



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

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

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

7th SEMESTER

DIPLOMA IN ENGINEERING  
PROBIDHAN-2016

**MECHANICAL TECHNOLOGY (670)**  
**7<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	67071	Design of Machine Elements	3	3	4	60	90	25	25	200
2	67072	Tool Design	2	3	3	40	60	25	25	150
3	67073	Heat Treatment of Metal	2	3	3	40	60	25	25	150
4	67074	Mechanical Engineering Project	0	6	2	0	0	50	50	100
5	67075	Production Planning & Control	3	0	3	60	90	0	0	150
6	67076	Mechatronics & PLC	3	3	4	60	90	25	25	200
7	65853	Innovation & Entrepreneurship	2	0	2	40	60	0	0	100
<b>Total</b>			<b>15</b>	<b>18</b>	<b>21</b>	<b>300</b>	<b>450</b>	<b>150</b>	<b>150</b>	<b>1050</b>

**AIMS**

- To be able to understand the basic concepts and principles of design of simple machine elements.
- To be able to understand the basic concept, Principles and technique of designing of different machine elements.
- To be able to understand the basic concept, principles and technique of selecting safe stress of different machine elements.
- To be able to understand the basic concept, principles and techniques of computing strength equations considering the theories of failures and be able to determine the size of machine elements.
- To be able to develop knowledge, skill and attitude of designing simple machine elements.

**SHORT DESCRIPTION**

Stresses in machine elements; Causes of failure of machine member; Pressure vessels; Screwed joints; Knuckle joint; Shaft; keys; couplings; Power screw; Belt & ropes; Springs; Gears; Clutches and Brakes.

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

- 1 Understand the analysis of stresses induced in machine elements & causes of failure of machine elements.**
  - 1.1 State machine elements.
  - 1.2 Describe working stress and factor of safety.
  - 1.3 Describe selection of suitable factor of safety for static, dynamic and fatigue loading.
  - 1.4 Describe thermal stress, impact stress, bending stress and torsional shear stress, combine stress.
  - 1.5 Define failures of machine elements.
  - 1.6 Define stress concentration factors.
  - 1.7 Describe stress concentration factors for both static and fatigue loading.
- 2 Understand pressure vessels.**
  - 2.1 Define pressure vessel.
  - 2.2 Distinguish between thin and thick pressure vessels.
  - 2.3 Define hoop stress.
  - 2.4 Identify longitudinal and circumferential stresses.
  - 2.5 Express the deduction of the equation relating to longitudinal and circumferential stresses for design pressure vessels.
  - 2.6 Solve problems related to the design of thin pressure vessels considering internal pressure.
- 3 Understand the principle of designing screwed joint.**
  - 3.1 State common types of screw fastening and fastener.
  - 3.2 Describe the designation of screw thread.
  - 3.3 Describe the stress developed in screwed fastening.
  - 3.4 Illustrate the formula of axially loaded screwed joints.
  - 3.5 Illustrate the formula of eccentric loaded screwed joints.
  - 3.6 Solve problems related to screwed joints.

- 4 Understand the principles of designing knuckle joint.**
  - 4.1 State knuckle joint.
  - 4.2 Sketch different types of knuckle joints.
  - 4.3 Illustrate the strength equations of knuckle joints.
  - 4.4 Solve problems related to the design of different components of knuckle joints.
  
- 5 Understand the principles of shaft design.**
  - 5.1 Distinguish among spindle, shaft and axle.
  - 5.2 State various types loading of shafts.
  - 5.3 State shock & fatigue factors.
  - 5.4 Formulate the equation of combine torsional and bending stress on shaft.
  - 5.5 Describe the design procedure of shaft.
  - 5.6 Formulate the effect of torque, bending moment, axial thrust, combined torque and bending moment and rigidity.
  - 5.7 Calculate the diameter of a shaft (solid or hollow) subjected to torque, bending moment, axial thrust, combined torque & bending moment and on the basis of rigidity.
  - 5.8 Solve problems related to the design of shafts.
  
- 6 Understand the principle of key design.**
  - 6.1 Define key.
  - 6.2 Describe different types of key.
  - 6.3 Deduce strength equations for keys.
  - 6.4 Solve the problems relating to the design of keys.
  
- 7 Understand the principle of coupling design.**
  - 7.1 Define coupling
  - 7.2 Describe different types of coupling.
  - 7.3 Deduce strength equations for bolt and flange of flangescoupling.
  - 7.4 Describe design procedure of flanged and coupling.
  - 7.5 Solve the problems relating to the flanged coupling.
  
- 8. Understand the principle of design power screw.**
  - 8.1 Define power screw.
  - 8.2 State the uses of power screw.
  - 8.3 Describe screw threads used in power screws.
  - 8.4 Point out advantages and disadvantages of different threads used in power screw.
  - 8.5 Describe stresses induced in screw threads.
  - 8.6 Deduce of the formula for calculating torques to raise and to lower loads by square threaded & acme threaded screw.
  - 8.7 Calculate the efficiency of screw threads.
  - 8.8 Explain self-locking and overhauling of screw threads.
  - 8.9 Solve problems related to the design of power screw threads.
  
