

**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

***Department of Mechanical Engineering***

B.Sc. Engineering 1<sup>st</sup> Year Backlog Examination, 2021

ME 1105

(Thermal Engineering)

Time: 3 Hours

Total Marks: 210

- N.B.:** i) Answer any THREE questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.  
iii) Steam table, Mollier diagram and Psychromatic chart may be supplied on request.  
iv) Assume reasonable data if any missing.

**SECTION – A**

- 1(a) What are the available sources of energy in Bangladesh? Describe the present energy situation of the World. 12
- 1(b) Write short notes on the followings: 10  
(i) Ocean thermal energy  
(ii) Solar energy
- 1(c) In this global energy crisis situation, design a solution plan for Bangladesh from the Mechanical Engineering point of view. 13
- 2(a) Explain the steps of steam formation at constant pressure with necessary diagrams. 09
- 2(b) Derive the expression of internal energy of steam in different conditions. 08
- 2(c) Calculate the internal energy of 1 kg of steam at a pressure of 10 bar when the steam is (i) 92% dry and (ii) dry saturated. 10
- 2(d) Draw and explain the temperature vs total heat graph during steam formation. 08
- 3(a) What are the selection criteria of a steam boiler? 06
- 3(b) What are the differentiating features between a water tube and a fire tube boiler? 08
- 3(c) Explain the working procedure of a La-Mont boiler with neat sketch. 12
- 3(d) Explain the functions of blow off cock, fusible plug and economiser. 09
- 4(a) Explain why air preheaters are used in a high pressure boiler. 07
- 4(b) What are the mountings and accessories of a boiler? Why they are integrated with a boiler? 10
- 4(c) A boiler plant consists of the following particulars: 18  
Steam pressure = 20 bar, steam temperature = 260°C, steam generated = 40,000 kg, temperature of water entering the economiser = 20°C, temperature of water leaving the economiser = 92°C, fuel used = 4500 kg, energy of combustion of fuel = 30,000 kJ/kg.  
Calculate:  
(i) The equivalent evaporation per kg of fuel  
(ii) The thermal efficiency of the plant and  
(iii) The percentage of heat energy of the fuel utilized by the economiser.

### SECTION – B

- 5(a) What are meant by (i) calorific value of a fuel and (ii) stoichiometric air? Mention the difference between the higher and lower calorific value. 10
- 5(b) What are the important requirements of a good fuel? Mention the merits and demerits of gaseous fuels. 10
- 5(c) A certain fuel has the following composition by mass: 15  
C-80%, H<sub>2</sub>-10% and S-10%. The volumetric analysis of the fuel gas is CO<sub>2</sub>-13%, CO-1.5%, O<sub>2</sub>-8% and N<sub>2</sub>-77.5%.  
Find per kg of coal:  
(i) the minimum air required for combustion  
(ii) the actual air supplied and  
(iii) the excess air supplied.
- 6(a) What is meant by IC engine? Differentiate 2-stroke and 4-stroke cycle engines. 10
- 6(b) Briefly explain the actual indicator diagram of a four-stroke cycle petrol engine with neat sketch. 10
- 6(c) What are the Octane and Cetane number rating of a fuel? 06
- 6(d) Differentiate between the operation of a closed cycle and an open cycle gas turbine. 09
- 7(a) Define Ton of refrigeration and COP. 06
- 7(b) Describe the working principle of a simple vapour absorption refrigeration system with neat sketch. 11
- 7(c) What is refrigerant? Why CFC and HCFC are not used as a refrigerant now a days? 08
- 7(d) Explain the differences between a heat engine, refrigerator and heat pump. 10
- 8(a) Define: 06  
(i) Relative humidity  
(ii) Dew point temperature and  
(iii) Sensible heat factor.
- 8(b) What is meant by human comfort? Discuss the factors that affect comfort air conditioning. 09
- 8(c) Describe the working principle of winter air conditioning system with neat sketch. 10
- 8(d) Dry bulb temperature of air is 40°C and wet bulb temperature is 25°C. Determine: 10  
(i) Relative humidity, (ii) Specific humidity, (iii) Specific volume, (iv) Enthalpy and  
(v) Dew point temperature of this air using psychrometric chart.

