



**BANGLADESH TECHNICAL EDUCATION BOARD**  
Agargaon, Dhaka-1207

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

**MECHANICAL TECHNOLOGY**  
TECHNOLOGY CODE: **670**

5th SEMESTER

DIPLOMA IN ENGINEERING  
PROBIDHAN-2016

**MECHANICAL TECHNOLOGY (670)**

**5<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            | 67051        | Hydraulics & Hydraulic Machineries | 3         | 3         | 4         | 60           | 90         | 25           | 25         | 200         |
| 2            | 67052        | Mechanical Estimating & Costing    | 2         | 3         | 3         | 40           | 60         | 25           | 25         | 150         |
| 3            | 67053        | Advance Welding -1                 | 2         | 6         | 4         | 40           | 60         | 50           | 50         | 200         |
| 4            | 67054        | CAD & CAM                          | 1         | 6         | 3         | 20           | 30         | 50           | 50         | 150         |
| 5            | 67055        | Manufacturing Process              | 3         | 0         | 3         | 60           | 90         | 0            | 0          | 150         |
| 6            | 65851        | Accounting Theory & Practice       | 2         | 3         | 3         | 40           | 60         | 50           | 0          | 150         |
| <b>Total</b> |              |                                    | <b>13</b> | <b>21</b> | <b>20</b> | <b>260</b>   | <b>390</b> | <b>200</b>   | <b>150</b> | <b>1000</b> |

**AIMS**

To be able to understand the concepts of technical terms used in hydraulics and hydraulic machineries and the techniques used in hydraulics and hydraulic machineries with special emphasis on:

- Properties of fluids
- Fluid pressure measurement
- Continuity equation
- Bernoulli's equation
- Orifice and mouthpieces
- Notches and Weirs
- Impact of jet
- Water pumps & turbines
- Hydraulic devices

**SHORT DESCRIPTION**

Properties of fluid; Fluid pressure measurement; Flow of fluids through pipes; Bernoulli's equation; Flow through orifices; Flow through mouthpieces; Flow through Notches and Weirs; Viscous flow; Impact of jets; Water turbine; Reciprocating pumps; Centrifugal pumps; Rotary pumps; Hydraulic devices.

**DETAIL DESCRIPTION****Theory:****1. Understand the scope of hydraulics.**

- 1.1. Define fluid with types.
- 1.2. Compare the liquid, vapor and gas.
- 1.3. Define hydraulics and hydraulic machineries.
- 1.4. Outline the importance of hydraulics and hydraulic machineries.
- 1.5. Mention the branches of hydraulics.
- 1.6. Identify different application of hydraulics and hydraulic machineries in engineering field.

**2. Understand the fluid properties and fluid pressure.**

- 2.1 List the properties of fluids.
- 2.2 Define density, specific weight, surface tension, capillary, viscosity and fluid pressure.
- 2.3 State Pascal's law of fluid pressure.
- 2.4 Show the proof of the Pascal's law of fluid pressure.
- 2.5 Define atmospheric pressure, gauge pressure and absolute pressure.
- 2.6 Mention the relation among atmospheric pressure, gauge pressure and absolute pressure.
- 2.7 Express the derivation of the formulae for finding total pressure on immersed surface at horizontal, inclined and vertical position.
- 2.8 Solve problems on static fluid pressure.

**3. Understand Buoyancy.**

- 3.1 Define buoyancy and center of buoyancy.
- 3.2 State the meaning meta-centre and meta-centric height.
- 3.3 Mention the conditions of equilibrium of a floating body.

**4. Understand the features of fluid pressure gauges.**

- 4.1 State the meaning of pressure gauge.
- 4.2 Mention the classification of pressure gauges.
- 4.3 Define manometer.
- 4.4 Distinguish between simple manometer and differential manometer.
- 4.5 Mention the working principle of different types of pressure gauges.
- 4.6 Mention the specific application of different pressure gauges.
- 4.7 Solve problems relating to measurement of fluid pressure by different manometers.

**5. Understand the concept of fluid flow through pipes.**

- 5.1 State different types of fluid flow.
- 5.2 State the equation of continuity of flow.
- 5.3 State flow rate or discharge.
- 5.4 Compute the formula of flow rate.
- 5.5 State the equation of continuity of flow.
- 5.6 Solve the problems on continuity of flow.

**6. Understand the concept of Bernoulli's equation.**

- 6.1 Define head, pressure head, velocity head, datum head and total head.
- 6.2 State and interpret the Bernoulli's equation for flowing liquid.
- 6.3 Mention the limitation of Bernoulli's equation.
- 6.4 Mention the function of venture-meter, orifice-meter and pitot tube.
- 6.5 Describe the construction and operation of venture-meter, orifice-meter and pitot tube.
- 6.6 Express the derivation of formula to measure the quantity of liquid flowing through venture-meter.
- 6.7 Express the derivation of formula to measure the quantity of liquid flowing through orifice-meter.
- 6.8 Express the derivation of formula to measure the velocity of flowing liquid by the pitot tube.
- 6.9 Solve the problems on fluid through pipe, Bernoulli's equation and venture-meter, orifice-meter and pitot tube.

**7. Understand the concept of flow through orifices.**

- 7.1 Define orifice.
- 7.2 Mention the classification of orifices.
- 7.3 State hydraulic coefficients.
- 7.4 Define jet of water, vena-contracta, coefficient of contraction ( $C_c$ ), coefficient of velocity ( $C_v$ ), coefficient of discharge ( $C_d$ ) and coefficient of resistance.
- 7.5 Relate the  $C_c$ ,  $C_v$  and  $C_d$ .
- 7.6 Calculate different hydraulic coefficients.
- 7.7 Express the deduction of formulae for finding out the discharge of liquid through various orifices
- 7.8 Solve problems relating orifices.