- 9. Understand the principles of designing belts.**
  - 9.1 Define belt.
  - 9.2 State the uses of belt.
  - 9.3 Describe the different types of belt.
  - 9.4 Explain different types of belt drive.
  - 9.5 Deduce of the formula for calculating the power transmitted by belts .
  - 9.6 Identify the centrifugal tension in belt drives.
  - 9.7 Derive formula for calculating the velocity ratio of belt drive without belt slip and considering belt slip.
  - 9.8 Formulate the equation of tension ratio of belt drive
  - 9.9 Find out the conditions for maximum power transmission.
  - 9.10 Deduce of the formula for calculating the cross section of belts to transmit power.
  - 9.11 Solve problems relating to the design of belts.

## **10. Understand the principles of designing ropes.**

- 10.1 Define rope.
- 10.2 State the uses of rope.
- 10.3 Describe the different types of rope.
- 10.4 Deduce of the formula for calculating power transmitted by ropes.
- 10.5 Derive the equation of tension ratio of rope drive
- 10.6 Solve problems relating to the design of rope.

## **11. Understand the designing of springs.**

- 11.1 Describe different type's springs.
- 11.2 State the stress induced in helical and leaf springs.
- 11.3 Explain the terms solid height, free height, spring index, Spring rate and pitch .
- 11.4 Deduce the stress equation for helical spring of circular wire.
- 11.5 Deduce the equation of deflection of circular wired helical spring .
- 11.6 Describe the end conditions of helical compression springs.
- 11.7 Calculate the load shared by the two concentric helical compression springs, stresses induced in them and the deflections of them.
- 11.8 Solve problems relating to the design of helical spring.

## **12. Understand the principles of designing Spur gears & helical gears.**

- 12.1 Define different types of gears.
- 12.2 Explain the terms relating to spur gears and helical gears.
- 12.3 State interference of gear drive.
- 12.4 Deduce strength equation for spur gear tooth.
- 12.5 Solve problems relating to the design of spur gear.

## **13. Understand the principles of designing brakes.**

- 13.1 Describe the different types of brakes.
- 13.2 Explain the functions of brakes.
- 13.3 Calculate the force required to operate the brake.
- 13.4 Calculate the frictional torque for brakes.
- 13.5 Design the sizes of shoe brake, band brake, shoe and band brake.
- 13.6 Solve problems relating to the design of brakes.

## **14. Understand the principles of designing clutches.**

- 14.1 Describe the different types of clutches.
- 14.2 Explain the functions of clutches.
- 14.3 Calculate the force required to operate the disc clutch.
- 14.4 Calculate the frictional torque for disc clutch.
- 14.5 Design the size of disc clutch.
- 14.6 Solve problems relating to the design of disc clutch.

### **Practical:**

#### **1 Perform the designing and drawing of shafts.**

- 1.1 Take proper personal protective equipment (PPE)
- 1.2 Search and make lists of shafts use in different machines in different workshops and laboratories of the institute.
- 1.3 Design and draw a shaft.
- 1.4 Clean the work place properly.
- 2.1 Prepare report and submit.

#### **3 Perform the designing and draw a knuckle joint.**

- 3.1 Design and draw a standard knuckle joint.
- 3.2 Search and make lists of knuckle joints used in different machines in different workshops and laboratories of the institute.
- 3.3 Prepare report and submit.

- 4 Perform designing and drawing a standard flange coupling.**
  - 4.1 Design and draw a standard flange coupling.
  - 4.2 Search and make lists of couplings used in different machines in different workshops and laboratories of the institute.
  - 4.3 Prepare report and submit.
  
- 5 Make a power screw.**
  - 5.1 Design a power screw.
  - 5.2 Draw a detail drawing of a power screw as per design.
  - 5.3 Collect necessary materials for making power screw.
  - 5.4 Assemble and disassemble a power screw.
  - 5.5 Prepare report and submit.
  
- 6 Make a helical spring.**
  - 6.1 Design a helical spring.
  - 6.2 Draw a helical spring as per design.
  - 6.3 Make a model of helical spring.
  - 6.4 Prepare report and submit.
  
- 7 Make spur gear.**
  - 7.1 Design a spur gear.
  - 7.2 Draw a spur gear as per design.
  - 7.3 Prepare a blank for producing spur gear.
  - 7.4 Make a spur gear.
  - 7.5 Prepare report and submit.

**Reference Book:**

1. A text book of Machine Design- R.S. Khurmi& P.K. Gupta.
2. Machine Design- Nagpal.

**AIMS**

- To be able to understand the basic concepts, principles and techniques of using different tools, work holders and other specific tools.
- To be able to understand the basic concepts, principles and techniques of various types of cold and hot working operations. .
- To be able to develop knowledge, skill and attitude of application and precaution in the use of robots.
- To be able to develop knowledge, skill and attitude of construction of jigs and fixtures.

**SHORT DESCRIPTION**

Tools of tool maker; Construction and operation of tools; Tooling materials and heat, temperature; Materials of cutting tool; Chip and chip formation; Design concepts of material cutting tools; Location and clamping method; Jigs and fixtures; Press operation.

**DETAIL DESCRIPTION****Theory:****1 Understand the tools of tool maker.**

- 1.1 Define tools of tool maker
- 1.2 Describe different types of tool for tools maker.
- 1.3 List the tools of the tool maker.
- 1.4 Describe the necessity for the tool designer to be familiar with the tool room equipment used by the tool maker.
- 1.5 Describe the uses of different tools of the tool maker.
- 1.6 Differentiate between dial test indicator and regular indicator.
- 1.7 Describe the processes of hand finishing and polishing.
- 1.8 Identify screws and dowels.