**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

**Department of Mechanical Engineering**

B.Sc. Engineering 1<sup>st</sup> Year Backlog Examination, 2021

ME 1209

(Engineering Mechanics I)

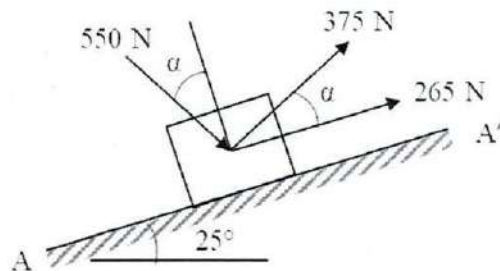
Time: 3 Hours

Total Marks: 210

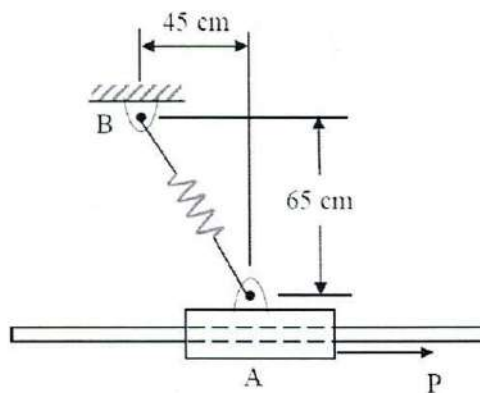
- N.B.:** i) Answer any THREE questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.  
iii) Assume reasonable data if any missing.

**SECTION – A**

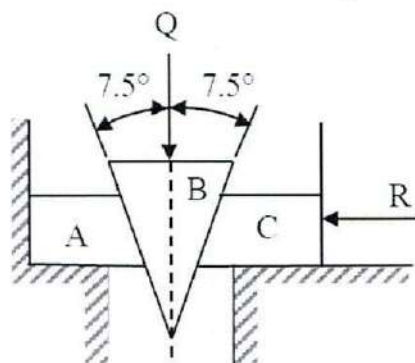
- 1(a) Knowing that  $\alpha = 65^\circ$ , determine the components of the forces and hence the resultant of the forces shown. 10



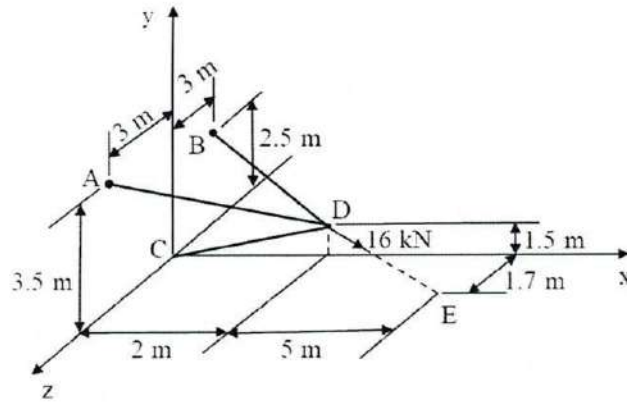
- 1(b) The collar A may slide freely on the horizontal frictionless rod. The spring attached to the collar has a constant of 10 N/cm and is undeformed when the collar is directly below support B. Determine the magnitude of the force P required to maintain equilibrium. 12



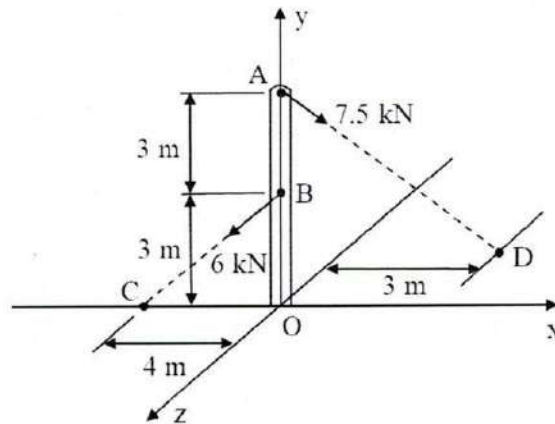
- 1(c) In Fig. let  $m_A = 1000$  kg,  $m_B = 260$  kg,  $m_C = 2500$  kg, and force  $R = 38$  kN. Neglecting friction at all surfaces, find the force Q on the top of the wedge and the reactions at the supports. Assume the reaction at A has two components. 13