**8. Understand the concept of flow through mouthpieces.**

- 8.1 Define and classify mouthpieces.
- 8.2 Express the deduction of formulae to calculate discharge through different types of mouthpieces.
- 8.3 State head losses of flowing liquid in a pipe.
- 8.4 List the causes of head loss of flowing liquid.
- 8.5 Express the deduction of formulae to calculate loss of head due to friction, sudden enlargement, sudden contraction and obstruction in pipe.
- 8.6 Express the deduction of formulae to calculate loss of head due to friction (Darcy's and Cheay's formulae).
- 8.7 Solve problems relating head losses and discharge through mouthpieces.

**9. Understand the concept of flow through notches and Weirs.**

9.1 Define notches and Weirs.

9.2 Identify different types of notches and Weirs with sketches such as rectangular notch v-notch trapezoidal notch.

9.3 Outline the importance of using notches and Weirs.

9.4 Solve problems relating head losses and discharge through notches and Weirs.

**10. Understand the concept of viscous flow.**

10.1 Define viscosity.

10.2 Mention the units of viscosity.

10.3 Define ideal fluid, real fluid, Newtonian fluid and non-Newtonian fluids.

10.4 Distinguish between the laminar flow and turbulent flow.

10.5 State Reynold's number.

10.6 Solve problems relating to viscosity.

**11. Understand the aspect of impact of jets.**

11.1 State impact of jet.

11.2 Express the deduction of formula to calculate the force of a jet impinging on a flat fixed vertical plate, inclined plate and hinged plate.

11.3 Solve problems on impact of jets relating to flat fixed plate, inclined fixed plate and hinged plate.

**12. Understand the features of water turbines.**

12.1 State the meaning of water turbine.

12.2 Mention the classification of water turbine.

12.3 Describe the principle of impulse and reaction water turbine.

12.4 Compare the impulse and reaction turbine.

12.5 Describe the construction of Pelton, Kaplan and Francis water turbine.

12.6 Describe the operation of Pelton, Kaplan and Francis water turbine.

12.7 State the specific speed of turbine.

12.8 Describe the governing system of impulse and reaction turbines.

12.9 Define draft tube and its classification.

**13. Understand the features of reciprocating pumps.**

13.1 Define reciprocating pump.

13.2 Mention the classification of reciprocating pumps.

13.3 Describe the construction of various reciprocating pumps.

13.4 Describe the operation of different types of reciprocating pumps.

13.5 State the meaning of slip of reciprocating pumps.

13.6 Mention the function of air vessel in single acting reciprocating pump.

13.7 Describe the operation of suction side and discharge side air vessel in a single acting reciprocating pump.

13.8 Express the deduction of formula to calculate the discharge of reciprocating pumps.

**14. Understand the features of centrifugal pumps.**

14.1 State the meaning of centrifugal pump.

14.2 Mention the classification of centrifugal pumps.

14.3 Compare the centrifugal and reciprocating pumps.

14.4 Describe the construction of various centrifugal pumps.

14.5 Describe the operation of different types of centrifugal pumps.

- 14.6 State the meaning of cavitation of centrifugal pumps.
- 14.7 Express the deduction of formula to calculate discharge of centrifugal pumps.
- 14.8 Power required to drive a centrifugal pump.
- 14.9 Mention the efficiencies of centrifugal pump.

**15. Understand the features of rotary pumps.**

- 15.1 State what is meant by rotary pump.
- 15.2 Mention the classification of rotary pumps.
- 15.3 Describe the construction of various rotary pumps.
- 15.4 Describe the operation of different types of rotary pumps.
- 15.5 List the advantages and disadvantage of rotary pumps over centrifugal and reciprocating pumps.
- 15.6 Mention the application of rotary pumps.

**16. Understand the features of hydraulic devices.**

- 16.1 State hydraulic devices.
- 16.2 Identify the hydraulic devices.
- 16.3 Mention the function of hydraulic devices viz. hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift, etc.
- 16.4 Describe the construction of various hydraulic devices.
- 16.5 Describe the operation of different types of hydraulic devices.

**PRACTICAL:**

**1. Calibrate a bourdon tube pressure gauge with a dead weight gauge.**

- 1.1 Level the tester on a strong table top using spirit level and adjusting the level
- 1.2 Make sure 2/3 oil level in oil reservoir cup
- 1.3 Close the oil reservoir valve and make sure air is out from the system
- 1.4 Connect the pressure gauge in gauge connection using proper adapter
- 1.5 Open the oil reservoir until required height
- 1.6 Rotate the lifted weight slowly and compare the pressure gauge indication

**2. Verify Bernoulli's equation by Bernoulli's apparatus equipped with hydraulic test bench.**

- 2.1 Start the pump and initiate a flow through the test section
- 2.2 Regulate the flow to the inlet head tank
- 2.3 Measure the height of the water level in each manometer head
- 2.3 Measure the time taken to fill the measuring tank
- 2.4 Record the heights of liquid in the manometer tubes
- 2.5 Calculate the flow area, flow rate, velocity, static head and total head.
- 2.6 Plot a graph.
- 3. Determine  $C_c$ ,  $C_v$ , and  $C_d$  by orifice apparatus equipped with hydraulic test bench.
- 4. Determine the discharge through a pipe by the venturi meter or orifice meter equipped with hydraulic test bench.
- 5. Determine the loss of head due to sudden enlargement of pipe by the manometer.
- 6. Determine the loss of head due to friction by fluid friction apparatus.
- 7. Determine the fluid energy loss through various fittings (elbows, bends and valves).
- 8. Determine the moment force of a jet of water striking targets of different shape with the impact of jet apparatus.
  - 8.1 Fix the required diameter jet, and the vane of required shape in position and zero the force indicator

