SHORT DESCRIPTION**

Fundamental of mechanics and unit conversion, Composition and resolution of forces. Moment and their applications. Equilibrium of force and couples, centroid and center of gravity, moment of inertia. Friction, support reactions, frame and truss, projectiles, work, power and energy, lifting machine, gear trains.

**Theory :****1. Understand Fundamental of Mechanics.**

- 1.1. Define mechanics.
- 1.2. Classify applied mechanics.
- 1.3. Importance of units in the engineering field.
- 1.4. Discuss the conversion of units.
- 1.5. Illustrate the fundamental mathematics (algebra, trigonometry & calculus) used in mechanics.

**2. Understand the composition and resolution of forces.**

- 2.1. State the effect and characteristics of a force.
- 2.2. Describe different system of forces.
- 2.3. Describe resultant force and composition of forces.
- 2.4. Find the resultant force graphically and analytically.
- 2.5. State the laws of forces.
- 2.6. Define resolution of a force.
- 2.7. Deduce the formula for finding the rectangular components.
- 2.8. Find the magnitude and position of the resultant force graphically and analytically
- 2.9. Solve problems related to resultant force.

**3. Understand the aspects of moment of forces and couples.**

- 3.1. Define moment of force and mention the units of moment.
- 3.2. Identify the clockwise and anticlockwise moment.
- 3.3. State the Varignon's principle of moments.
- 3.4. State the laws of moments.
- 3.5. Define and classify the lever.
- 3.6. State and classify parallel forces.
- 3.7. Define and classify a couple.
- 3.8. Solve the problems related to couple.
- 3.9. Solve problems related to moment of forces and couple.

#### **4. Understand the aspects of equilibrium of forces.**

- 4.1. State the principles of equilibrium of forces.
- 4.2. State the Lami's theorem.
- 4.3. Express the derivation of Lami's theorem.
- 4.4. Describe different methods of the equilibrium of coplanar forces and non-coplanar forces.
- 4.5. Explain the conditions of equilibrium.
- 4.6. Mention the various types of equilibrium of forces.
- 4.7. Solve problems related to equilibrium of forces.

#### **5. Understand the concept of centroid and center of gravity.**

- 5.1. Define center of gravity and centroid.
- 5.2. Distinguish between center of gravity and centroid.
- 5.3. Explain the methods of finding out centroid of simple geometrical figure.
- 5.4. Identify the axis of reference and axis of symmetry.
- 5.5. Determine the centroid of rectangle, triangle, semicircle geometrically and by integration.
- 5.6. Determine the centroid of plain geometrical figure by principle of first moments.
- 5.7. Calculate the centroid of various composite areas.
- 5.8. Calculate the center of gravity of solid bodies.

#### **6. Understand the application of moment of inertia.**

- 6.1. Explain the term moment of inertia and the units of moment of inertia.
- 6.2. Express the derivation of the formulae for moment of inertia of an area.
- 6.3. Describe the methods for finding out the moment of inertia.
- 6.4. Find the moment of inertia of simple areas by the method of integration.
- 6.5. State and proof of the theorem of perpendicular axis as applied to moment of inertia.
- 6.6. State the parallel axis theorem in the determination of moment of inertia of areas.
- 6.7. Explain the radius of gyration and section modulus.
- 6.8. Define mass moment of inertia.
- 6.9. Application of mass moment of inertia.
- 6.10. Calculate the moment of inertia and section modulus of composite sections and simple solid bodies.

#### **7. Understand the principles and application of friction**

- 7.1. Define friction.
- 7.2. Advantage and disadvantage of friction.
- 7.3. Identify the types of friction.
- 7.4. State the laws of static and dynamic friction.
- 7.5. Explain the angle of friction.
- 7.6. Explain coefficient of friction.
- 7.7. Explain free body diagrams of a body lying on horizontal, inclined and vertical surfaces, ladder and wedge.
- 7.8. Determine the frictional force of a body lying on horizontal and inclined surfaces.
- 7.9. Identify the methods of solving the problems of ladder
- 7.10. Identify the methods of solving the problems of wedge.

#### **8. Understand the fundamentals of support reaction on beams and Truss**

- 8.1. Define support and support reactions.
- 8.2. Identify types of beam.
- 8.3. Explain the types of loading on beams.

- 8.4. Determine the support reactions of simple, overhanging and cantilever beam with different loading conditions.
- 8.5. Define frame.
- 8.6. Identify the frames and trusses with their end supports.
- 8.7. State the method of finding support reactions and forces on the member of the frame.
- 8.8. Identify the nature of force on the members of trusses.
- 8.9. Calculate the support reactions and forces on different end support of simple truss by joint method and section method.

**9. Understand the features and principle of projectile.**

- 9.1. Describe projectiles with example.
- 9.2. Describe the term relating to projectiles.
- 9.3. Identify the motion of a body thrown horizontally in the air.
- 9.4. Describe the motion of a projectile.
- 9.5. Derivation of the equation of the path of a projectile.
- 9.6. Derivation of the time of flight of a projectile on a horizontal plane.
- 9.7. Derivation of horizontal range of a projectile.
- 9.8. Derivation of the equation of maximum height of a projectile on a horizontal plane.
- 9.9. Derivation of velocity and direction of motion of a projectile after a given interval of time.
- 9.10. Solve problems related to projectiles.

