B.Tech. I - Sem.(Main/Back) Exam - Jan-Feb. 2012
105 – Engineering Mechanics
(Common to all Branches of Engg.)

Time : 3 Hours

Maximum Marks : 80
Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five questions** selecting one question from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

UNIT - I

Q1. (a) Four forces of magnitude P, 2P, 3√3P and 4P are acting at a point O. The angles made by these forces with x-axis are 0°, 60°, 150° and 300° respectively. Find the magnitude and direction of the resultant force.   6

(b) Determine the forces in all the members of a cantilever truss as shown in fig. 1.
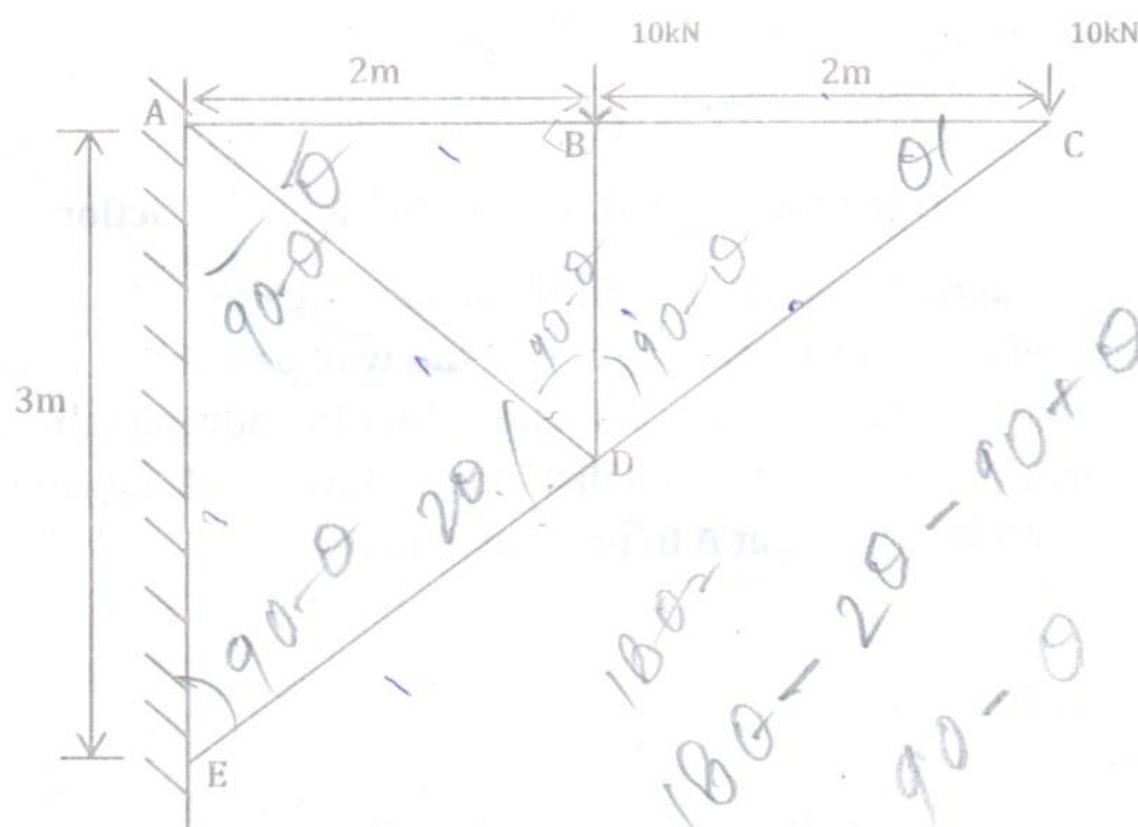
                                                                                                    10

Fig. 1

Q1   (a) The resultant of two forces P and Q acting at a point is R, If Q is doubled, the force R also gets doubled and if Q is reversed, R is again doubled. Show that the ratio of P, Q and R is given by   8

$$P: Q: R = \sqrt{2}: \sqrt{3}: \sqrt{2}$$

(b) our forces of magnitude 20 N, 30 N, 40 N and 50N are acting respectively along the four sides of a square taken in order. Determine the magnitude, direction and position of the resultant force.   8