**2 Understand the construction and operation of jig-boring**

- 2.1 Define jig-boring
- 2.2 Describe the main operations of jig-boring.
- 2.3 Describe the constructional precaution of jig bushing.
- 2.4 List the points to be considered for manufacturing punches and dies.
- 2.5 Application of the jig-boring
  - 2.6 List the tools for locating holes.
  - 2.7 Describe operations of hole location.

**3 Understand the designing concepts of material as cutting tools.**

- 3.1 Describe the basic requirement of cutting tools.
- 3.2 List the elements of cutting process.
- 3.3 Describe the geometry of a single point cutting Tools.
- 3.4 State function of different cutting angles.
- 3.5 Explain the velocity relation of cutting tools.
- 3.6 Describe thermal aspects of metal cutting.
- 3.7 List the causes of tool wear and failure & their controlling aspect.

**4 Understand the chip and chip formation.**

- 4.1 Describe chips formation.
- 4.2 List different types of chips.
- 4.3 Describe the mechanism of chip formation.
- 4.4 Explain the geometry of chip formation.

**5 Understand the location and clamping methods.**

- 5.1 Describe the freedom of movements.
- 5.2 Describe the six point locations.
- 5.3 Explain the method of movement restriction for any object.
- 5.4 Differentiate clamp, locators and holders.
- 5.5 Identify suitable clamps and locators for various jobs.

- 6 Understand the basic concept of jigs and fixtures.**
- 6.1 Describe jigs and fixtures.
  - 6.2 Differentiate between jigs and fixtures.
  - 6.3 Describe jig bushing.
  - 6.4 List different types of jigs and jig bushing.
  - 6.5 List different types of fixtures.
  - 6.6 Describe the construction of different types of jigs.
  - 6.7 Describe the construction of different types of fixtures.
  - 6.8 Design of plate jigs for drilling operation.
- 7 Understand the fundamentals of press tools.**
- 7.1 Define press.
  - 7.2 Classify of press according to frame, power and speed of work.
  - 7.3 Describe mechanical and hydraulic press.
  - 7.4 Explain Working principle of mechanical and hydraulic press
  - 7.5 Mention merits and demerits of hot and cold working press.
- 8 Understand the press operations.**
- 8.1 Describe blanking & piercing dies, bending dies, forming dies and rubber dies.
  - 8.2 Describe drawing operations.
  - 8.3 Describe the method of preparing economical strip layout.
  - 8.4 Describe the method of determining blank size.
  - 8.5 Define capacity of press.
  - 8.6 Describe the action of shearing force, bending force, drawing force and stripping force in press operation.
  - 8.7 Explain the necessity of auxiliary press tools e. g. pilots, strippers, pressure pads, knockout and pineer pads.
- 9 Understand the concept of plastics as tooling materials.**
- 9.1 Define plastics tools.
  - 9.2 List the plastics commonly used as tooling materials.
  - 9.3 State application of epoxy plastic tools.
  - 9.4 State construction methods of plastic tooling.
  - 9.5 Describe metal forming operations with plastic tools.
  - 9.6 Calculate forces for pressure pads.
  - 9.7 Describe additive manufacturing using 3D printer.
- 10 Understand of die and punch.**
- 10.1 Define die and punch
  - 10.2 Classify of die and punch.
  - 10.3 Explain the Shearing action in die and punch operation.
  - 10.4 Explain purpose of die clearance
  - 10.5 Mention merit and demerits of simple die, compound die, progressive die, combination die.
  - 10.6 Design a die and punch for simple cut-off operation.

**Practical:**

- 1 Make a single point cutting tool by using mild steel bar.**
- 1.1 Draw working drawing of a single point lathe cutting tool.
  - 1.2 Collect the raw materials for single point cutting tool
  - 1.3 Grind the bar to angles as per specification.
  - 1.4 Measure the angles to verify the correctness.
  - 1.5 Prepare report and submit.
- 2 Make twist drill bit using mild steel rod.**
- 2.1 Develop a layout of the drill bit.

- 2.2 Construct spiral flutes, margin, land, shank, tang and neck.
- 2.3 Grind and measure the cutting angles.
- 2.4 Prepare report and submit.

**3. Make a box jig.**

- 3.1 Design a model of box jig.
- 3.2 Develop the working drawing of the jig.
- 3.3 Select and Collect the raw materials.
- 3.4 Make the different parts.
- 3.5 Assemble the parts and Check the workability of jig and adjust as required.
- 3.6 Prepare report and submit.

**4 Make a simple die and punch.**

- 4.1 Design a model of simple die and punch.
- 4.2 Draw a working drawing as per design.
- 4.3 Select and Collect the raw materials as per drawing.
- 4.4 Write down the schedule of work and select the steps of operation.
- 4.5 Produce various parts as specified.
- 4.6 Assemble the parts for a unit.
- 4.7 Test the workability of the model.
- 4.8 Prepare report and submit.

**5 Design a urethane/epoxy resin forming die/mold.**

- 5.1 Draw the working drawing of the job and collect the materials.
- 5.2 Make a master pattern as per design.
- 5.3 Mix base materials (resin) with curing agent/hardener as per recommended ratio and pouring into the master pattern.
- 5.4 Machine the cast plastic blank as per drawing to produce the required die/mold.
- 5.5 Prepare report and submit.