**10. Understand the aspects of work, power and energy.**

- 10.1. Define work, power and energy.
- 10.2. State the units of work, power and energy.
- 10.3. Explain the work done in rotation.
- 10.4. Mention the types of engine power.
- 10.5. Define and classify engine efficiency.
- 10.6. Mention types of energy.
- 10.7. Explain the derivation of the equation of kinetic & potential energy.
- 10.8. State the law of conservation of energy.
- 10.9. Solve problems related to work, power and energy.

**11. Understand the simple lifting machines.**

- 11.1. Define lifting machine.
- 11.2. State Mechanical advantage, velocity ratio, input of a machine, output of a machine, efficiency of a machine.
- 11.3. Explain the relation between efficiency, mechanical advantage and velocity ratio of a lifting machine.
- 11.4. Explain the maximum mechanical advantage of a lifting machine by using the equation of law's of machine.
- 11.5. Describe lifting machine such as simple wheel & axle, differential wheel & axle, Weston's differential pulley block and geared pulley block.
- 11.6. Solve the problems related to above specific objects.

**12. Understand the various aspects of gear trains.**

- 12.1. State what is meant by gear.
- 12.2. Identify the types of gears.
- 12.3. Identify the simple gear drive.
- 12.4. Express the derivation of the equation of velocity ratio of simple gear drive.

- 12.5. Identify the compound gear drive and gear train.
- 12.6. Identify the equation of power transmitted by simple and compound train.
- 12.7. Identify the epicyclical gear train.
- 12.8. Express the derivation of the velocity ratio of an epicyclical gear train.
- 12.9. Solve problems related to gear trains.

## **PRACTICAL :**

### **1. Determine the resultant force by using force board.**

- 1.1 Set up the force board.
- 1.2 Set up the accessories on the force board.
- 1.3 Find the resultant force.
- 1.4 Calculate the magnitude of resultant force.
- 1.5 Compare the calculated values with experimental values.

### **2. Determine the compression load using crane boom.**

- 2.1 Set up the crane boom.
- 2.2 Set up the accessories on the crane boom.
- 2.3 Find the compression load on the jib.
- 2.4 Calculate the compression analytically.
- 2.5 Compare the experimental values with analytical values.

### **3. Determine the equilibrium force by using Kennon force table.**

- 3.1 Set up the Kennon force table.
- 3.2 Set up the accessories on the Kennon force table.
- 3.3 Find the magnitude and direction of a force establishing equilibrium.
- 3.4 Calculate the magnitude and direction of equilibrium force.
- 3.5 Compare the calculated values with experimental values.

### **4. Determine the center of a triangular lamina.**

- 4.1 Select a triangular lamina and a plumb bob.
- 4.2 Set up the plumb bob.
- 4.3 Find the center point of the triangular lamina.

### **5. Determine the center of gravity of solid body.**

- 5.1 Select solid bodies such as solid rod, step rod and body with cut out holes.
- 5.2 Select a fulcrum.
- 5.3 Set up the fulcrum.
- 5.4 Find the center point.
- 5.5 Compare the analytical values with experimental values.

### **6. Determine the co-efficient of friction.**

- 6.1 Set up the friction apparatus.
- 6.2 Select the materials of which coefficient of friction is to be determined.
- 6.3 Place the materials over each other.
- 6.4 Raise one end of the body until the other body slides down.
- 6.5 Find the angle of friction.
- 6.6 Find the co-efficient of friction.

### **7. Determine the action of load on the member of simple frame or truss.**

- 7.1 Select two members of which one end roller and other end pin point.
- 7.2 Select a tension spring.
- 7.3 Make a unit as a simple frame or truss.
- 7.4 Apply the load.
- 7.5 Read the tension load on spring.

**8. Determine the torque of engine by prony brake.**

- 8.1 Set up the prony brake with the engine flywheel.
- 8.2 Tighten the hand wheel of prony brake.
- 8.3 Measure the length of torque arm.
- 8.4 Start the engine.
- 8.5 Take the reading of spring scale.
- 8.6 Find the torque of engine.
- 8.7 Compare the calculated values with the manufacturers' recommended values.

**9. Determine the BHP of an engine by chassis dynamometer.**

- 9.1 Place the vehicle on chassis dynamometer.
- 9.2 Start the vehicle engine.
- 9.3 Transmit power at different gear position.
- 9.4 Find the B. H. P. of the engine by chassis dynamometer at different speeds.
- 9.5 Compare the experimental value with the manufactures' recommended value.

**10. Determine the velocity ratios among the driver and driven gears.**

- 10.1 Set a simple train of gears.
- 10.2 Compare the velocity ratios of the same.
- 10.3 Set a compound train of gears.
- 10.4 Compare the velocity ratios of the same.

**REFERENCE BOOKS**

- 1 Applied Mechanics – R. S. Khurmi
- 2 Applied Mechanics – R. K. Jain
- 3 Applied Mechanics – Fairries
- 4 Analytical Mechanics – Faires & Nash
- 5 Mechanics of Materials – Morgan



## AIMS

To provide the students with an opportunity to develop knowledge, skill and attitude in the area of automotive equipment and work shop practice with special emphasis on :

- automotive shop work and safety
- shop layout
- shop tools and equipment
- lifting tackles
- connecting rod aligning practice
- different equipment used in modern automobile shop.
- automotive shop safety.

