



# INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Mid-Spring Semester 2018-19

Date of Examination : 25/02/2019

Session (FN/AN): FN

Duration: 2 hrs

Full Marks: 60

Subject No. : ME10001

Subject : Mechanics

Department/Center/School : All 1<sup>st</sup> Year UG

**Special Instructions:** Attempt all six questions. Marks are indicated against the corresponding question. **Answer all the parts of one question at one place only.** Assume any data, if required, after clearly stating the reason and the value(s).

**Question 1:** (a) For what value of  $F$  the simplest resultant of the given coplanar force system (Figure 1) will pass through point C? (b) Find the magnitude and the direction of the resultant force? (c) If the direction of the force along AE is reversed but the value of  $F$  unaltered, then find the point where the simplest resultant will intersect the  $x$ -axis. **(4+2+4)**

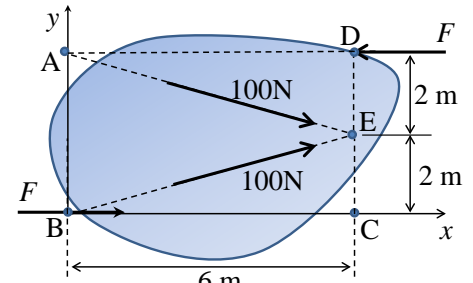


Figure 1

**Question 2:** A frame made of weight-less members shown in Figure 2 is held in equilibrium with the help of a couple of moment  $M$ . (a) Draw the free body diagrams (FBD) of members AD and BE. (b) Identify two-force member, if any. (c) Determine the value of  $M$ . (d) Calculate the magnitude and direction of the pin reaction on BE at B. **(4+1+3+2)**

**Question 3:** Determine the forces and their nature (T or C) carried by members AB, BC and BF of the truss shown in Figure 3. **(3×3)**

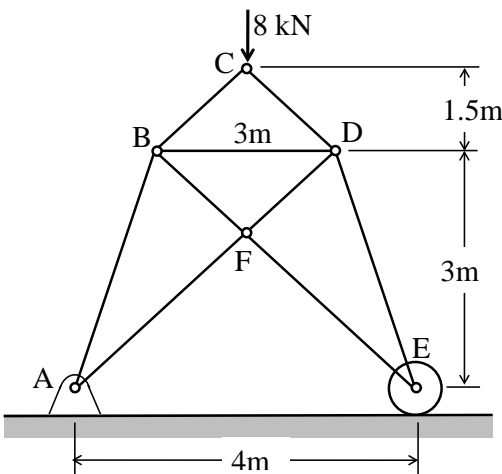
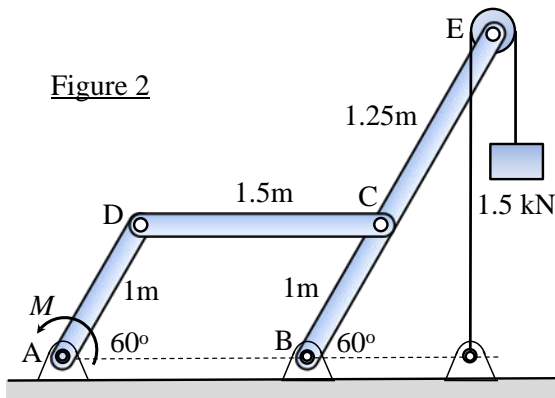


Figure 3

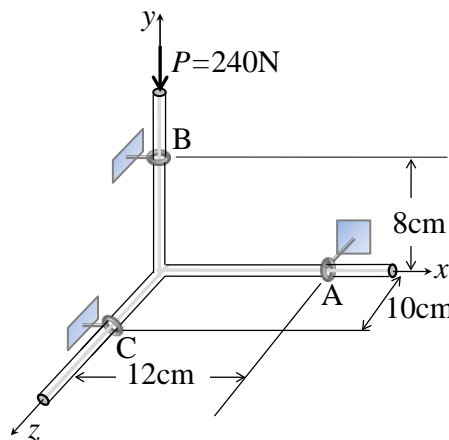


Figure 4

**Question 4:** Three rods are welded together to form a corner that is supported by three eyebolts (rings) as shown in Figure 4. Neglecting friction and assuming that the eyebolts can only prevent motion perpendicular to the axis of the rod (but not rotation), determine the reactions at A, B and C for a given load of  $P = 240$  N. **(3×3)**

**Question 5:** The 50-kg spool rolls on its hub (radius 75 mm) up the circular incline under the action of 12-kg weight attached to the cord around its rim (radius 200 mm). The spool comes to rest at an angle  $\theta$  as shown in Figure 5. (a) Draw the FBD of the spool at this angle. (b) Find the value of  $\theta$ . (c) Determine the minimum coefficient of static friction required for the spool to be at rest in that position. **(4+4+3)**

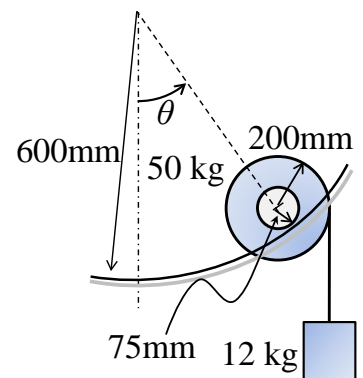


Figure 5

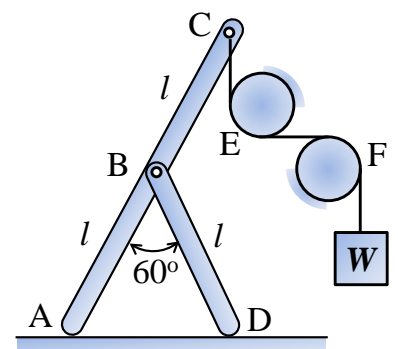


Figure 6

**Question 6:** Consider the loaded stand shown in Figure 6. The weight of link BD is  $w$  and that of link AC is  $2w$ . The pulleys at E and F are fixed (cannot rotate). The coefficient of static friction between the ground and links is 0.7 (at points A and D) and that between the pulleys and the rope (at E and F) is 0.2. (a) Draw FBD of links AC and BD. (b) Find the minimum weight  $W$  (in terms of  $w$ ) required to *disturb the equilibrium*. (c) State at all the places where there will be slip between the contacting bodies on impending motion. **(4+5+2)**