**REFERENCE BOOKS**

1. Tools Design, by Donaldson – 3rd edition.
2. Job / Experiment, by Technical Education Board.

**AIMS**

- To be able to understand the basic concepts and principles of physical metallurgy and the theory of alloys.
- To be able to apply the principles of Time-Temp in the processes of heat treatment and surface treating of metals and alloys.
- To be able to understand the concepts principles and techniques of powder metallurgy in making high tech, complicated machine parts.
- To be able to practice in the laboratory on the preparation of specimen, handling of microscope and interpreting micro-structure of metals and alloys.
- To be able to maintain the metallurgical tools and equipment.

**SHORT DESCRIPTION**

Physical metallurgy; Theory of alloys; Heat treatment processes; Surface treatment; Treatment of alloy steel; Microscopic examination; Application of alloy steel; Selection specification and code number of metal.

**DETAIL DESCRIPTION****Theory:****1 Understand the physical metallurgy.**

- 1.1 Describe the scope of physical metallurgy.
- 1.2 Describe the metallic state of pure metals.
- 1.3 Describe the structure of the atom with neat sketch.
- 1.4 Explain the phenomena of metallic bonding.
- 1.5 Explain crystalline state of metals with sketch.
- 1.6 Describe the manner of crystallization.
- 1.7 Explain the deformation of metals.
- 1.8 Explain the recrystallization, germination & cold crystallization and their effects on the properties of metal.
- 1.9 Describe the models of body centred, face centred and hexagonal pattern with the help of the tennis ball.

**2 Understand the theory of alloys.**

- 2.1 Describe thermal and cooling curves for binary alloys with neat sketch.
- 2.2 Explain the zero equilibrium diagram.
- 2.3 Explain the thermal equilibrium diagram for binary and ternary alloys.
- 2.4 Explain the thermal equilibrium diagrams and their construction.
- 2.5 Explain the lever rule for constructing equilibrium diagram.
- 2.6 Explain the iron and iron-carbon equilibrium diagram.
- 2.7 Draw three phase iron carbon equilibrium diagram.
- 2.8 Explain the grain structure of 0.25%carbon steel with neat diagram.
- 2.9 Explain the uses of equilibrium diagram.

**3 Understand the heat treatment processes.**

- 3.1 Define heat treatment.
- 3.2 Explain the importance of heat treatment.
- 3.3 Mention objectives of heat treatment.
- 3.4 Explain the critical temperature diagram of plain carbon steel and its role in the heat treatment.
- 3.5 Explain in detail the following heat treating processes with diagram:  
annealing, normalizing, quench hardening, tempering, austempering and martempering.
- 3.6 Describe different types of media for annealing.
- 3.7 Describe different types of quenching media for hardening.
- 3.8 Explain the functions of quenching media.

- 4 Understand the heat treating furnaces and pyrometers.**
- 4.1 Describe the various heat treating furnaces and equipment.
  - 4.2 Describe the construction of muffle type furnace and its advantages over other furnace.
  - 4.3 Describe different types of pyrometers.
  - 4.4 Describe of thermocouple pyrometers.
  - 4.5 Discuss the uses of different types of pyrometers.
- 5 Understand the surface treatment.**
- 5.1 Describe the purpose of surface treatment.
  - 5.2 Describe the process of electro plating and coating.
  - 5.3 Explain the process of hard facing by flame hardening and induction hardening.
  - 5.4 Explain the following carburizing processes:  
Solid or pack carburizing, Liquid bath carburizing and gas carburizing.
  - 5.5 Explain the heat treatment processes after carburizing..
  - 5.6 Explain the advantages and disadvantages of carburizing processes.
  - 5.7 Explain the cyaniding and nitriding process of surface treatment.
  - 5.8 Describe the furnace used in nitriding process with neat sketch.
  - 5.9 Explain the superiority of nitrided steel over other surface hardness steel.
  - 5.10 Explain the uses of surface treated steel by various methods of surface treatment.
- 6 Understand the heat treatment of alloy steels.**
- 6.1 Describe the behavior and influence of following alloying elements in steel during the heat treatment:
    - a) Carbon
    - b) Manganese
    - c) Silicon
    - d) Nickel
    - e) Tungsten
    - f) Molybdenum
    - g) Chromium
 At the following stages:
    - i) Pearlitic
    - ii) Martensitic and
    - iii) Austenitic
  - 6.2 Describe the behavior of Carbon steel, Chromium steel, Nickel steel, Molybdenum steel, Stainless steel, High Speed Steel.
- 7 Understand the process of microscopic examinations.**
- 7.1 Explain the importance of microscopic examination of metals.
  - 7.2 Describe various components of metallurgical microscope with sketch.
  - 7.3 Describe the process of handling microscope properly for microscopic examination.
  - 7.4 Explain the necessity of preparing specimen before microscopic examination.
  - 7.5 Describe the process of preparing specimen either by hand polishing or machine polishing.
  - 7.6 Describe the process of mounting of specimen.
  - 7.7 Describe etching and different types of etching agent used for different metals.
  - 7.8 Describe the process of etching before microscopic examination.
  - 7.9 Interpret the micro structure before and after heat treatment.
  - 7.10 Describe the process of maintenance of microscope and equipment for preparing and preserving specimens.
- 8 Understand application of alloy steel.**
- 8.1 Explain the reason of using particular alloy steel for a particular industries.
  - 8.2 List the suitable alloy steel with reason for using in the following industries:  
machine tools, power plant, arms and ammunition, agricultural implements, jute, textile and sugar mills, paper and board industries.