## SHORT DESCRIPTION

Automotive shop work; Shop safety; Shop layout; Shop hand tools; Cutting tools; Measuring tools; Power tools; Lifting tackles; Cylinder boring; Cylinder honing; Crankshaft grinding; Connecting rod alignment; Valve face refracting; Valve seat grinding; Front end alignment; Brake drum & disc reconditioning; Wheel aligning, wheel balancing, tyre changing, engine scanning, suspension testing, brake testing, petrol injector testing, ATF changin & automotive shop safety.

## DETAIL DESCRIPTION

### Theory

#### 1. Understand the shop works in automotive shop.

- 1.1 State what is meant by shop works.
- 1.2 List the name of jobs generally done in automotive shop.
- 1.3 Draw shop layout of your auto- shop.

#### 2. Understand the features of automotive shop equipment and tools.

- 2.1 Distinguish between equipment and tools.
- 2.2 Mention the classification of automotive shop equipment and tools.
- 2.3 List the common & special hand tools used in the automotive shop.
- 2.4 List the different type of testing shop equipment used in automotive workshop.
- 2.5 List & mention the use of 10 special service tools(SST)

#### 3. Understand the features of cutting and power tools used in automotive shop.

- 3.1 Define cutting tools.
- 3.2 List the cutting tools used in automotive works.
- 3.3 List the basic measuring tools used in automotive shop.
- 3.4 Define power tools.
- 3.5 List the basic shop equipment and power tools used in a typical automobile shop.
- 3.6 Mention the uses of electric, pneumatic and hydraulic power tools in automotive shop.

**4. Understand the features of lifting tackles used in automotive shop.**

- 4.1 State what is meant by the lifting tackle.
- 4.2 State the purpose of lifting tackles in automotive shop.
- 4.3 Identify the different types of lifting tackle used in automotive shop.
- 4.4 Mention the specific application of lifting tackles in automotive shop.
- 4.5 Describe the operation of hydraulic jack.

**5. Understand the features of compressed air in automotive shop.**

- 5.1 State the necessity of compressed air in automotive shop.
- 5.2 Mention the specific applications of compressed air in automotive shop & industries.
- 5.3 Describe the operation of an air compressor.

**6. Understand the features of machine shop equipments.**

- 6.1 Define cylinder boring, cylinder honing, crankshaft grinding, valve refacing & valve seat grinding valve seat & face lapping.
- 6.2 Explain the importance of cylinder boring, cylinder honing, crankshaft grinding, valve refacing, valve seat grinding & valve seat & face lapping.
- 6.3 Mention the checkup procedure of different machine shop jobs related to automobile.

**7. Understand the features of connecting rod aligner.**

- 7.1 Define connecting rod alignment.
- 7.2 Identify the faults of connecting rod.
- 7.3 Describe the steps of connecting rod alignment by a connecting rod aligner.

**8. Understand the feature of a wheel aligner.**

- 8.1 Explain the necessity of wheel alignment.
- 8.2 Mention the use of wheel aligner.
- 8.3 List the components of wheel aligner.
- 8.4 Describe the wheel alignment procedure.
- 8.5 Mention the precaution during wheel alignment.

**9. Understand the feature of a wheel balancer.**

- 9.1 Mention the necessity of wheel balancer.
- 9.2 Explain the faults of wheel.
- 9.3 Describe the wheel balancing procedure.

**10. Understand the feature of brake drum and disc cutting lathe.**

- 10.1 Identify the defects of brake drum and disc.
- 10.2 Define ovality of a brake drum.
- 10.3 Explain the use of brake drum & disc cutting lathe.

**11. Understand the feature of tire changer.**

- 11.1 Mention the necessity of tire changer.
- 11.2 Explain the tire changing procedure.
- 11.3 Identify the faults of tire.

**12. Understand the feature of Auto Transmission Fluid (ATF) changer.**

- 12.1 Mention the necessity of ATF changer.
- 12.2 Describe the ATF changing procedure with an ATF changer.

**13. Understand the feature of Petrol injector tester & cleaner.**

- 13.1 Mention the necessity of petrol injector tester & cleaner.

