PES University, Bengaluru

(Established under Karnataka Act No. 16 of 2013)

UE20CV101

APRIL 2021: END SEMESTER ASSESSMENT B Tech 1 SEMESTER

UE20CV101 – ENGINEERING MECHANICS

Time: 3 Hours	Answer All Questions	Max Marks: 100

1	a)	State and Prove the Varignon's theorem.	**05**
	b)	The mechanism shown is used to lower disabled persons into a whirlpool tub for therapeutic treatment. In the unloaded configuration, the weight of the boom and hanging chair induces a compressive force of 575 N in hydraulic cylinder AB. (Compressive means that the force which cylinder AB exerts on point B is directed from A toward B.) If θ = 30°, determine the moment of this cylinder force acting on pin B about (a) point O and (b) point C as shown in figure 1. b	**07**
	c)	Replace the three forces which act on the bent bar by a force-couple system at the support point A. Then determine the x-intercept of the line of action of the stand-alone resultant force R as shown in figure 1.c	**08**

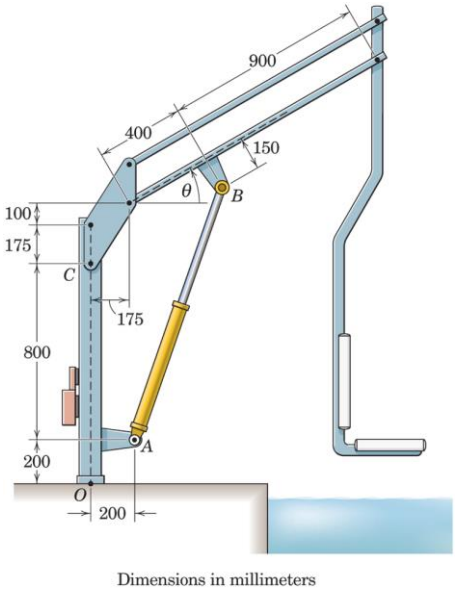

Figure 1. b

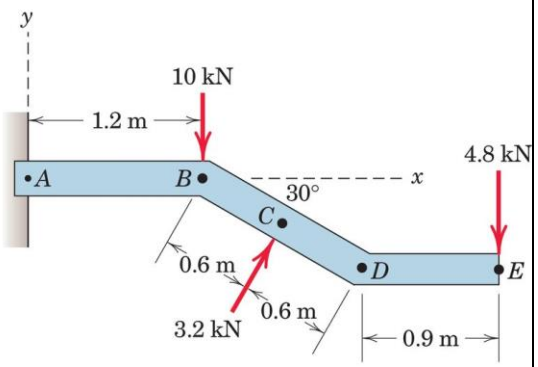

Figure 1. c

2	a)	What do you understand by the terms 'Roller Support', 'Hinge Support', and 'Fixed Support?	**05**
	b)	The 80-kg exerciser is beginning to execute some slow, steady bicep curls. As the tension T = 65 N is developed against an exercise machine (not shown), determine the normal reaction forces at the feet A and B.Friction is sufficient to prevent slipping, and the exerciser maintains the position shown with center of mass at G as shown in figure 2.b	**07**
	c)	A person is performing slow arm curls with a 10-kg weight as indicated in the figure. The brachialis muscle group (consisting of the biceps and brachialis muscles) is the major factor in this exercise. Determine the magnitude F of the brachialis-muscle group force and the magnitude E of the elbow joint reaction at point E for the forearm position shown in the figure 2.c.Take the dimensions shown to locate the effective points of application of the two muscle groups; these points are 200 mm directly above E and 50 mm directly to the right of E. Include the effect of the 1.5-kg forearm mass with mass center at point G.	**08**

