**II-SEM COMMON/2019(W)/ (New)**

**Th.4 ENGINEERING MECHANICS**

Full Marks: 80 Time : 3 Hours

Answer any FIVE Questions including Q No. 1& 2

Figures in the right hand margin indicates marks

| | | |
|---|---|---|
| 1 | Answer ALL the Questions: | 2×10 |
| (a) | What are various characteristics of a force? | |
| (b) | A rectangular block of weight W is resting over a smooth horizontal surface. Draw free body diagram of rectangular block. | |
| (c) | State and explain the Triangle law of forces. | |
| (d) | Two forces are acting at $120^0$. The greater force is 40N and the resultant is acting at $90^0$ to the smaller force. Find the magnitude of the smaller force. | |
| (e) | State and explain the Varignon's theorem (Principle of moments). | |
| (f) | What are conditions of equilibrium for a co-planar non-concurrent force system? | |
| (g) | A rectangular block of 10 kg rests on a horizontal plane. The coefficient of static and kinetic friction are 0.4 and 0.3 respectively. Calculate limiting value of frictional force at the point of impending motion. | |
| (h) | State Parallel Axis Theorem in calculating moment of inertia. | |
| (i) | State Mechanical Advantage and Velocity Ratio of a simple machine. | |
| (j) | A screw jack has a thread of 10 mm pitch, length of handle is 400mm. Calculate effort applied P to lift a load of 2kN if efficiency of screw jack is 45%. | |
| 2. | Answer any SIX Questions: | 5×6 |
| (a) | Two forces are applied at point B of beam AB as shown in the Figure 1. Determine the magnitude and direction of their resultant force using the Parallelogram law. | |
| (b) | Two forces are applied at point B of beam AB as shown in the Figure 1. Determine the magnitude and direction of their resultant force using the Triangle law of forces. | |

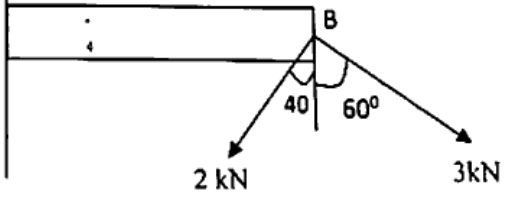


Figure 1

| | | |
|---|---|---|
| (c) | At a point, the following forces act: 20kN North East, 25kN North, 30kN North-West, 35kN South-West. Determine magnitude and direction of resultant force. | |
| (d) | Two like parallel forces of 50 N and 200N acts at the ends of a rod 260mm long. Find magnitude of the resultant force and the point where it acts. | |
| (e) | A hollow circular section has an external diameter 80mm and internal diameter 60mm. Find it's moment of inertia about an axis passing through its centroid and polar moment of inertia. | |

| | | |
|---|---|---|
| (f) | In an lifting machine it is observed that a 120N effort raises a load of 1296N and 200N force is required for a load of 2600N. Determine:<br>(i) Law of machine<br>(ii) Effort required to raise a load of 3.5kN. | |
| (g) | A truck of mass 15tonne travelling at a speed of 1.6m/sec impacts with a buffer spring, which gets compressed 1.25mm/kN. Applying the concept of conservation of energy, calculate maximum compression of spring. | |
| 3 | Two cylinders of diameter 60mm and 30mm weighing 160N and 40N respectively are placed between two vertical walls as shown in the Figure 2. All the contact surfaces are smooth. Find reactions at 'A', 'B' & 'C'. | 10 |
| 4 | A semicircular area is removed from a trapezoidal lamina as shown in the Figure 3. Determine co-ordinate of centroid of the remaining area. | |
| 5 | A block of weight 1600 N is in contact with a plane inclined at $30^0$ to the horizontal. A force 'P' parallel to the plane and acting up the plane is applied to body. Coefficient of friction between contact surfaces is 0.2 Find<br>(i) Magnitude of 'P' just impend the block up along plane<br>(ii) 'P' required to prevent the block slide down the plane | |
| 6 | Motion of a particle moving along a straight line is expressed as $x = t^3 - 4.5t^2 + 5$ where "x" is expressed in meter and "t" in second. Plot the following for a time period of 0 sec to 5 sec in an interval of 1 sec:<br>(i) Displacement-time curve<br>(ii) Velocity-time curve<br>(iii) Acceleration-time curve | |
| 7 | Write short note on any TWO:<br>(i) Coefficient of Restitution<br>(ii) Worm & Worm Wheel<br>(iii) Couple with example and neat sketch | |

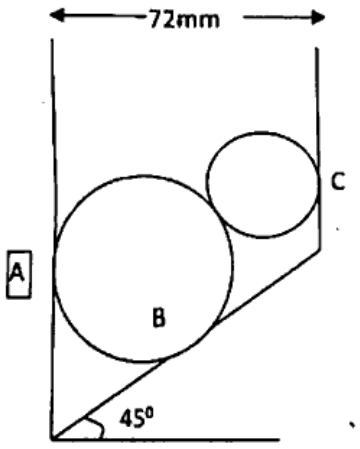


Figure 2

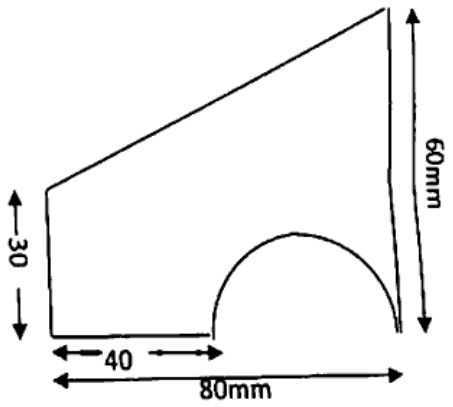


Figure 3