UNIT - II

Q2.   (a) Explain the principal of virtual work.   4

(b) A simply supported beam is loaded as shown in fig. 2. Using the method of virtual work determine the reactions at the supports A and B.   8
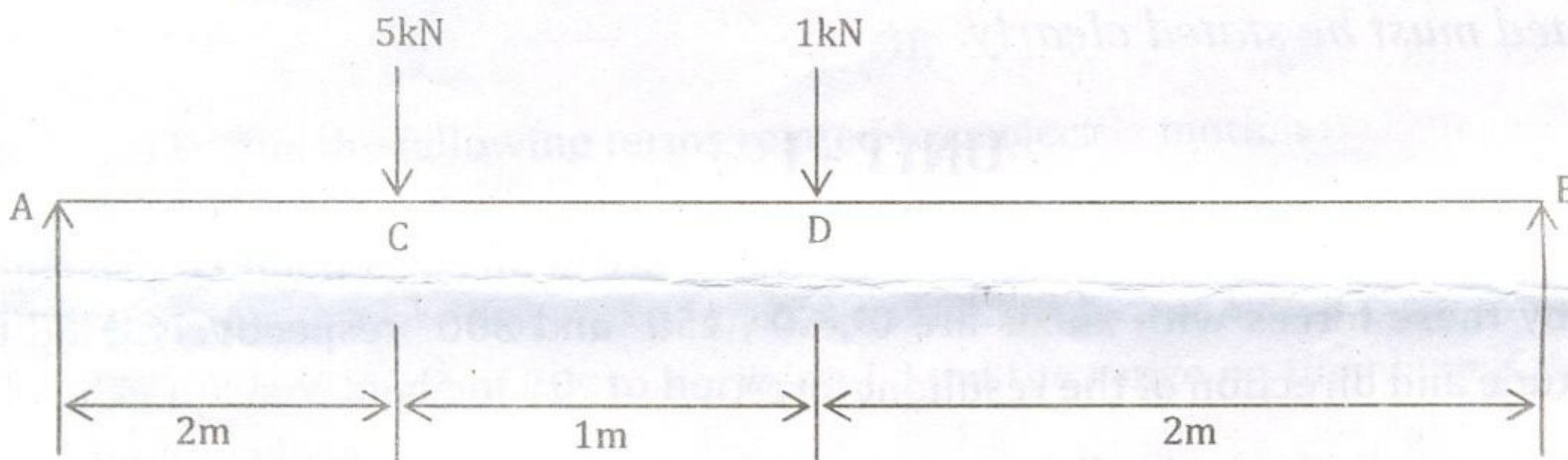

Fig – 2

(c) Define angle of repose and cone of friction.   4

OR

Q2.   (A) Define the terms (i) co –efficient of friction (ii) angle of friction.   6