## **9 Understand the selection, specifications and code number of metals.**

- 9.1 Describe the practical purpose of selection, specifications and code number of metals for engineering use.
- 9.2 Explain the code number of metal.
- 9.3 Describe the uses of metal hand book

### **Practical:**

#### **1. Make the model of body centered and hexagonal pattern with tennis ball.**

- 1.1 Collect 9 tennis balls.
- 1.2 Make a cube template.
- 1.3 Keep 4 tennis balls in template in touch and glue them.
- 1.4 Place 1(one) tennis ball at center gap of 4 glued tennis ball and then glue them.
- 1.5 Place rest 4 tennis ball in the same template and glue them.
- 1.6 Allow them for setting.
- 1.7 Prepare report and submit.

#### **2. Identify metals by spark test (mild steel, high carbon steel, high speed steel, stainless steel, axel. stud bolt).**

- 2.1 Create spark of specimen metal on a bench grinder or by a portable grinder.
- 2.2 Observe the pattern of the sparks
- 2.3 Compare the sparks pattern with chart.
- 2.4 Identify the metal.
- 2.5 Prepare report and submit.

#### **3. Perform annealing process of alloy steel/high carbon steel.**

- 3.1 Prepare the cast iron annealing box with fire brick.
- 3.2 Keep the specimen in sand in the annealing box and close it. Make the cover air tight with a layer of fire clay.
- 3.3 Place the box in furnaces and heat it slowly up to  $700^{\circ}\text{C}$  -  $815^{\circ}\text{C}$  for steel.
- 3.4 Keep the box in the same temperature for one hour.
- 3.5 Cool the box keeping it in the furnace for 40-60 hrs.
- 3.6 Prepare report and submit.

#### **4. Perform normalizing process of a mild steel rod by using necessary equipment.**

- 4.1 Select a specimen
- 4.2 Find out the hardness number of the specimen
- 4.3 Prepare furnace.
- 4.4 Perform normalizing operation.
- 4.5 Cool the specimen according to the process.
- 4.6 Find hardness number after cooling.
- 4.7 Compare the result and comments.
- 4.8 Prepare report and submit.

#### **5. Perform quench-hardening and tempering process on a alloy steel/high carbon steel plate .**

- 5.1 Select a specimen
- 5.2 Find out the hardness number of the specimen
- 5.3 Prepare furnace.
- 5.4 Perform quench-hardening operation.
- 5.5 Cool the specimen according to the process.
- 5.6 Perform tempering process.
- 5.7 Cool the specimen according to tempering process.
- 5.8 Find hardness number after cooling.
- 5.9 Compare the result and comments.
- 5.10 Prepare report and submit

6. **Perform electroplating & coating process on a mild steel plate.**
  - 6.1 Collect a specimen.
  - 6.2 Prepare electroplating bath.
  - 6.3 Select anode & cathode part.
  - 6.4 Connect electricity.
  - 6.5 Wait for required time.
  - 6.6 Check the plating time to time.
  - 6.7 Complete the process.
  - 6.8 Prepare report and submit
7. **Hard the surface of a mild steel flat ring by carburizing process.**
  - 7.1 Select a specimen
  - 7.2 Collect carburizing materials.
  - 7.3 Find out the hardness number of the specimen
  - 7.4 Prepare furnace.
  - 7.5 Perform carburizing process.
  - 7.6 Cool the specimen according to the process.
  - 7.7 Find hardness number after cooling.
  - 7.8 Compare the result and comments.
  - 7.9 Prepare report and submit
8. **Hard the surface of a alloy steel having aluminum & vanadium by Nitriding process.**
  - 8.1 Industry visit
  - 8.2 Prepare report and submit.
9. **Draw the micro structure of a metal before and after heat treatment using metallurgical microscope.**
  - 9.1 Select the specimen
  - 9.2 Prepare the specimen.
  - 9.3 Perform etching.
  - 9.4 Place the specimen under microscope
  - 9.5 Observe and draw micro structure.
  - 9.6 Do the same process after "Heat treatment".
  - 9.7 Prepare report and submit

## REFERENCE BOOK

1. Metallurgy – by Johnson.
2. Metallurgy & Heat treatment – by Join
3. Elementary Metallurgy – by Frier.
4. Material science and Metallurgy - O.P Khanna

**AIMS**

- To be able to develop knowledge, skill and attitude to apply subject knowledge in manufacturing of mechanical component.
- To be able to develop knowledge, skill and attitude to determine the economic benefit of the produced components using mechanical estimating subject.
- To be able to know that there are real possibilities for entrepreneurship and employment.

**While doing the project work the following factors should be considered.**

1. Component which is related to the mechanical engineering should be undertaken for the project work.
2. A technical report will be prepared.
3. In order to manufacture the product, a project planning document should be prepared considering the following points:-
  - (a) Pre Concept
  - (b) Market survey for raw materials& accessories.
  - (c) Equipment layout
  - (d) Estimating
  - (e) Flow diagram
- (f) Procurement of raw materials
  - (g) Production processes
  - (h) Costing of the product

**CONTENTS:**

On the basis of the physical facilities and other facilities one or more than one product will be selected for production. The class teacher will acts as a manager and one or two students will act as foreman for the project class.