- 8.2 Keep the delivery valve closed and switch on the pump
- 8.3 Close the front transparent cover tightly
- 8.4 Open the delivery valve and adjust the flow rate of water as read on the Rota meter
- 8.5 Observe the force as indicated on force indicator
- 8.6 Note down the diameter of the jet, shape of vane , flow rate and force and tabulate the results
- 8.7 Switch off the pump after the experiment is over and close the delivery valve.
9. Test the performance of a reciprocating pump with the reciprocating pump test rig.
10. Test the performance of a centrifugal pump with the centrifugal pump test rig.
11. Test the performance of an impulse turbine with (Francis) turbine test rig.
  - 11.1 Prime the pump and start it with closed gate valve.
  - 11.2 Guide vanes in the turbine must be in closed position while starting the pump.
  - 11.3 Now slowly open the gate valve and open the chock fitted to the pressure gauge and see that the pump develops the rated head.
  - 11.4 If the develops the required head, slowly open the turbine guide vanes by rotating the hand wheel until the turbine attains the rated speed.
  - 11.5 Load the turbine slowly and take the readings.
12. Test the performance of reaction turbine with (Pelton wheel) turbine test rig.
  - 12.1 Connect the supply water pump-water unit to 3 ph, 440V, 30A, electrical supply, with neutral and earth connections and ensure the correct direction of the pump motor unit.
  - 12.2 Keep the Gate Valve and Sphere valve closed.
  - 12.3 Keep the Brake Drum loading at zero.
  - 12.4 Press the green button of the supply pump starter. Now the pump picks- up the full speed and becomes operational.
  - 12.5 Slowly open the Sphere Valve so that the turbine rotor picks the speed and conduct Experiment on constant speed.
  - 12.6 Note down the speed, load, and pressure gauge readings. Tabulate the readings.

#### REFERENCE BOOKS

1. Hydraulics and Hydraulic Machinery – Kings
2. Hydraulics and Hydraulic Machinery – Luiss
3. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines – R. S. Khurmi
4. Fluid Mechanics Hydraulics and Hydraulic Machines – K. R. Arora
5. Hydraulics, Fluid Mechanics, and Fluid Machines – S. Ramamrutham
6. Fluid Mechanics including Hydraulics Machines – K. Subramanya
7. Hydraulics and Fluid Mechanics – Dr. P. N. Modi & Dr. S. M Seth

**AIMS**

- To be able to understand the concepts and working definition of technical terms used in mechanical estimation.
- To be able to understand the concepts and techniques of estimating & costing including the elements of costs, components of costs, direct and indirect expenses of a particular product.

**SHORT DESCRIPTION**

Mechanical estimating; Costing; Cost of materials; Cost of labor; Expenses as a term of estimating; Cost of components; Idleness; Depreciation; Calculation of areas; Volumes & weights; Job estimation of sheet metal shop, Machine shop, welding shop and Foundry shop; Project planning; Material cost economy.

**DETAIL DESCRIPTION****Theory:****1. Understand the concept, scope and importance of mechanical estimating.**

- 1.1 Explain the term mechanical estimating, administration, management, organization, bill of materials, idle time, scraps, waste, spoilage, by product, bonus and capital...
- 1.2 Describe the scope of mechanical estimating.
- 1.3 Explain importance of mechanical estimating.
- 1.4 Illustrate organization set up of estimating department.
- 1.5 Explain the function of estimating.
- 1.6 Describe the qualities of estimating and estimator.
- 1.7 Describe the estimating procedure.
- 1.8 Explain the constituents of estimation.

**2. Understand the costing.**

- 2.1 Explain costing.
- 2.2 Distinguish between estimating and costing.
- 2.3 Explain standard cost.
- 2.4 Describe costing methods of material.
- 2.5 Explain the three elements that control the cost.

**3. Understand the elements of cost.**

- 3.1 Explain elements of cost.
- 3.2 Explain material cost and distinguish between direct and indirect material cost.
- 3.3 Explain the procedure of costing of material.
- 3.4 Explain labor cost and distinguish between direct and indirect labor cost.
- 3.5 Describe Time and Motion study.
- 3.6 Explain the procedure of finding of labor cost.
- 3.7 Explain the term expenses with types.
- 3.8 Distinguish between direct and indirect expenses.
- 3.9 Distinguish between fixed and variable overheads.
- 3.10 Explain and classify idleness.

- 4. Understand the components of cost.**
  - 4.1 Explain components of cost.
  - 4.2 Describe different components of cost.
  - 4.3 Describe the steps for calculating selling price.
- 5. Understand the methods of determining depreciation.**
  - 5.1 Define depreciation.
  - 5.2 Distinguish between depreciation and obsolescence.
  - 5.3 Explain the causes of depreciation.
  - 5.4 Describe different methods of determining depreciation.
  - 5.5 Determine depreciation by straight line method, sinking fund method, diminishing balance method, annuity charging method, sum of year's digits method and machine hour basis method.
- 6. Understand the application of formulae of mensuration to find the area, volume and weight of engineering parts.**
  - 6.1 Describe formulae of mensuration to find the area and volume of different engineering parts.
  - 6.2 Describe the steps of determining volume and weight of different engineering parts.
  - 6.3 Determine area and volume of different geometrical figures.
  - 6.4 Calculate the weight of different engineering parts.
  - 6.5 Solve problems involving volume and weight.
- 7. Understand the methods of estimation of fitting shop job.**
  - 7.1 Estimate the material cost of divider, wrench, bucket, funnel, mug.
  - 7.2 Estimate the labor cost of the jobs.
  - 7.3 Estimate the overhead cost of the jobs.
  - 7.4 Determine the total cost of the jobs.
- 8. Understand the methods of estimation of machine shop job.**
  - 8.1 Estimate the material cost of a ball peen hammer, vee block, center punch.
  - 8.2 Estimate the labor cost of the job.
  - 8.3 Estimate the overhead cost of the job.
  - 8.4 Determine the total cost of the job.
- 9. Understand the methods of estimation of welding shop job.**
  - 9.1 Estimate the material cost of lap welding job, butt welding job and pipe welding job.
  - 9.2 Estimate the labor cost.
  - 9.3 Estimate the overhead cost.
  - 9.4 Determine the total cost of the job.
- 10. Understand the methods of estimation of the pattern shop and foundry shop job.**
  - 10.1 Estimate the pattern cost of pulley, flange, bracket.
  - 10.2 Estimate the overhead cost.
  - 10.3 Estimate the total cost of the job.
- 11. Understand Project planning.**
  - 11.1 Concept of project planning.
  - 11.2 Describe the steps of project planning.
  - 11.3 Explain Break Even Point and analysis.