(b) A ladder of length 4m weighing 200N is placed against a vertical wall as shown in fig.3. The co-efficient of friction between the wall and the ladder is 0.2 and that between the floor and the ladder is 0.3. The ladder in addition to its own weight has to support a man weighing 600N at a distance of 3m from A. Calculate the minimum horizontal force to be applied at A to prevent slipping.   10
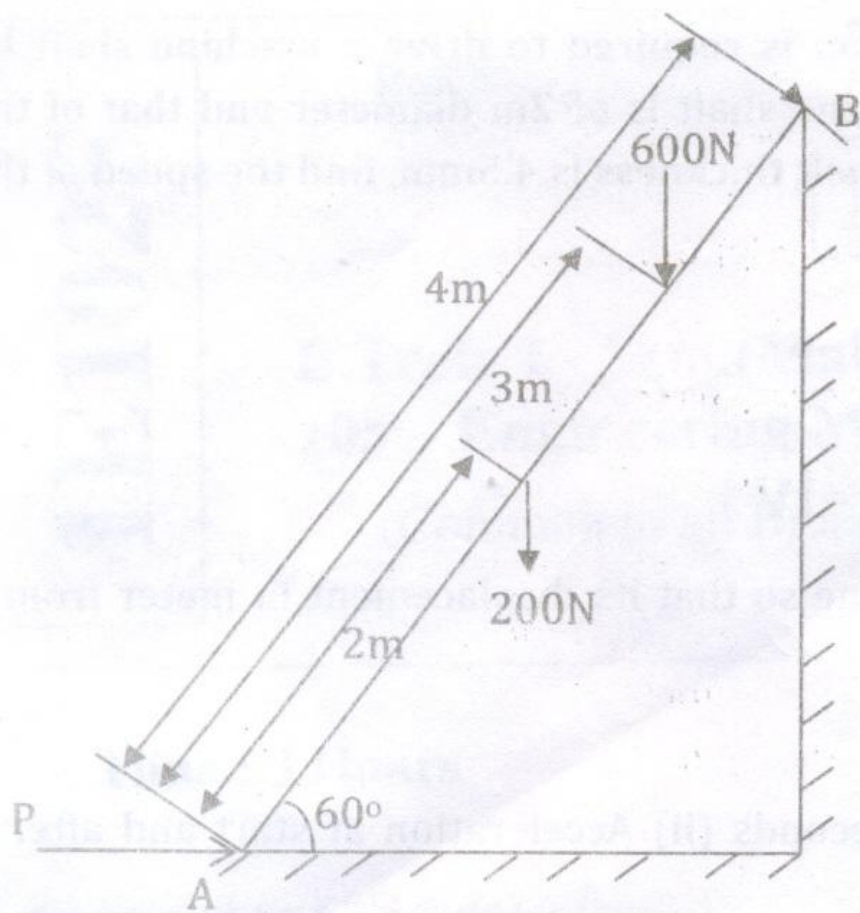
Fig. 3

UNIT - III

Q3. Determine the moment of inertia of a T- Section as shown in Fig.4 about the horizontal and vertical axes passing through the centroid of the section.   16
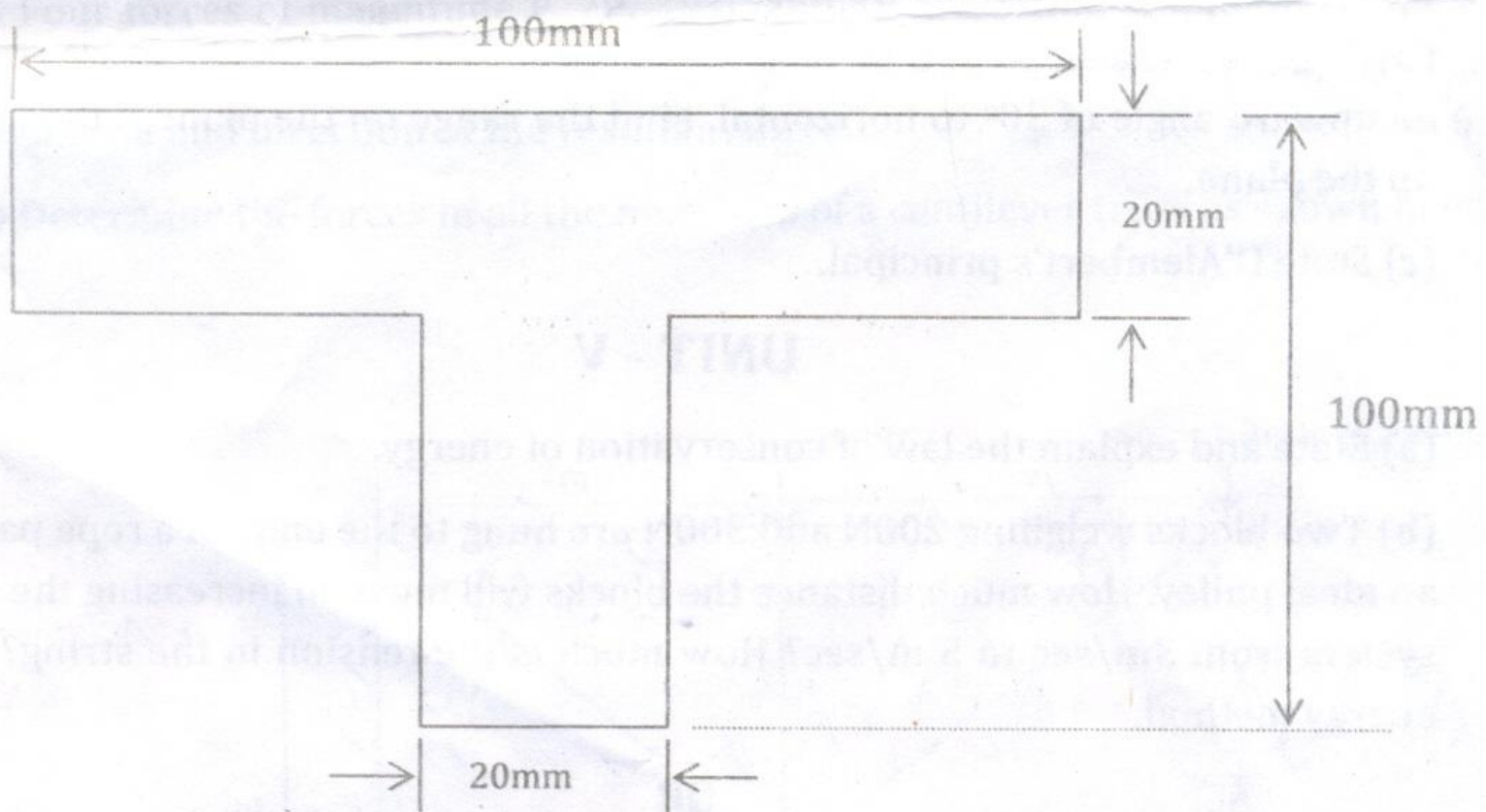