- 2(a) Three cables are connected at D, where a 16 kN force is applied as shown. Determine the tension in each cable. 18

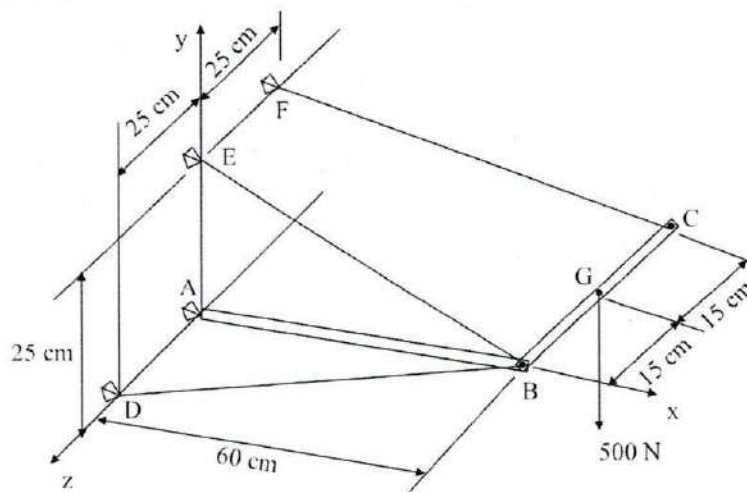


- 2(b) Two forces are applied to the vertical pole as shown in figure. Determine the components of the forces and couple at O equivalent to the two-force system. 17



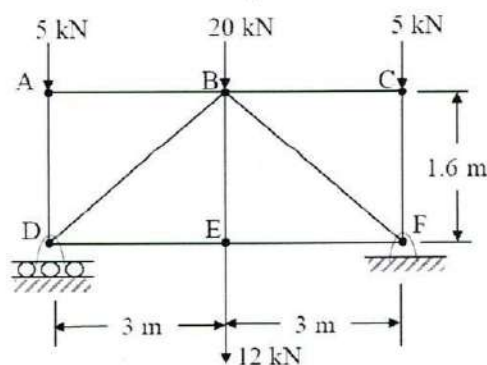
- 3(a) Distinguish between (i) Free body diagram and space diagram; (ii) Concurrent force system and coplanar force system. 05

- 3(b) The rigid L-shaped member ABC is supported by a ball and socket at A and by three cables. Determine the tension in each cable and the reaction at A caused by the 500 N load applied at G. 30

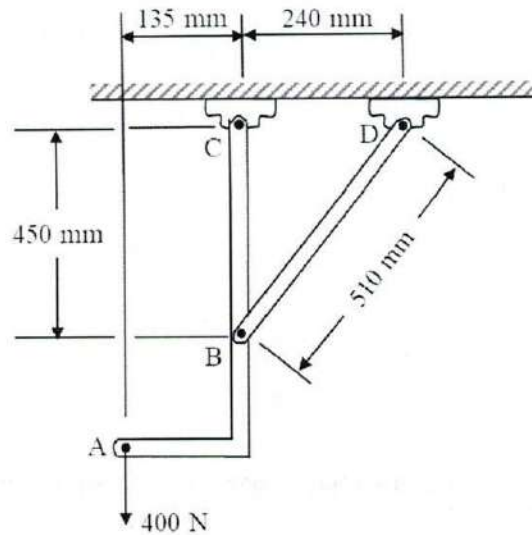


- 4(a) Distinguish among truss, frame and machine with neat sketch. 05

- 4(b) Determine the forces in members BC, BF and EF of the truss shown in figure. State whether each member is in tension or compression. 15