## **12. Understand the material cost economy.**

12.1 Define material cost economic.

12.2 Explain the role of material cost in the net profit of a production industry.

12.3 Mention the steps of material cost economy that help to increase the profit in a production industry.

12.4 Estimate the selling price of a cast iron gear. (from pattern making to packaging)

### **PRACTICAL:**

#### **1. Estimate the production cost of a M.S. Divider :**

1.1 Sketch and dimension the divider

1.2 Add necessary allowances

1.3 Calculate weight of raw materials

1.4 Calculate price of raw materials

1.5 Adding overhead charges determine estimated production cost.

#### **2. In similar way of no. 1 estimate the production cost of a Wrench.**

#### **3. Estimate the production cost of a G.I. Mug :**

3.1 Sketch and dimension the mug

3.2 Identify the simple parts of the mug

3.3 Develop the surfaces of the parts

3.4 Add necessary allowances

3.5 Calculate weight of raw materials

3.6 Calculate price of raw materials

3.7 Adding overhead charges determine estimated production cost.

#### **4. In similar way of no.3 estimate the production cost of a Funnel/Bucket/Duct.**

#### **5. Estimate the production cost of a M.S. Center Punch:**

5.1 Sketch and dimension the center punch

5.2 Divide the figure into simple geometric parts

5.3 Calculate volume of each part

5.4 Adding allowances Calculate total volume

5.5 Calculate weight

5.6 Calculate price of raw materials

5.7 Calculate machining time of each part

5.8 Calculate total machining time

5.9 Calculate labor cost

5.10 Calculate overhead charges

5.11 Determine estimated production cost.

#### **6. In similar way of no. 5 estimate the production cost of a M.S. Ball Peen Hammer.**

#### **7. Estimate the production cost of a C.I. Pulley/ Flange/ Bracket.**

7.1 Sketch and dimension the Pulley/ Flange/ Bracket.

7.2 Divide the figure into simple geometric parts

7.3 Calculate volume of each part

7.4 Adding allowances Calculate total volume

7.5 Calculate weight

- 7.6 Calculate price of raw materials
- 7.7 Calculate pattern cost
- 7.8 Calculate labor cost
- 7.9 Calculate overhead charges
- 7.10 Determine estimated production cost

**8. Estimate the production cost of a Screw jack/Bench Vise/Tail Stock.**

**9. Estimate the production cost of a wooden pattern of a Pulley/Flange/Lever.**

#### **REFERENCE BOOKS**

- 1. Mechanical Estimating & costing – T.R BANGA & S.C. SHARMA
- 2. Mechanical Estimating & costing – O.P. Khanna
- 3. Mechanical Estimating & costing – B. P. Shinha
- 4. Mechanical Estimating – TTTC

**AIMS**

- To be able to understand the concepts, principles and techniques of various welding such as gas welding, electric welding method and gas cutting, Soldering, Brazing, Resistance welding, G-position welding method.
- To be able to practice welding of various metals, such as steel, cast iron, alloy steels and non-ferrous metals.
- To be able to understand welding defects and testing of welding joint.
- To be able to perform different welding joints of different metals & alloys.

**SHORT DESCRIPTION**

Scope and importance of welding; Safety rules; Arc welding; Electrodes & function of coating; Principles of arc welding process; Principle of gas welding; soldering and brazing, Principle of gas cutting; Resistance welding process; Defects of welding; Test of welding joints.

**DETAIL DESCRIPTION****Theory:**

- 1. Understand the scope and importance of welding.**
  - 1.1 Define welding.
  - 1.2 Classify the different welding processes.
  - 1.3 Explain the Advantages and disadvantages of welding processes.
  - 1.4 Describe weld ability of metals.
  - 1.5 Explain the metallurgical change in welding.
  - 1.6 Describe different types of welding joint.
  - 1.7 Identify positions of welding.
  - 1.8 Describe common safety rules for welding shop.
- 2. Understand the arc welding processes.**
  - 2.1 State the principles of arc welding.
  - 2.2 Describe the process of operation of arc welding set.
  - 2.3 Explain the effects of striking voltage, arc voltage and open circuit voltage.
  - 2.4 Explain the voltage and current regulation of the arc welding set.
  - 2.5 Describe electrode with specification.
  - 2.6 Describe the ingredients used in coating on electrode.
  - 2.7 Describe the selection procedure of electrode.
  - 2.8 Explain different types of Polarity.
  - 2.9 Describe electric arc welding processes.
- 3. Understand the gas welding.**
  - 3.1 State gas welding and mention its type.
  - 3.2 State different types of gas welding flame and mention its uses.
  - 3.3 Describe acetylene generator.
  - 3.4 State the different between oxygen and acetylene cylinder.
  - 3.5 Explain the uses of flux in gas welding.
  - 3.6 Mention the uses of filler rod of gas welding.