13.2 Explain the faults of petrol injector.

13.3 Describe the cleaning & testing procedure of a petrol injector with a petrol injector tester & cleaner

**14. Understand the feature of Suspension tester.**

14.1 Mention the necessity of suspension tester.

14.2 Explain the faults of suspension system.

14.3 Describe the testing procedure of a suspension tester with a suspension tester.

**15. Understand the feature of brake tester.**

15.1 Mention the necessity of brake tester.

15.2 Explain the faults of brake system.

15.3 Describe the testing procedure of a brake with a brake tester.

**16. Understand the feature of automotive scanner.**

16.1 Mention the importance of scanner.

16.2 Describe the scanning procedure.

16.3 Mention the precaution of scanning by a scanner.

**17. Understand the automotive shop safety.**

17.1 Define shop safety.

17.2 Identify the automotive shop hazards.

17.3 List the automotive shop hazards due to unsafe work (faulty work habits).

17.4 List the automotive hazards due to unsafe conditions (equipment defect).

17.5 Identify the hazardous material and hazardous waste in the automotive shop.

17.6 Explain the methods of disposing hazardous waste from automobile shop.

17.7 Mention the general and specific safety rules of automotive shop.

**PRACTICAL:**

**1. Study the tools and equipment of automobiles workshop practice.**

1.1 Identify the tools used in auto workshop.

1.2 Identify the special tools and equipment used in auto workshop.

1.3 Prepare the specification of common tools and equipment.

**2 Practice the cylinder boring.**

2.1 Place the cylinder boring machine on cylinder block.

2.2 Center the boring bar and fix the machine.

2.3 Fix the cutter and adjust correctly.

2.4 Perform the cutting operation.

**3 Practice cylinder honing.**

3.1 Place the hone stone in the cylinder.

3.2 Adjust the hone.

3.3 Perform the honing operation.

**4 Perform the alignment of connecting rod.**

4.1 Clean the connecting rod and check visually.

4.2 Fix the connecting rod with aligner.

4.3 Measure the bending and twisting.

4.4 Remove the connecting rod from aligner.

4.5 Make necessary correction.

4.6 Recheck the connecting rod for bending and twisting.

**5 Practice the valve face refacing.**

- 5.1 Fix the valve with chuck and set at the proper angle.
- 5.2 Set the valve face and grinding stone at proper angle.
- 5.3 Switch on the coolant supply.
- 5.4 Start the motor of grinding wheel and chuck.
- 5.5 Perform the operation of valve refacing.

**6 Practice the valve seat grinding.**

- 6.1 Clean the valve seat and valve guide.
- 6.2 Set the pilot stand.
- 6.3 Select the grinding stone of proper grade and angle.
- 6.4 Fix the stone and holder.
- 6.5 Place the stone and holder on pilot stand.
- 6.6 Set the motor with stone holder.
- 6.7 Perform the valve seat grinding operation.

**7 Practice the lapping operation of valve face and valve seat.**

- 7.1 Clean the valve face and valve seat.
- 7.2 Apply the course grinding paste on valve seat.
- 7.3 Place the valve on the seat.
- 7.4 Set the lapping tool on the valve head.
- 7.5 Perform the lapping operation.
- 7.6 Repeat the operation using fine grinding paste.

**8 Perform the alignment of wheel.**

- 8.1 Inflate the tires at the correct pressure.
- 8.2 Check the wear of wheel bearing and ball joints.
- 8.3 Check the caster angle and adjust correctly.
- 8.4 Check the king pin inclination
- 8.5 Check the toe- in and toe-out.
- 8.6 Check the toe-out on turn and adjust correctly.

**9 Perform the wheel balancing.**

- 9.1 Identify different parts of wheel balancer.
- 9.2 Perform wheel balancing of an automobile.

**10 Perform brake drum reconditioning.**

- 10.1 Set the brake drum with brake drum lathe.
- 10.2 Center the drum with lathe.
- 10.3 Set the cutter accurately.
- 10.4 Perform the operation with the lathe.
- 10.5 Recheck ovality and other wears.

**11 Perform Auto Transmission Fluid (ATF) changing**

- 11.1 Disconnect the cooler hose of engine.
- 11.2 Connect the hose of ATF changer with proper connector.
- 11.3 Pour ATF in new tank.
- 11.4 Start the engine & check the inspection tube whether used fluid is going to used tank.
- 11.5 Before finish the used fluid change the direction knob for distribute the new fluid.
- 11.6 Shift the gear lever (L,1,2,3,D,N & P) with apply the brake for proper filtering.
- 11.7 Inspect the new fluid flow tube & colour after filter, check the gear box fluid level.

**12 Perform the tyre changer.**

12.1 Identify different parts of tyre changer.

12.2 Perform tyre changing.

**13 Perform the scanning procedure.**

13.1 Identify different parts of automotive scanner.

13.2 Perform scanning of an automobile engine and diagnosis its problems.

**REFERENCE BOOKS**

- 1 Automotive Mechanics - Crouse-Anglin
- 2 Auto Mechanics - Mitchell

**AIMS**

To provide the students with an opportunity to acquire knowledge, skill and attitude in the area of engineering thermodynamics with special emphasis on.

- Heat, temperature and pressure
- Application of heat
- Thermodynamic systems
- Thermodynamic laws and processes
- Properties of gas, vapor and steam
- Thermodynamic cycles
- Transmission of heat

**SHORT DESCRIPTION**

Fundamentals of thermodynamics; specific heat of gases; laws of perfect gases; laws of thermodynamics; Internal energy and enthalpy of gases; thermodynamic processes of perfect gases; entropy of perfect gases; properties of vapor and steam, aspects of thermodynamic cycles, thermodynamic air cycles, thermodynamics vapor cycles, refrigeration and heat pumps and heat transfer.