**1 Perform the production and report writing of the perfect work.**

- 1.1 Select any one or two products for the project work.
- 1.2 Make detailed working drawings of the selected product / products.
- 1.3 Prepare a list of raw-materials required for the manufacture of the product.
- 1.4 Draw a flow diagram of operations.
- 1.5 Select jigs/fixture or dies/molds or any other special tools if necessary
- 1.6 Set up relevant machines and equipment for producing the product.
- 1.7 Produce the job.
- 1.8 Prepare a technical report on the project work / works on the basis of the following points:
  - (a) Name of project.
  - (b) Objectives
  - (c) Requirements:
    - (i) Machines
    - (ii) Materials
    - (iii) Detail working drawing & assembly drawing.
    - (iv) Flow diagram of operation
  - (d) Estimating
  - (e) Manufacturing procedures
  - (f) Calculating direct cost, indirect cost and overhead cost
  - (g) OSH (occupational safety& health)
  - (h) Conclusion
  - (i) References

**AIMS**

- To be able to understand the concepts, principles and techniques in terms of production in appreciating to choose efficient methods of production.
- To be able to understand the concepts, principles and techniques of production planning with a purpose in selecting appropriate site to set up a new factory.
- To be able to interpret new condition on a practical field for solving production problems.
- To be able to understand the production principles, techniques and their effect in production.
- To be able to appreciate the importance of familiarization with the various activities involved in the method and planning of production.

**SHORT DESCRIPTION**

Production system; Division of labor; Production planning; Localization of industry; Time study and motion study; Selection of factory site; Factory building; Plant layout; Equipment layout; Operation of factory; Production control; Quality control; Cost control; Inventory control; Materials handling; Case study.

**DETAIL DESCRIPTION****1 Understand different production systems.**

- 1.1 Define production system.
- 1.2 Describe the scope and activity of production systems.
- 1.3 Describe the factors to be considered in production.
- 1.4 Distinguish job, batch and mass production.
- 1.5 Describe the scale of production.
- 1.6 Describe cloud computing.
- 1.7 Describe drone technology for various industries.

**2 Understand the importance and scope of production planning.**

- 2.1 Define production planning.
- 2.2 Describe importance of production planning.
- 2.3 State the different types and techniques of production planning.
- 2.4 Describe routing and scheduling procedures.
- 2.5 Describe machine loading.
- 2.6 Describe products dispatching and follow up.
- 2.7 State the benefits of production planning.
- 2.8 Describe job planning, execution of job and monitoring.
- 2.9 Describe simulation of production process.

**3 Understand the importance of time and motion study.**

- 3.1 Define motion study, micro-motion study and time study.
- 3.2 Describe work simplification.
- 3.3 Describe the uses of equipment of motion study.
- 3.4 Describe the different techniques of motion study.
- 3.5 Describe time study procedures and its limitations.
- 3.6 Describe GANT chart and the THERBLIGS.
- 3.7 Distinguish between time study and motion study.
- 3.8 Determine the standard time for a job with the help of stop-watch method.

- 4 Understand the importance of localization of industry.**
  - 4.1 Describe localization of industry.
  - 4.2 Describe the factors which effect the localization of industry.
  - 4.3 Narrate the advantages of proper localization of industry.
- 5 Understand the importance of selection of factory site.**
  - 5.1 Describe the basis of site selection of a factory.
  - 5.2 Describe the factors for correct selection of factory site.
  - 5.3 Narrate the advantages of correct site selection.
- 6 Understand the importance of factory building.**
  - 6.1 State the characteristics of factory building.
  - 6.2 State the different types of factory building.
  - 6.3 Describe the factors involved in selecting factory building.
  - 6.4 Mention the advantages and disadvantages of different types of building.
- 7 Understand the importance of plant layout.**
  - 7.1 Explain plant lay out.
  - 7.2 Describe the fundamental factors of plant layout.
  - 7.3 Describe the different types of manufacturing plants.
  - 7.4 Relate the influences of processes on plant layout.
  - 7.5 Explain the necessity of studies of plant layout.
- 8 Understand the importance of equipment layout.**
  - 8.1 Define equipment layout.
  - 8.2 Identify the factors to be considered for equipment layout.
  - 8.3 State the different types of equipment layout.
  - 8.4 Compare product and process layout.
- 9 Understand the techniques involved in operation of factory.**
  - 9.1 Define operation, operation sheet and operation schedule.
  - 9.2 Prepare operation sheet.
  - 9.3 Prepare operation schedule.
  - 9.4 Distinguish between process chart and flow diagram.
- 10 Understand the importance of production control.**
  - 10.1 Define production control.
  - 10.2 Describe the factors involved in production control.
  - 10.3 Narrate the advantages of production control.
- 11 Understand the importance of quality control.**
  - 11.1 Define quality control.
  - 11.2 Describe objectives and principle of quality control.
  - 11.3 Describe procedure of quality control.
  - 11.4 Describe the benefits of quality control.
  - 11.5 Discuss the role of quality control department.
- 12 Understand the importance of cost control.**
  - 12.1 Define cost control.
  - 12.2 State the objectives of cost control.
  - 12.3 Describe the procedures of cost control.
  - 12.4 Describe the advantages of cost control.