- 3.7 Describe the oxy-acetylene gas welding process.
- 3.8 Describe back fire, flash back, pre-heat, and gas economizer.
- 3.9 Mention safety precautions of gas welding.
- 4. Understand the equipments of gas welding.**
  - 4.1 Define the principles of gas regulators.
  - 4.2 Describe different types of regulators.
  - 4.3 Describe oxygen and acetylene cylinder.
  - 4.4 Explain the operating principles of welding torches.
  - 4.5 Describe the uses of different types of welding torches.
  - 4.6 Identify different types of torch tips.
  - 4.7 Describe selection procedure of torch tips.
  - 4.8 Mention the uses of oxy-acetylene and oxy-Natural gas welding.
  - 4.9 Mention safety rules in operation of gas regulator.
- 5. Understand the soldering and brazing.**
  - 5.1 Define the soldering and brazing.
  - 5.2 Describe composition of solders.
  - 5.3 Mention filler metals used in soldering and brazing.
  - 5.4 Describe essential steps in soldering operation.
  - 5.5 Describe essential steps in brazing operation.
  - 5.6 Explain different types of flux used in soldering and brazing.
- 6. Understand the principles of gas cutting.**
  - 6.1 Describe the construction of gas cutting torch
  - 6.2 Explain the selection of gas cutting torch tip.
  - 6.3 Distinguish between a gas welding torch and a gas cutting torch.
  - 6.4 Describe flame machining and gouging.
  - 6.5 Advantages and disadvantages of gas cutting and arc cutting.
  - 6.6 Describe gas cutting processes.
  - 6.7 Mention safety precautions in gas cutting.
- 7. Understand the resistance welding processes.**
  - 7.1 Describe the principles of resistance welding.
  - 7.2 Describe the construction and operation of resistance welding machine.
  - 7.3 Classify the different types of resistance welding.
  - 7.4 Describe the different types of resistance welding processes.
  - 7.5 Outline the limitations of resistance welding process.
  - 7.6 Distinguish between resistances welding with other welding processes.
  - 7.7 Mention safety precautions of resistance welding.
- 8. Understand the techniques of Various G- positions welding.**
  - 8.1 Describe the G-position welding technique.
  - 8.2 Describe 1G & 2G position for plate and pipe welding.
  - 8.3 Describe 3G & 4G position for plate welding.
  - 8.4 Describe 5G & 6G position for pipe welding.
  - 8.5 Mention care and safety needed for various G-position plate and pipe welding.
- 9. Understand thermit welding.**
  - 9.1 State principle of thermit welding.
  - 9.2 Mention Applications of Thermit welding.
  - 9.3 Advantages and limitations of Thermit welding.
  - 9.4 Describe Thermit welding processes.

**10. Understand the defects of welding and their causes.**

- 10.1 Identify the defects of welding.
- 10.2 State the causes of defects in welding.
- 10.3 Describe the remedies of defects in welding
- 10.4 Describe the inspection methods of detecting welding defects.

**11. Understand the principles of testing of welding joints.**

- 11.1 Explain the necessity of testing the welds.
- 11.2 Describe the non-destructive tests of detecting welding defects.
- 11.3 Describe the destructive tests of welding.
- 11.4 Usefulness of testing of welding joint.

**PRACTICAL:**

1. Perform setting of arc welding machine, tools, equipment, accessories, current and voltage according to the job requirements and techniques of holding electrode and job with PPE.
- 2. Perform the straight weld bead welding on MS flat bar in flat position by electric arc welding.**
  - 2.1. Prepare drawing.
  - 2.2. Select materials.
  - 2.2. Select and hold electrode.
  - 2.3. Set the voltage and current according to metal.
  - 2.4. Cut MS flat bar according drawing.
  - 2.5. Select and practice PPE.
  - 2.6. Perform straight weld bead by electric arc welding m/c.
  - 2.7. Close the connection of arc welding m/c.
  - 2.8. Clean the job and work place.
- 3. Perform lap joint on MS plate in flat position by electric arc welding.**
- 4. Perform single –V butt joint on MS plate in flat position by electric arc welding.**
- 5. Perform T joint on MS plate in horizontal position by electric arc welding.**
- 6. Perform lap joint by gas welding.**
  - 6.1. Prepare drawing.
  - 6.2. Select and cut metal according to drawing and clean metal.
  - 6.3. Select gas welding tools, filler metal, flux and accessories.
  - 6.4. Select and adjust oxygen and acetylene pressure regulator of cylinder.
  - 6.5. Select and practice PPE.
  - 6.6. Make gas flame by adjusting oxygen and acetylene knob of welding torch.
  - 6.7. Perform lap joint according to drawing.
  - 6.8. Stop the gas flow.
  - 6.9. Clean the job and work place.
- 7. Perform butt joint by gas welding.**
- 8. Perform gas welding on horizontal position.**
- 9. Perform straight gas cutting on MS plate.**
  - 9.1. Prepare drawing.
  - 9.2. Select metal to be cut.
  - 9.3. Select gas cutting torch.
  - 9.4. Select and adjust oxygen and acetylene pressure regulator of cylinder.
  - 9.5. Select and practice PPE.
  - 9.6. Make gas flame by adjusting oxygen and acetylene knob of cutting torch.
  - 9.7. Perform straight gas cutting on MS plate.

- 9.8. Stop the gas flow.
- 9.9. Clean the job and work place.

- 10. Perform circular gas cutting on MS plate.**
- 11. Perform brazing on steel pipes.**
- 12. Make a square wiremesh by spot welding.**
- 13. Perform V-butt joints on pipe by 2G position.**
- 14. Perform V-butt joints on plate by 3G & 4G position.**
- 15. Perform V-butt joints on pipe by 5G position.**
- 16. Perform V-butt joints on pipe by 6G position.**
- 17. Perform joining of broken shaft by Thermit welding.**
- 18. Perform radiographic and tension test of welding joints.**
- 19. Make a metal rack/window grill/bookshelf by welding.**

#### **REFERENCES:**

1. Welding processes Hand book-by Klas Weman
2. Advanced Welding processes-by Norrish.
3. Advanced Joining Technology-by T.H.North.
4. Production Technology- By R.K Jain
5. Advanced Manufacturing Technologies-by Gupta.
6. Advanced Welding Technology-by Som Ashutosh.

**AIMS**

- To be able to understand the basic concept, principle of design process and the role of CAD.
- To be able to understand the process of defining a model.
- To be able to understand the principle and techniques of geometric modeling.
- To be able to understand the principle of applying CAD model in design.
- To be able to understand the principle of design manufacturing interface.
- To be able to understand the link to machine control.
- To be able to acquire skills for drawing and designing using CAD software.
- To be able to acquire skills on part programming for NC and CNC machines.