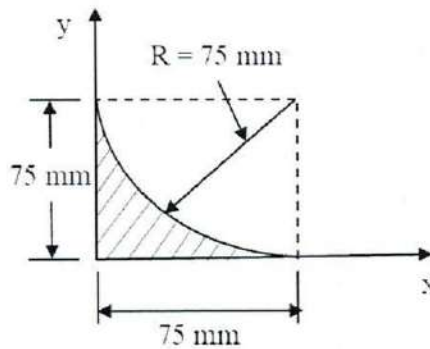


- 4(c) Determine the force in member BD and the components of the reaction at C of the frame shown in figure. 15

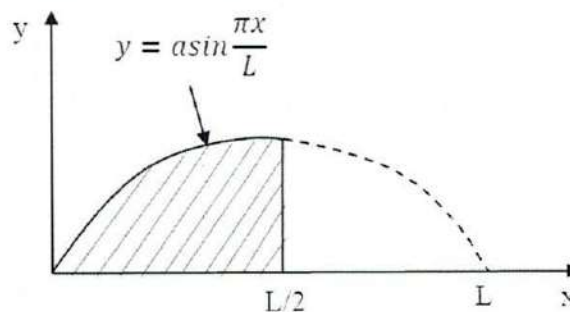


**SECTION – B**

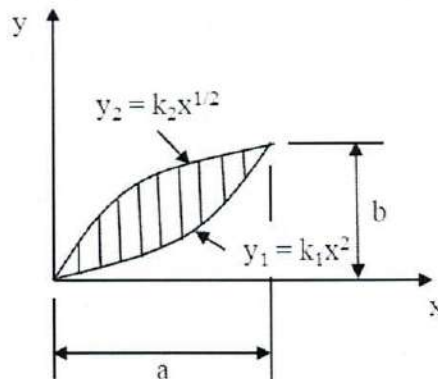
- 5(a) Determine the centroid of the shaded area as shown in figure. 17



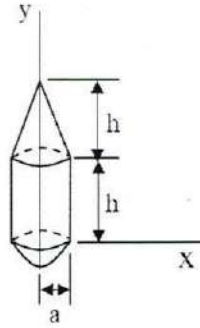
- 5(b) Determine by direct integration the centroid of the area shown in figure. 18



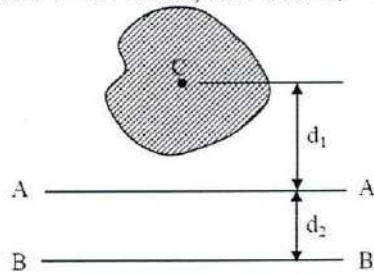
- 6(a) Determine by direct integration the moment of inertia and radius of gyration of the shaded area as shown with respect to x-axis. 17



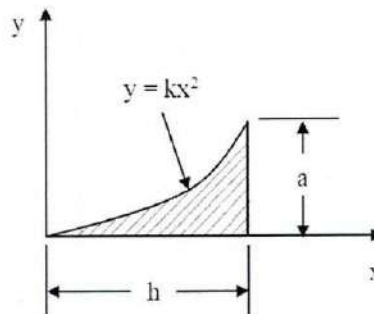
- 6(b) A hemisphere, a cylinder and a cone are placed together as shown in figure. Determine the location of the centroid of the composite body. 18



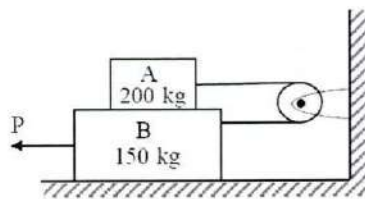
- 7(a) Determine the shaded area and its moment of inertia with respect to a centroidal axis parallel to  $AA'$ , knowing that its moment of inertia with respect to  $AA'$  and  $BB'$  are respectively  $2.2 \times 10^6 \text{ mm}^4$  and  $4 \times 10^6 \text{ mm}^4$ , and that  $d_1 = 25 \text{ mm}$  and  $d_2 = 10 \text{ mm}$ . 18