**THEORY:****1. Understand the fundamentals of thermodynamics.**

- 1.1 Define thermodynamic, system, boundary, surroundings and the universe.
- 1.2 Mention types of systems- close, open, isolated, flow, non-flow systems with examples.
- 1.3 Identify different applications of thermodynamics in the engineering field.
- 1.4 Define thermodynamic state, path, process, reversible & irreversible process, thermodynamic equilibrium, point function, path function, control volume.
- 1.5 Define heat, temperature and pressure.
- 1.6 Explain different types of heat, temperature scale and pressure.
- 1.7 Mention units of heat, temperature scale and pressure.
- 1.8 Convert one unit to another unit of heat, temperature scale and pressure.
- 1.9 Solve problems on heat, temperature scale and pressure.

**2. Understand the concept of specific heat of gases.**

- 2.1 Define specific heat, thermal capacity and water equivalent.
- 2.2 Describe the terms specific heat at constant pressure ( $C_p$ ) and specific heat at constant Volume ( $C_v$ ).
- 2.3 Mention Regnault's law.
- 2.4 Relate two specific heats ( $C_p$  and  $C_v$ ).
- 2.5 Explain the ratio of two specific heats ( $\gamma$ )
- 2.6 Mention the standard value of  $C_p$ ,  $C_v$ , and  $\gamma$  for some common gases.
- 2.7 Explain the molar specific heats of a gas.
- 2.8 Solve problems on  $C_p$ ,  $C_v$ , and  $\gamma$ .

**3. Understand the laws of perfect gases.**

- 3.1 Define perfect gas.
- 3.2 Explain the variables of perfect gases.
- 3.3 State Boyle's law, Charles' law and Gay-Lussac law, Avogadro's law.
- 3.4 Explain the general gas equation, characteristic gas equation and universal gas constant or molar constant.
- 3.5 Solve problems using gas laws and equations.

**4. Understand the laws of thermodynamics.**

- 4.1 State the laws of thermodynamics.
- 4.2 Explain the 1st law of thermodynamics and its limitation.
- 4.3 Mention the corollaries of 1st law of thermodynamics.
- 4.4 Explain the 2nd law of thermodynamics and its limitation.
- 4.5 Mention the corollaries of 2nd law of thermodynamics.
- 4.6 Mention the physical significance of 1st and 2nd law of thermodynamics.
- 4.7 Explain the 3rd law of thermodynamics.

- 4.8 Explain the Zeroth law of thermodynamics.
- 4.9 Solve problems on the laws of thermodynamics.

**5. Understand the internal energy and enthalpy of gases.**

- 5.1 Define internal energy.
- 5.2 Define enthalpy & specific enthalpy.
- 5.3 Explain the internal energy of a gas heated at constant volume and constant pressure.
- 5.4 Relate between internal energy and enthalpy.
- 5.5 Explain Joule's law.
- 5.6 Solve problems on change of internal energy and enthalpy of gases.

**6. Understand the thermodynamic processes of perfect gases.**

- 6.1 Define thermodynamic processes.
- 6.2 Explain the flow processes and non-flow processes of gases.
- 6.3 Describe the various non-flow thermodynamic processes with P-V and T-S diagrams.
- 6.4 Determine the work done by the gases during the above process.
- 6.5 Explain the steady and unsteady flow processes.
- 6.6 Describe the steady flow energy equations.
- 6.7 Solve problems on thermodynamic processes.

**7. Understand the entropy of perfect gases.**

- 7.1 Define entropy.
- 7.2 Mention the importance of entropy.
- 7.3 Describe the principle of increase of entropy.
- 7.4 Establish the relation between heat & entropy.
- 7.5 Explain the general expression for change of entropy of a perfect gas during various thermodynamic processes.
- 7.6 Solve problems on entropy of different thermodynamic processes.

**8. Understand the properties of vapor and steam.**

- 8.1 Name the three-state of a substance.
- 8.2 Distinguish between the steam and vapors.
- 8.3 Discuss the triple point of a substance.
- 8.4 List the properties of vapors.
- 8.5 Explain the formation of steam at constant pressure.
- 8.6 Describe the important terms for steam (wet steam, dry saturated steam, superheated steam, dryness fraction, specific volume of steam, etc)
- 8.7 Explain the method of using steam table.
- 8.8 Find out the different properties of steam from a steam table at a certain pressure and temperature.

**9. Understand the aspects of thermodynamic cycles.**

- 9.1 Define thermodynamic cycle.
- 9.2 Classify the thermodynamic cycle
- 9.3 List the assumption in thermodynamic cycles.
- 9.4 Explain the reversible and irreversible cycles.
- 9.5 State the meaning of air standard cycle. Gas power cycle and vapor power cycle.

**10. Understand the thermodynamic air cycles.**

- 10.1 Describe the Carnot cycle with P-V and T-S diagrams.
- 10.2 Determine air standard efficiencies of Carnot cycles.
- 10.3 Describe the conventional air cycles i.e. Otto cycle, Diesel cycle with P-V and T-S diagrams.
- 10.4 Determine the air standard efficiency of Otto cycle, Diesel cycle, Dual cycle and Brayton/Joule cycle.
- 10.5 Compare Otto, Diesel and Dual cycles.
- 10.6 Compare the theoretical Otto and Diesel cycles with the actual Otto and Diesel cycles.
- 10.7 Solve problems on different air cycles.