**SHORT DESCRIPTION**

Basic concept of CAD and CAM; Principle of design process; Model definition; Three-dimensional modeling scheme; Model design; CNC machine tools & control system; Link to Machine control, Part programming and industrial robots.

**DETAIL DESCRIPTION****THEORY:****1. Understand basic concept of CAD & CAM.**

- 1.1 Define CAD & CAM
- 1.2 Explain the benefits of CAD/CAM.
- 1.3 Differentiate between CAD and CAM
- 1.4 Explain the product cycle.
- 1.5 Introduce the concept, and background of CIM.
- 1.6 Introduce the Software and hardware of CIM.
- 1.7 Describe the relation between automation and CAD & CAM.
- 1.8 Describe Design process.

**2. Understand the Computer aided Drafting**

- 2.1 Understand applications of CAD models.
- 2.2 Introduce CAD software like Auto Cad, Solid Works, CATIA.
- 2.3 Describe entity draw line, circle, arc, ellipse, basic editing, dimensioning and area commands.
- 2.4 Understand drawing a part.
- 2.5 Understand the assembly of the parts.

**3. Understand Geometrical models and modeling techniques.**

- 3.1 Define Geometrical solid models.
- 3.2 Describe 2-D & 3-D model technique and dimension transformation.
- 3.3 Explain the terms: Layer, Colors, Grids, Groups, Dragging, Clipping and transformation.
- 3.4 Describe modify, annotations, blocks, inserts, hatches, layouts and template commands.
- 3.5 Explaining View sets, Virtual realism.
- 3.6 Discuss wireframe, B-Rep, CSG and Hybrid modeling.
- 3.7 Discuss surface modeling- Analytical and Synthetic approaches

#### **4. Understand the computer Aided Manufacturing (CAM).**

- 4.1 Explain CAM concept.
- 4.2 Discuss CAD/CAM database.
- 4.3 Discuss about CAD/CAM software.
- 4.4 Discuss rationale for CAD/CAM.
- 4.5 Describe elements of CAM system.
- 4.6 Discuss NC system in CAM.

#### **5. Understand the NC machine tool control.**

- 5.1 State the principle of NC, DNC and CNC technology.
- 5.2 Describe the tooling and Nomenclature of CNC machine all type axis.
- 5.3 Describe the types of NC co-ordinate: Point – to – point, Straight Cut, and Contouring.
- 5.4 Describe the uses of NC part programming: G code and M-code. Reference Point (Machine Zero, Work zero, Tool zero & Tool offset).
- 5.5 Explain all APT motion commands and Macro subroutines.
- 5.6 Explain Simple part program for CNC lathe & milling machine.
- 5.7 Describe control mode of MDI, JOG and Tool geometry for CNC machine.

#### **6. Understand CNC machine tools & control systems.**

- 6.1 Define CNC machining centers.
- 6.2 Classify the machining centers.
- 6.3 Describe different types of CNC turning center.
- 6.4 Describe machine control unit.
- 6.5 Illustrate the organization of modern MCU function.
- 6.6 State the subsystem of the MCU.
- 6.7 Describe support unit of CNC machine.

#### **7. Understand industrial robots.**

- 7.1 Define industrial robot.
- 7.2 Describe types of robot configurations.
- 7.3 Discuss robotic sensor.
- 7.4 Describe motion system of robot.
- 7.5 Describe six degree's freedom of a robot.
- 7.6 Describe the important technical features of robot.
- 7.7 Describe the basic drive system of robot.

#### **PRACTICAL:**

1. Set drawing environment using unit, limits, drawing sheet size, zoom etc.
2. Make a drawing template file for future use.
3. Draw geometrical drawing involving line, arc, and circle in two-dimensional environment.
4. Annotate the given drawing with text and dimensions.
5. Prepare a title block of drawing.
6. Print and plot drawing with proper scale.
7. Draw a 3-D object using conventional process.
8. Draw a 3-D object using solid model technique.
9. Prepare different part program of different object using 'G' and 'M' code.
10. Use CAM software for simulation of Dynamic Systems on CNC machine.
11. Prepare NC program: linear cutting, Chamfering and multiple diameter cutting.

## **REFERENCE BOOKS**

1. CAD/CAM Computer aided design and Manufacturing – Groover Mikel P.
2. CAD/CAM, Theory and Practice – Ibrahim Zaid
3. CAD/CAM From principle to Practice - McMahon Chris, Jimmi Brown.
4. CAD/CAM principles & applications - Dr. P N Rao

## **CAD SOFTWARES**

1. Solid Works
2. CATIA - V5
3. Auto Cad

**AIMS**

- To be able to understand the basic concepts, principles and techniques of manufacturing processes and system.
- To be able to understand the principles and techniques of making appropriate parts or elements of machines observing the proper methods.
- To be able to develop the knowledge to hot and cold working Processes.
- To be able to understand the polymeric materials and their manufacturing processes.
- To be able to understand the plastic materials and their manufacturing processes.
- To be able to understand the corrosion of metals and their protection.
- To be able to understand different surface treatment processes.

**SHORT DESCRIPTION**

Manufacturing process & system ; Hot working process; Cold working process; Corrosion of metals; Electro plating; Surface treatment; polymerization; plastic materials, welding and joining processes of plastic materials; Glass; Ceramics. Flexible Manufacturing Systems(FMS)

**DETAIL DESCRIPTION****Theory:****1. Understand the manufacturing process & system.**

- 1.1 Define manufacturing process.
- 1.2 Explain the concept of manufacturing process.
- 1.3 Mention the different types of manufacturing process.
- 1.4 State the manufacturing system with block diagram.
- 1.5 Discuss the importance of reverse engineering in Bangladesh perspect.
- 1.6 Define concurrent engineering.
- 1.7 Describe four phases of concurrent engineering.
- 1.8 Describe the criteria for determining the economical product.
- 1.9 Explain scope and benefits of manufacturing process.