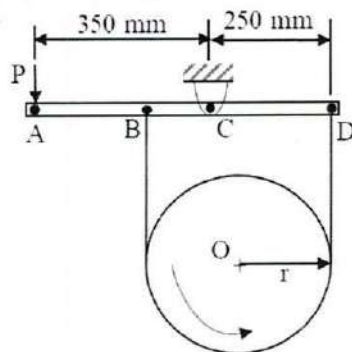
- 7(b) The area shown is revolved about the x-axis to form a homogeneous solid of revolution of mass  $m$ . Express the mass moment of inertia of the solid with respect to the x-axis in terms of  $m$ ,  $a$ , and  $h$ . 17



- 8(a) Knowing that  $\mu = 0.25$  at all surfaces of contact, determine the magnitude of the force  $P$  required to move block B to the left. Assume that the coefficient of friction on pulley is 0.15. 18



- 8(b) A band brake drum of radius  $r = 150 \text{ mm}$  is rotating counterclockwise when a force  $P$  of magnitude  $65 \text{ N}$  is applied at A. Knowing that the coefficient of friction at O is 0.40, determine the moment about O of the friction forces applied to the drum. 17



— X —

**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

***Department of Mechanical Engineering***

B.Sc. Engineering 1<sup>st</sup> Year Backlog Examination, 2021

ME 1107

(Manufacturing Process)

Time: 3 Hours

Total Marks: 210

- N.B.:** i) Answer any THREE questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.  
iii) Assume reasonable data if any missing.

**SECTION – A**

- 1(a) Define permeability. Explain the factors affecting the permeability of a sand mold. 10
- 1(b) List various pattern allowances and explain the shrinkage allowance. 10
- 1(c) With the help of necessary sketches, briefly explain lost wax casting method by mentioning its applications. 10
- 1(d) Compare and contrast between the removable and disposable pattern. 05
- 2(a) Explain the reciprocating type continuous casting process with necessary figure. Also give example of five products that are produced by continuous casting. 14
- 2(b) What is a core? Describe the essential properties of a good core. 08
- 2(c) Explain the common defects that are likely to be found in casting and their remedies. Also, mention the different methods to detect casting defects. 13
- 3(a) Describe the various flames produced in Oxy-acetylene gas welding with their applications. 12
- 3(b) Differentiate between Spot, Seam and Projection welding. Also compare TIG and MIG welding processes. 10
- 3(c) Illustrate and explain the submerged arc welding mentioning its merits and demerits. 13
- 4(a) Why metal forming process is needed? Differentiate between hot and cold working processes. 09
- 4(b) Define the following operation: 08  
(i) Coining, (ii) Blanking, (iii) Lancing and (iv) Piercing.
- 4(c) Explain the direct extrusion method. Also, describe how a toothpaste tube can be manufactured. 10
- 4(d) Illustrate the various rolling arrangements used in rolling mills. 08

**SECTION – B**

- 5(a) What are the factors affecting metal cutting? Differentiate between orthogonal and oblique cutting. 10
- 5(b) Define chip. Describe different types of chips formed in metal cutting. Why chip breaker is used? 13
- 5(c) Define cutting fluid. Illustrate and explain a single point cutting tool showing its different angles and elements. 12

- 6(a) Why lathe machine is said to be universal machine? Explain feed and depth of cut during turning with neat sketches. 10
- 6(b) How lathe machine is specified? What are the differences between 3-jaw universal chuck and 4-jaw independent chuck? 12
- 6(c) Name and describe the major parts of a lathe machine, mentioning their functions with a neat sketch. 13
- 7(a) What is indexing? What are the common methods of indexing? Explain any one of them. 12
- 7(b) How shaper machine is specified? Describe centerless grinding method with its advantages and limitations. 13
- 7(c) Differentiate between: (i) conventional milling and climb milling, (ii) drilling and boring. 10
- 8(a) Write short notes on: 06  
(i) Honing, (ii) Lapping and (iii) Superfinishing
- 8(b) Explain the necessity of modern machining processes. Derive the expression for MRR in ECM process. 13
- 8(c) Why non conventional methods of machining are important? Explain. 06
- 8(d) Write down the functions of dielectric fluid in EDM. What are the advantages and disadvantages of USM? 10