**11. Understand the aspects of thermodynamics vapor cycles.**

- 11.1 Define vapor cycle.
- 11.2 Describe the Rankine cycle with incomplete evaporation and modified Rankine cycle with superheated steam.
- 11.3 Define reheat, regenerative and reheat-regenerative vapor cycles.
- 11.4 Explain the reheat, regenerative and reheat-regenerative vapor cycles with P-V and T-S diagrams.
- 11.5 Compare the reheat, regenerative and reheat-regenerative vapor cycles.

## 12. Understand the features of refrigeration and heat pumps.

- 12.1 State the meaning of heat engine, refrigeration and heat pump.
- 12.2 Describe the reverse cannot cycle with P-V and T-S diagrams.
- 12.3 Describe the vapor compression mechanical refrigeration cycle.
- 12.4 Determine the Coefficient of performance COP (heating & refrigerating)
- 12.5 Describe the capacity of the refrigerating machine.
- 12.6 Describe the vapor absorption refrigeration cycle.
- 12.7 Solve problems on COP and TR.

## 13. Understand the heat transfer.

- 13.1 Explain the three modes of heat transfer with examples.
- 13.2 Compare conduction, convection and radiation of heat.
- 13.3 Explain Fourier's law of thermal conductivity.
- 13.4 Explain Newton's law of cooling for convective heat transfer.
- 13.5 Define heat exchanger.
- 13.6 Mention the classification of the heat exchangers.

## PRACTICAL:

- 1. Verify Boyle's law with Boyle's law test apparatus, i.e.  $P_1V_1=P_2V_2\ldots\ldots\ldots = \text{constant}$ .
- 2. Verify Gay – Lussac law by measuring gas pressure in a cylinder or refrigerant cylinder in different temperature at (ambient and ice-cooling) i.e.  $\frac{P_1}{T_1} = \frac{P_2}{T_2} \ldots\ldots\ldots = \text{constant}$ .
- 3. Observe the 4-stroke Otto Cycle with a model.
- 4. Observe the 4-stroke Diesel Cycle with a model.
- 5. Observe the 2-stroke diesel Cycle with a model.
- 6. Determine the mechanical equivalent of heat by Joule's apparatus to verify the first law of thermodynamics.
- 7. Observe the heat transfer modes (Conduction, convection and radiation) with refrigerator or an engine.
- 8. Observe Rankine cycle with a steam engine/steam turbine model.
- 9. Observe the refrigeration cycle to verify the second law of thermodynamics.
- 10. Study and compare various heat exchangers such as, radiators, evaporators, condensers, plate heat exchangers.
- 11. Verify that "a black body is a good heat absorber as well as a good heat emitter".

## Reference Books: -

Author	Title	Publisher
Mahesh M Rathore	Thermal Engineering	Tata McGraw HillPublication
A R Basu	Thermal Engineering Heat Power	Dhanpat Rai and Co.(P)Ltd, New Delhi
R. S. Khurmi and J. K. Gupta	A Text book of Thermal Engineering	S. Chand and Co.Ltd
P K Nag	Basic and applied thermodynamics	Tata McGraw HillPublication
Rai&Sarao	Applied Thermodynamics	Satya Prokashan
Dr. D.S. Kumar	Heat & Mass Transfer	S.K. Kataria & sons
A.S. Sarao	Thermal Engineering	Satya Prokashan
H.B. Kaswani	Heat and Mass Transfer	Satya Prokashan
Brijlal N. Subrahmanyam P.S. Hemen	Heat Thermodynamics and Statistical Physics	S. Chand and Co.Ltd.



**AIMS:**

- To be able to understand the basic concepts and principles of business organization.
- To be able to understand the banking system.
- To be able to understand the trade system of Bangladesh.
- To be able to understand the basic concepts of communication and its types, methods.
- To be able to perform in writing, application for job, complain letter & tender notice.

**SHORT DESCRIPTION:**

Principles and objects of business organization; Formation of business organization; Banking system and its operation; Negotiable instrument; Home trade and foreign trade. Basic concepts of communication Communication model & feedback; Types of communication; Methods of communication; Formal & informal communication; Essentials of communication; Report writing; Office management; Communication through correspondence; Official and semi- official letters.

**DETAIL DESCRIPTION:****Theory:****1 Concept of Business organization.**

- 1.1 Define business.
- 1.2 Mention the objects of business.
- 1.3 Define business organization.
- 1.4 State the function of business organization.

**2 Formation of Business organization.**

- 2.1 Define sole proprietorship, partnership, Joint Stock Company. and co-operative
- 2.2 Describe the formation of sole proprietorship, partnership, joint stock Company, & co operative.
- 2.3 Mention the advantages and disadvantages of proprietorship, partnership and Joint Stock Company.
- 2.4 State the principles of Co operative & various types of Co operative.
- 2.5 Discuss the role of co-operative society in Bangladesh.

**3 Basic idea of Banking system and negotiable instrument.**

- 3.1 Define bank.
- 3.2 State the service rendered by bank.
- 3.3 Describe the classification of bank in Bangladesh.
- 3.4 State the functions of Bangladesh Bank in controlling money market.
- 3.5 State the functions of commercial Bank in Bangladesh
- 3.6 Mention different types of account operated in a bank.
- 3.7 Mention how different types of bank accounts are opened and operated.
- 3.8 Define negotiable instrument.
- 3.9 Discuss various types of negotiable instrument.
- 3.10 Describe different types of cheque.