**2. Understand the Concept of cold working process.**

- 2.1 Define cold working process.
- 2.2 Mention different types of cold working process.
- 2.3 Explain the controlling parameters of cold working process.
- 2.4 Explain the effects of cold working process.
- 2.5 Describe the advantages of cold working process.
- 2.6 Describe the limitation of cold working process.
- 2.7 Merits & demerits of plating on cold working process.
- 2.8 List the name of products of cold working process.

**3. Understand deferent processes used in cold working**

- 3.1 Classify cold working processes.
- 3.2 Describe different types of squeezing.
- 3.3 Describe different types of shearing processes.
- 3.4 Describe different types of cold drawing processes.
- 3.5 Describe different types of bending processes.
- 3.6 List the machines and accessories used in cold working processes.

- 4. Understand concept of hot working process.**
  - 4.1 Define hot working process.
  - 4.2 Mention different types of hot working process.
  - 4.3 Explain the controlling parameters of hot working process.
  - 4.4 Explain the effect of hot working of materials.
  - 4.5 Mention the advantages of hot working process.
  - 4.6 Describe the limitation of hot working process.
  - 4.7 Merits and demerits of plating on hot working process
  - 4.8 List the name of products of hot working process.
- 5. Understand deferent processes used in hot working.**
  - 5.1 Classify hot working processes
  - 5.2 Describe different types of rolling processes.
  - 5.3 Describe different types of forging processes.
  - 5.4 Describe different types of extrusion processes.
  - 5.5 Describe different types of piercing processes.
  - 5.6 Describe different types of cupping processes.
  - 5.7 Describe different types of spilling processes.
  - 5.8 List the machines and accessories used in hot working processes.
- 6. Understand the corrosion of metals.**
  - 6.1 Define and classify corrosion.
  - 6.2 Explain the mechanism of corrosion.
  - 6.3 Explain the controlling parameters of corrosion.
  - 6.4 Explain the electro-chemical process of corrosion of metal, plastic and ceramic materials.
  - 6.5 Describe the preventive methods of corrosion.
  - 6.6 Describe the different types of corrosive environment.
  - 6.7 Describe the application methods of protective coating.
  - 6.8 Explain electro-motive chart of corrosion.
  - 6.9 Describe the process of vacuum metalizing.
- 7. Understand the fundamental aspect of electroplating.**
  - 7.1 Explain the meaning of electroplating.
  - 7.2 Narrate the objectives of electroplating.
  - 7.3 Describe steps of pre-preparation of electroplating
  - 7.4 Explain pickling, polishing, bobbing for electroplating.
  - 7.5 State the meaning of electro-polishing and ultrasonic cleaning.
  - 7.6 Describe the construction of electroplating equipment.
  - 7.7 Describe the application method of electroplating.
  - 7.8 Mention electroplating machinery and accessories
  - 7.9 Discuss hazards of electroplating.
- 8. Understand the surface treatment processes.**
  - 8.1 Describe the necessity of surface treatment.
  - 8.2 Describe various surface treatment processes.
  - 8.3 Describe the importance of cleaning for surface treatment.
  - 8.4 Explain anodic and cathodic coating.
  - 8.5 Explain methods of electro-deposition.
  - 8.6 Explain hot dipping and metal spray processes.

- 8.7 Explain metal cladding and anodized coating.
- 8.8 Describe the electro-static coating process.
- 8.9 Differentiate paints and varnishes.

**9. Understand the polymeric materials.**

- 9.1 Define and classify polymer and polymerization.
- 9.2 Show the addition and condensation polymerization with molecular formula.
- 9.3 Mention the ingredients of polymer.
- 9.4 Describe the characteristics of polymer.
- 9.5 Mention the source of the raw materials of polymer.
- 9.6 Describe the different manufacturing procedures of polymer.
- 9.7 Usages limitation of polymer:
- 9.8 Effects of polymers on environments.
- 9.9 Application of polymers.

**10. Understand the plastic materials.**

- 10.1 Define and classify plastics.
- 10.2 Differentiate thermo-plastics and thermosetting plastics.
- 10.3 State the characteristics of plastic.
- 10.4 Mention the ingredients of plastic.
- 10.5 Name the different components of die and mold.
- 10.6 Describe the following moulding methods:
  - (a) Compression moulding
  - (b) Extrusion moulding
  - (c) Transfer moulding
  - (d) Injection moulding
  - (e) Laminating plastics
  - (f) blow moulding and
  - (g) Vacuum forming.
- 10.7 Describe the joining of plastics.
  - (a) mechanical fasteners
  - (b) welding of plastics
  - (c) Solvent
- 10.8 Narrate the importance of recycling of plastic
- 10.9 Identify the different types of plastics
- 10.10 Mention uses of plastic materials.

**11. Understand the fundamental aspects of glass.**

- 11.1 State the characteristics of glass.
- 11.2 Mention the ingredients of glass.
- 11.3 Explain the controlling parameter of glass
- 11.4 Describe powder formation of glass ingredients.
- 11.5 Describe the construction of glass melting/annealing furnace.
- 11.6 Describe the process of mixing and melting of glass ingredients.
- 11.7 Explain fabrication of glass articles.
- 11.8 Describe the flame cutting process of glass.
- 11.9 Describe the process of annealing of glass articles.
- 11.10 Classify the glass products and their application.

**12. Understand the fundamental aspects of ceramics.**

- 12.1 State the characteristics of ceramics as materials.
- 12.2 Narrate the ingredients of ceramics.
- 12.3 Mention the source of ceramic raw materials
- 12.4 Explain the controlling parameter of ceramics
- 12.5 Describe sieving and mixing of ceramic powders.
- 12.6 Describe the process of preparation of ceramic powder.
- 12.7 Describe the forming technique of ceramic products
- 12.8 Explain screening, de-airing and separating water.
- 12.9 Describe the process of :
  - (a) molding
  - (b) drying
  - (c) finishing and
  - (d) firing articles
- 12.10 Classify the ceramic products and their application.