Fig. 4

OR

Q3. (a) Explain the difference between a reversible machine and a self locking machine. The efficiency of a machine is 80% when an effort of 15N is required to lift a load of 130N. Calculate the velocity ratio and the frictional force of the machine in terms of effort and load.   8

(b) An engine shaft running at 250 rpm is required to drive a machine shaft by means of a belt. The pulley on the engine shaft is of 2m diameter and that of the machine shaft is of 1m diameter. If the belt thickness is 4.5mm, find the speed of the belt when :

(i) there is no slip

(ii) there is a slip of 4 %   8

UNIT - IV

Q4   (a) A particle moves along a straight line so that its displacement in meter from a fixed point is given by

$$S = t^3 + 3t^2 + 4t + 5$$

Find (i) velocity at start and after 4 seconds (ii) Acceleration at start and after 4 seconds .   8

(b) A ball is dropped from the top of a tower 30m high. At the same instant a second ball is thrown upward from the ground with an initial velocity of 15m/sec. When and where do they cross and with what relative velocity?   8

OR

Q4.   (a) Define the following terms related to projectile motion :

        (i) Range (ii) Height and (iii) Time of flight   6

(b) A plane has a slope of 5 in 12. A shot is projected with a velocity of 200 m/sec at an upward angle of 30° to horizontal. Find the range on the plane if the shot is fired up the plane.   8

(c) State D'Alembert's principal.   2

UNIT - V

Q5.   (a) State and explain the law of conservation of energy.   8

(b) Two blocks weighing 200N and 300N are hung to the ends of a rope passing over an ideal pulley. How much distance the blocks will move in increasing the velocity of system from 3m/sec to 5 m/sec? How much is the tension in the string? Use work energy method.   8

OR

Q5.   (a) Define undamped free vibrations. Drive the expression for this vibration of a single degree freedom system.   8

(b) A steel ball of 0.5N falls from a height of 8m and rebounds to a height of 6m. Find the impulse and the average force between the ball and the floor if the contact between the ball and the floor lasts for $1/10^{th}$ of a second.   8