#### **4 Home & foreign trade**

- 4.1 Define home trade.
- 4.2 Describe types of home trade.
- 4.3 Define foreign trade.
- 4.4 Mention the advantages and disadvantages of foreign trade.
- 4.5 Discuss the import procedure & exporting procedure.
- 4.6 Define letter of credit.
- 4.7 Discuss the importance of foreign trade in the economy of Bangladesh.

#### **5 Basic concepts of communication**

- 5.1 Define communication & business communication.
- 5.2 State the objectives of business communication.
- 5.3 Describe the scope of business communication.
- 5.4 Discuss the essential elements of communication process.

#### **6 Communication model and feedback.**

- 6.1 Define communication model.
- 6.2 State the business functions of communication model.
- 6.3 Define feedback.
- 6.4 State the basic principles of effective feedback.

#### **7 Types and Methods of communication.**

- 7.1 Explain the different types of communication;-
  - a) Two-way communication
  - b) Formal & informal communication
  - c) Oral & written communication
  - d) Horizontal & vertical communication
  - e) external & internal communication
  - f) Spoken & listening communication.
- 7.2 Define communication method.
- 7.3 Discuss the various methods of communication.
- 7.4 Distinguish between oral and written communication.

#### **8 Essentials of communication.**

- 8.1 Discuss the essential feature of good communication.
- 8.2 Describe the barriers of communication.
- 8.3 Discuss the means for overcoming barriers to good communication.

#### **9 Report writing.**

- 9.1 Define report, business report & technical report.
- 9.2 State the essential qualities of a good report.
- 9.3 Describe the factors to be considered while drafting a report.
- 9.4 Explain the components of a technical report.
- 9.5 Prepare & present a technical report.

#### **10 Office management.**

- 10.1 Define office and office work.
- 10.2 State the characteristics of office work.
- 10.3 Define filing and indexing.
- 10.4 Discuss the methods of filing.

10.5 Discuss the methods of indexing.

10.6 Distinguish between filing and indexing.

#### **11 Official and semi-official letters.**

11.1 State the types of correspondence.

11.2 State the different parts of a commercial letter.

11.3 Define official letter and semi-official letter.

11.4 Prepare & present the following letters: Interview letter, appointment letter, joining letter and application for recruitment. Complain letters, tender notice.

#### **REFERENCE BOOK:**

1. উচ্চ মাধ্যমিক ব্যবসায়নীতি ও প্রয়োগ -মোহাম্মদ খালেকুজ্জামান
2. উচ্চ মাধ্যমিক ব্যাংকিং ও বীমা -প্রফেসর কাজী নুরুল ইসলাম ফারুকী
3. আধুনিক কারবার পদ্ধতি -লতিফুর রহমান
4. কারবার যোগাযোগ ও সচিবের কার্যপদ্ধতি -প্রফেসর লতিফুর রহমান ও প্রফেসর কাজী নুরুল ইসলাম ফারুকী
5. ব্যবসায়িক যোগাযোগ এবং অফিসের কর্মপ্রণালী -ড. এম, এ, মান্নান
6. ব্যবসায় যোগাযোগ – মোহাম্মদ খালেকুজ্জামান ও মোঃ মুশাররফ হোসেন চৌধুরী
7. Business organization & management- M.C. Shukla
8. Business organization & management- R.N. Gupta

**AIMS**

- To be able to understand the basic concepts of environment and environmental pollution.
- To be able to understand the concepts of ecology and ecosystems
- To be able to understand the basic concepts of environmental degradation relating to industrial production.
- To be able to understand the major environmental issues and problems.
- To be able to understand legislative measures to protect environment.

**SHORT DESCRIPTION**

Basic concepts of environment; natural resources; biogeochemical cycling; ecology and ecosystem; air; water; soil; solid waste management; development and environment; global environmental challenges; legislative protection of environment.

**DETAIL DESCRIPTION****1. Understand the multidisciplinary nature of environmental studies.**

- 1.1. Define environment, nature, pollution, pollutant, contaminant.
- 1.2. Describe the scope of environmental studies.
- 1.3. Describe the importance of environmental studies.
- 1.4. Describe the formation and structure of the Earth.
- 1.5. Describe the earth's natural system.
- 1.6. Describe the changing attitudes to the natural world.
- 1.7. Mention the main components of environment.
- 1.8. Define natural and man-made environment.
- 1.9. Distinguish between natural and man-made environment.

**2. Understand the natural resources.**

- 2.1. Define natural resources.
- 2.2. Classify natural resources.
- 2.3. Describe forest resources.
- 2.4. Describe water resources.
- 2.5. Describe mineral resources.
- 2.6. Describe food resources.
- 2.7. Describe energy resources.
- 2.8. Describe land resources.
- 2.9. Describe environmental problem relating to resources use.
- 2.10. Describe the role of an individual in conservation of natural resources.