**13 Understand the necessity of inventory control.**

- 13.1 Define inventory control.
- 13.2 State the objectives of inventory control.
- 13.3 Describe the different types of inventory control methods.
- 13.4 State the advantages of inventory control.
- 13.5 Describe the effects of inventory control for store management.
- 13.6 State economic order quantity and economic lot size.
- 13.7 Determine economic order quantity and economic lot size.
- 13.8 State computer integrated production planning system.
- 13.9 Describe the elements of JUST IN TIME SYSTEM.

**14 Understand the effects of material handling .**

- 14.1 Describe the principles, limitations and advantages of management.
- 14.2 Make materials handling layout.
- 14.3 Explain the factors to be considered for materials handling and handling equipment.
- 14.4 Classify handling equipment.
- 14.5 Describe derrick, Gantry cranes and lifting devices.
- 14.6 Classify conveyors.
- 14.7 Describe the uses and maintenance of conveyors.
- 14.8 Explain economic considerations of using conveyors & other devices.
- 14.9 Explain safety requirements.

**15. Understand casestudy.**

- 15.1 Define case study.
- 15.2 Explain the necessity of case study.
- 15.3 Explain 'SIX M'.
- 15.4 Studyspecific Cases relating Production.

**REFERENCE BOOKS**

1. Production Planning Control and Industrial management  
– K.C Jain  
L.N Aggarwal
2. The principle of Industrial management  
– Alford and Betty
- 3 উৎপাদনব্যবস্থাপনা  
– নাছিমআনজুম
4. কারবারব্যবস্থাপনা  
– দুর্গা দাসভট্টাচার্য্য

**AIMS**

To be able to understand mechatronics with the basic skill required for the synergistic integration of technical & engineering with electronics & intelligent computer control in the manufacture of products and process.

**SHORT DESCRIPTION**

Concept of mechatronics; System integration; Sensor & transducer; Displacement, position & proximity sensor; Different types of sensors; Signal conditioning; Digital & analogue signal; Pneumatic & hydraulic actuation system; Electric actuator; Basic system of model; Closed loop controllers; Microcomputer system Microcontroller; Programmable logic controller (PLC); Machine vision.

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

- 1 Understand mechatronics.**
  - 1.1 Define mechatronics.
  - 1.2 Explain the importance of mechatronics for industrial development.
  - 1.3 Discuss the integration of electrical, electronics and ICT with mechanical engineering.
  - 1.4 Discuss the use of mechatronics in computer integrated manufacturing environment.
- 2 Understand system.**
  - 2.1 Describe system.
  - 2.2 Define measurement system.
  - 2.3 Explain control system.
  - 2.4 Obtain open and closed loop system.
  - 2.5 Describe basic elements of closed loop system.
  - 2.6 Describe sequential controllers.
- 3 Understand the sensor & transducer.**
  - 3.1 Define sensor.
  - 3.2 Define transducer.
  - 3.3 Classify transducer.
  - 3.4 State the performance terminology related to sensor.
  - 3.5 State static characteristics of sensor & transducer.
  - 3.6 State dynamic characteristics of sensor & transducer.
- 4 Understand displacement, position & proximity sensor.**
  - 4.1 Define displacement, position & proximity sensor.
  - 4.2 Discuss the condition of selecting of different types of sensors.
  - 4.3 List different types of displacement sensors.
  - 4.4 List different types of position sensor.
  - 4.5 List different types of proximity sensor.
  - 4.6 Describe different types of sensors potentiometer, strain gauge, capacitive, differential eddy current proximity, fractal, bimetallic strips, resistance temperature detectors (RTDs), LVDT, thermistor; transistor, thermocouple and light sensor.
- 5 Understand the signal conditioning.**
  - 5.1 Define signal conditioning.
  - 5.2 Describe signal conditioning process.
  - 5.3 Explain the principles of operational amplifier.
  - 5.4 Explain the pin connection for operational amplifier with diagram
  - 5.5 Describe different types operational amplifier.

- 6 Understand the digital & analogue signals & their conversions.**
- 6.1 State digital & analogue signals.
  - 6.2 Describe process of conversion from analogue to digital.
  - 6.3 Explain sampling theorem.
  - 6.4 Describe the process of conversion from digital to analogue.
  - 6.5 Explain analogue to digital conversion and digital to analogue conversion.
  - 6.6 Describe the function of multiplexer.
- 7 Understand the pneumatic & hydraulic actuation system.**
- 7.1 Define actuation system.
  - 7.2 Describe the power supply system of pneumatic & hydraulic actuation system.
  - 7.3 State the directional control valve.
  - 7.4 Identify the symbol of different valves used in pneumatic & hydraulic actuation system.
  - 7.5 Describe different types of valves.
  - 7.6 Describe the actuator sequential operation of cylinder.
  - 7.7 Describe valve bodies and plugs.
  - 7.8 Describe fluid control system.
  - 7.9 Describe the rotary actuator.
- 8 Understand the electrical actuator.**
- 8.1 List the basic devices used in electrical actuation system.
  - 8.2 Describe the sequence of operation of the relay control system.
  - 8.3 Describe diodes, thyristor & triacs and explain their characteristics.
  - 8.4 Explain the bipolar transistor.
  - 8.5 Distinguish between Mosfer transistor and bipolar transistor.
  - 8.6 Explain working principle of solenoid.
  - 8.7 Define the stepper motor,
  - 8.8 Classify stepper motor.
  - 8.9 List use of different types of stepper motor in industry.
  - 8.10 Describe the excitation procedure of stepper motor.
- 9 Understand the basic system of model.**
- 9.1 Define modeling.
  - 9.2 Mention the purpose of basic system models.
  - 9.3 Describe the elements of mechanical system .
  - 9.4 Describe the elements of electrical system.
  - 9.5 State the structure of mechanical system.
  - 9.6 Explain modeling of measurement system.
  - 9.7 Discuss the importance of Laplace transformation pairs.
  - 9.8 State transfer function.
  - 9.9 Explain model diagram.
  - 9.10 Explain zeroth & first order system.
- 10 Understand the closed loop controllers.**
- 10.1 State continuous & discrete process.
  - 10.2 Define lag.
  - 10.3 Define steady state error.
  - 10.4 Find out the unity feed of a system.
  - 10.5 Define different types of control mods.
  - 10.6 Describe different types of controller.
- 11 Understand the microcomputer system.**
- 11.1 Explain the diagram of general computer system.
  - 11.2 Describe basic parts of CPU.