**13. Understand Flexible Manufacturing Systems(FMS)**

- 13.1 Define Flexible manufacturing system(FMS)
- 13.2 State requirement of FMS.
- 13.3 Describe flexible manufacturing cell (FMC)
- 13.4 Mention Components of FMS
- 13.5 Advantages of FMS

**REFERENCES -**

- 1. Manufacturing Science by Ghosh and Mallick AK
- 2. Manufacturing Technology by RAO PN
- 3. Introduction to Manufacturing Processes by Schey J
- 4. Material and Processes in Manufacturing by De Garmo EP and Black JT
- 5. Manufacturing Processes by SK Sharma and Savita Sharma
- 6. Production Technology by R.K. Jain

**AIMS**

- To be able to understand the principles and practices of book keeping and accounting.
- To be able to understand the procedures of general accounting, financial accounting and their applications.
- To be able to understand the concept of income tax , VAT & Public works accounts.

**Course Outlines**

Concept of book keeping and accounting; Transactions; Entry systems; Accounts; Journal; Ledger; Cash book; Trial balance; Final accounts; Cost account & financial accounting; Income Tax; Public works accounts.

**DESCRIPTION;****Theory****1. Concept of book keeping and accounting.**

- 1.1 Define book keeping and accountancy.
- 1.2 State the objectives & of book keeping.
- 1.3 State the advantages of book keeping.
- 1.4 Differentiate between book keeping and accounting.
- 1.5 State the necessity and scope of book keeping and accounting.

**2. Transactions Analysis.**

- 2.1 Define transactions and business transaction.
- 2.2 Describe the characteristics of transaction.
- 2.3 Discuss the classification of transaction.

**3. Entry system of Accounting.**

- 3.1 State the aspects of transactions.
- 3.2 Define single & double entry system ..
- 3.3 Discuss the principles of double entry system.
- 3.4 Distinguish between single entry and double entry system of book keeping.
- 3.5 Justify whether double entry system is an improvement over the single entry system.

**4. Classification of accounts.**

- 4.1 Define accounts.
- 4.2 State the objectives of accounts.
- 4.3 Illustrate different type of accounts with example.
- 4.4 Define "Golden rules of Book keeping".
- 4.5 State the rules for "Debit" and "Credit" in each class of accounts.
- 4.6 Define accounting cycle.

**5. Journal.**

- 5.1 Define Journal.
- 5.2 State the functions of Journal.
- 5.3 Mention the various names of Journal.
- 5.4 Interpret the form of Journal.

## **6. Ledger.**

- 6.1 Define ledger.
- 6.2 Interpret the form of ledger.
- 6.3 State the functions of ledger.
- 6.4 Distinguish between Journal and Ledger.
- 6.5 Explain why ledger is called the king of all books of accounts.
- 6.6 Explain the following terms: Balance, Balancing; Debit balance; credit balance.

## **7. Cash book & Its Classification.**

- 7.1 Define cash book.
- 7.2 Classification of cash book.
- 7.3 Explain cash book as both Journal and Ledger.
- 7.4 Define discount.
- 7.5 Explain the different types of discount.

## **8. Trial balance.**

- 8.1 Define trial balance.
- 8.2 State the object of a trial balance.
- 8.3 Discuss the methods of preparation of a trial balance.
- 8.4 Explain the limitations of a trial balance.
- 8.5 Prepare trial balance from given ledger balance. (practical)

## **9. Final accounts.**

- 9.1 State the components of final account.
- 9.2 Distinguish between trial balance and balance sheet.
- 9.3 Select the items to be posted in the trading account, profit & loss account and the balance sheet.
- 9.4 State the adjustment to be made from the given information below or above the trial balance.
- 9.5 Explain the following terms: revenue expenditure; capital expenditure; depreciation; annuity method demnishing balance method, machine hour method

## **10. Cost and financial accounting.**

- 10.1 Define financial accounting.
- 10.2 State the objectives of financial accounting.
- 10.3 Define cost accounting.
- 10.4 State the elements of direct cost and indirect cost.
- 10.5 Discuss the capital budgeting
- 10.6 Explain the following terms:
  - a. Fixed cost    b. Variable cost    c. Factory cost    d. Overhead cost    e. Process cost
  - f. Direct cost    g. Operating cost    h. Standard cost

## **11. Income Tax**

- 11.1 Define Income Tax.
- 11.2 State the objects of Income Tax.
- 11.3 Classification of assesses.
- 11.4 Taxable income of assesses.
- 11.5 Tax rebate.
- 11.6 Explain the following terms: Income tax year; assessment year, NBR.

## **12. Public works accounts.**

- 12.1 State the important aspects of public works accounts.

- 12.2 Describe the main features of public works accounts.
- 12.3 Define Value Added Tax (VAT)
- 12.4 State the merits and demerits of VAT.
- 12.5 Explain the following terms :Revenue ; Grant ; Bill; Voucher.

### **PRACTICAL**

1. Identify the transaction from given statements stating reasons.
2. Determine Debtor (Dr) and Creditor (Cr.) from given transactions applying golden rules.
3. Journalize from given transactions.
4. Prepare ledger from given transactions.
5. Prepare double column cash book from given transactions showing balances.
6. Prepare triple column cash book from given transaction and find out the balances.
7. Prepare analytical and imprest system of cash book.
8. Prepare trial balance from the given ledger balance.
9. Prepare trading account, profit & loss account and balance sheet from the given trial balance & other information.
10. Prepare cost sheet showing prime cost, factory cost, cost of production, total cost and selling price.

### **REFERENCE BOOKS**

1. Book-keeping & Accounting - Prof. Gazi Abdus Salam
2. Principles of Accounting - Hafiz uddin
3. Cost Accounting - Prof. Asimuddin Mondol
৪. হিসাবরক্ষণ ও হিসাববিজ্ঞান - পরেশ মন্ডল
৫. উচ্চ মাধ্যমিক হিসাববিজ্ঞান - হক ও হোসাইন
৬. আয়কর - ড. মনজুর মোরশেদ