**3. Understand the biogeochemical cycling.**

- 3.1. Define biogeochemical cycle.
- 3.2. Describe hydrologic cycle.
- 3.3. Describe carbon cycle.
- 3.4. Describe nitrogen cycle.
- 3.5. Describe oxygen cycle.
- 3.6. Describe phosphorus cycle.

- 3.7. Describe sulfur cycle.
- 3.8. Describe nutrient cycle.

#### **4. Understand the ecology and ecosystem.**

- 4.1. Define ecology and ecosystem.
- 4.2. Structure and function of an ecosystem.
- 4.3. Describe the components of ecosystem.
- 4.4. Explain the stability of ecosystem.
- 4.5. Describe ecological factors.
- 4.6. Describe interdependency between abiotic and biotic component.
- 4.7. Describe the meaning of following terms: species, population, community, ecological succession, community periodicity, climax community, ecological niche, habitat, plankton, nekton, ecological indicator, evolution, adaptation, producers, consumers, decomposers, food chains, food webs, ecological pyramids, bio-concentration, bio-magnification, biodiversity, threatened species, endanger species, extinct species, exotic species, biodiversity conservation and biogeography.
- 4.8. Describe energy flow in the ecosystem.
- 4.9. Describe the ecosystem of pond, ocean, estuary, grassland, cropland, forest, desert and mangrove.

#### **5. Understand the air as a component of environment.**

- 5.1. Define air.
- 5.2. Describe the composition of the clean dry atmospheric air at ground level.
- 5.3. Describe the atmospheric structure.
- 5.4. Define air pollution.
- 5.5. Describe major air pollutants and their impacts.
- 5.6. Describe the sources of air pollutants.
- 5.7. Explain the formation of photochemical smog and its effects.
- 5.8. Describe the effects of air pollution on vegetation, animal, human health and materials and resources.
- 5.9. Define sound and noise.
- 5.10. Describe the classification of sound.
- 5.11. Describe the effects of noise.

#### **6. Understand the water as a component of environment.**

- 6.1. Define water.
- 6.2. Describe the characteristics of water.
- 6.3. Describe the sources of water.
- 6.4. Describe the uses of water.
- 6.5. Explain that the water is a universal solvent.
- 6.6. Define water pollution, biological oxygen demand (BOD), effluent treatment plant (ETP).
- 6.7. Describe the sources of water pollution.
- 6.8. Describe the effects of water pollution.

#### **7. Understand the soil as a component of environment.**

- 7.1. Define soil.
- 7.2. Describe the constituents of soil.
- 7.3. Define soil pollution.
- 7.4. Describe causes soil degradation.
- 7.5. Describe the sources of soil pollution.
- 7.6. Describe the effects of soil pollution.

**8. Understand the concept of solid waste management.**

- 8.1. Define solid waste, refuse, garbage, rubbish, trashes, demolition and construction waste, e-waste, agricultural waste, pathological waste, radioactive waste, hazardous waste, 3R, 4R.
- 8.2. List the sources of solid waste.
- 8.3. Mention the classification of solid waste.
- 8.4. Mention the methods of collection of solid waste.
- 8.5. Describe the recycling of solid wastes.
- 8.6. Describe resource recovery from solid waste.
- 8.7. Describe the potential method of disposal of solid waste.
- 8.8. Describe control measures of urban and industrial wastes.

**9. Understand the development and environment.**

- 9.1. Define environmental ethics and environmental stress.
- 9.2. Describe environmental stress.
- 9.3. Define sustainable development.
- 9.4. Define urbanization.
- 9.5. Describe the causes of urbanization.
- 9.6. Describe the effects of urbanization on environment.
- 9.7. Define industrialization.
- 9.8. Describe the causes of industrialization.
- 9.9. Describe the effects of industrialization on environment.

**10. Understand the global environmental challenges.**

- 10.1. Define greenhouse gas and greenhouse effects.
- 10.2. Make a list of greenhouse gases and their contribution on greenhouse effects.
- 10.3. Describe the causes and consequences of greenhouse effects.
- 10.4. Describe acid rain.
- 10.5. Describe importance of ozone layer.
- 10.6. Define ozone depleting substances (ODS).
- 10.7. Describe ozone layer depletion mechanism.
- 10.8. Describe hazardous waste.
- 10.9. Describe chemicals pesticides.
- 10.10. Describe radioactive pollution.
- 10.11. Describe natural disaster.

**11. Understand the legislative protection of environment.**

- 11.1. Define environmental impact assessment (EIA) and environmental auditing (EA).
- 11.2. Mention environmental act and legislations prescribed for air, noise, water, soil and wild life protection.
- 11.2. Describe environmental conservation act 1995 in Bangladesh.
- 11.3. Describe the environment conservation rule 1997 in Bangladesh.
- 11.4. Describe the environmental framework in Bangladesh.
- 11.5. Describe The Montreal Protocol and The Kyoto Protocol.
- 11.6. Describe role of an individual in prevention of pollution.

**REFERENCES:**

1. Fundamentals of Environmental Studies, Mahua Basu and S. Xavier, Cambridge.
2. Ecology and Environment, P.D. Sharma, Rastogi Publications.
3. Basics of Environmental Science, Michael Allaby, Routledge.
4. Environmental Science, Jonathan Turk and Amos Turk, Saunders golden sunburst series.