- 11.3 Explain different types of memory.
  - 11.4 Define computer words.
  - 11.5 Describe different types of computer words.
  - 11.6 Define buses.
  - 11.7 Classify buses.
  - 11.8 Describe the function of buses.
  - 11.9 Classify different types of registers.
- 12 Understand the programmable logic controller (PLC).**
- 12.1 Define PLC.
  - 12.2 Mention the advantages of PLC control system.
  - 12.3 Describe the characteristics of PLC.
  - 12.4 Define the basic structure of PLC.
  - 12.5 Describe the principle of operation of PLC.
  - 12.6 List the areas of application of PLC.
- 13 Understand the programming PLC.**
- 13.1 Describe input/output processing of PLC.
  - 13.2 Describe the ladder diagram.
  - 13.3 Describe logic function of PLC.
  - 13.4 Define latching & sequencing.
  - 13.5 Define memories.
  - 13.6 Define time circuit.
  - 13.7 Describe counter.
  - 13.8 Describe shift register.
- 14 Understand the microcontroller.**
- 14.1 Define microcontroller.
  - 14.2 List the building blocks of microcontroller.
  - 14.3 Describe pin diagram of the 8051 micro controller.
  - 14.4 Describe the memory organization of the 8051.
  - 14.5 Describe the commonly used instruction of 8051.
  - 14.6 Describe the interfacing the 8051 with DC motor and stepper motor.
- 15 Understand the machine vision system.**
- 15.1 Define the machine vision.
  - 15.2 Define the machine vision system.
  - 15.3 Describe the principle of working of machine vision system.
  - 15.4 Describe the function of machine vision system.
  - 15.5 Identify the field of machine vision system.
  - 15.6 Explain application of machine vision system.

**Practical:**

- 1. Construct a control system incorporating electrical, Mechanical and electronic components.**
- 1.1 Design the control system with specification.
  - 1.2 Collect the necessary component, tools & equipment.
  - 1.3 Connect the components according to design.
  - 1.4 Connect power supply.
  - 1.5 Check the functional output.
  - 1.6 Prepare report and submit

- 2. Construct a photosensitive auto-stop mechanism for a lathe machine.**
  - 2.1 Design the system with specification
  - 2.2 Collect the photo-sensor & necessary component.
  - 2.3 Connect the all component.
  - 2.4 Check the function & operating system.
  - 2.5 Prepare report and submit
- 3. Construct an auto stop mechanism using timer circuit to stop a pump after certain time.**
  - 3.1 Design the timer circuit.
  - 3.2 Collect the necessary component &tools.
  - 3.3 Connect the all component as per design.
  - 3.4 Check the performance.
  - 3.5 Make necessary correction (if required).
  - 3.6 Prepare report and submit
- 4 Construct a level indicator to show indication after reaching the required level and stopping the input valve automatically.**
  - 4.1 Design a circuitfor the job with specification of components.
  - 4.2 Collect the components.
  - 4.3 Connect the component according to design.
  - 4.4 Connect power supply
  - 4.5 Test the performance.
  - 4.6 Prepare report and submit
- 5 Construct pneumatic control system.**
  - 5.5 Design pneumatic system as per requirement.
  - 5.6 Collect the necessary component (such as air compressor, pneumatic cylinder, control valve , limit switch , solenoid valve, air tube etc)
  - 5.7 Connect the all component.
  - 5.8 Check the function.
  - 5.9 Adjust as per requirement.
  - 5.10 Prepare report and submit
- 6 Construct a system to operate a cylinder in a particular time using pneumatic valve.**
  - 6.1 Design the system.
  - 6.2 Collect component required.
  - 6.3 complete circuit according to design.
  - 6.4 Test the performance.
  - 6.5 Change some parameter to achieve requite time.
  - 6.6 observe performance for the job.
  - 6.7 Prepare report and submit

**Reference books:**

1. W. Bolton-Applied Mechatronics.
2. De. Silva- Mechatronics.
3. Bishop- Mechatronics.
4. Programmable controllers Theory and Implementation- L.A Bryan ,E.A Bryan.

**AIMS**

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

**SHORT DESCRIPTION**

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

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

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

**2. Understand the concept of entrepreneurship and economic development.**

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

**3. Environment for entrepreneurship development:**

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

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

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

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

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

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

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

## **7. Understand the concept of self employment.**

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

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

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

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

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

## **10. Understand the insurance and premium.**

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

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

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

## **12. Understand SDG 4,8 and 17**

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

## **Reference book :**

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