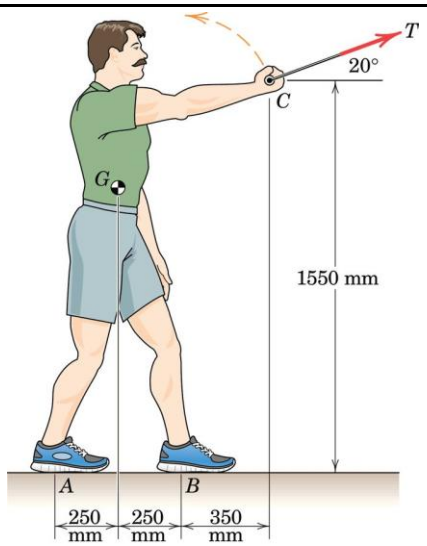

Figure 2. b

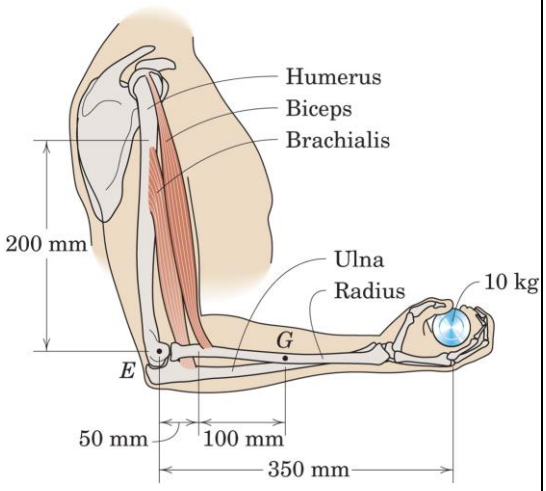

Figure 2. c

3	a)	What are the different types of beams? Explain with sketches.	**05**
	b)	Determine the reactions at A and C for the beam subjected to the combination of point and distributed loads as shown in figure 3.b	**07**
	c)	Determine the force in each member of the loaded truss as shown in figure 3.c	**08**

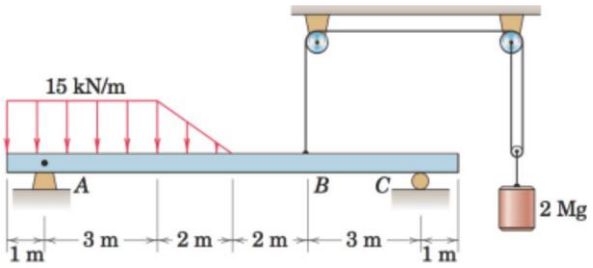

Figure 3. b

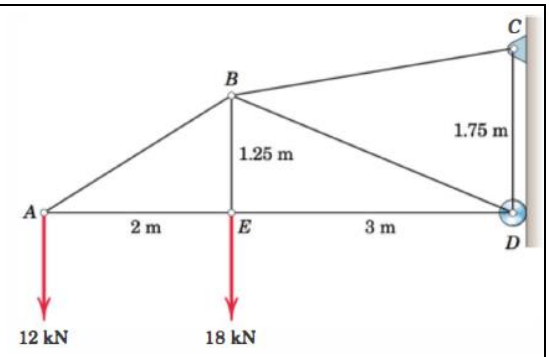

Figure 3. c

4	a)	Determine the moment of inertia of a circle about its centroidal x, y and polar z axis	**05**
	b)	Determine the y-coordinate of the centroid of the shaded area. The triangle is equilateral as shown in figure 4. b	**07**
	c)	Determine the moments of inertia of the Z-section about its centroidal x_o - and y_o – axes as shown in figure 4. c	**08**

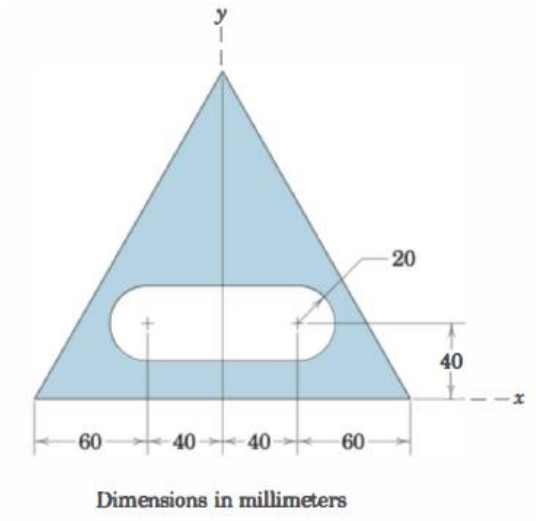

Figure 4. b

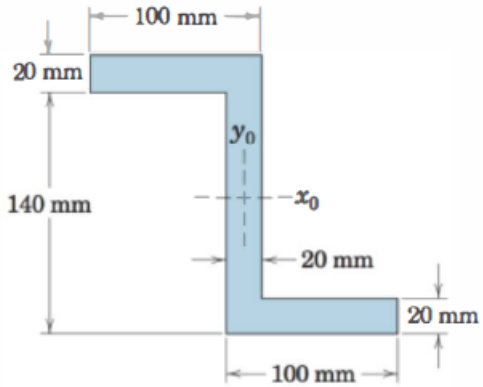

Figure 4. c

5	a)	With the help of sketches explain the theory of dry friction.	**05**
	b)	The 30-kg homogeneous cylinder of 400-mm diameter rests against the vertical and inclined surfaces as shown in figure 5.b. If the coefficient of static friction between the cylinder and the surfaces is 0.30, calculate the applied clockwise couple M which would cause the cylinder to slip.	**07**
	c)	The coefficient of static friction for both wedge surfaces is 0.40 and that between the 27-kg concrete block and the 20° incline is 0.70. Determine the minimum value of the force P required to begin moving the block up the incline as shown in figure 5.c. Neglect the weight of the wedge.	**08**

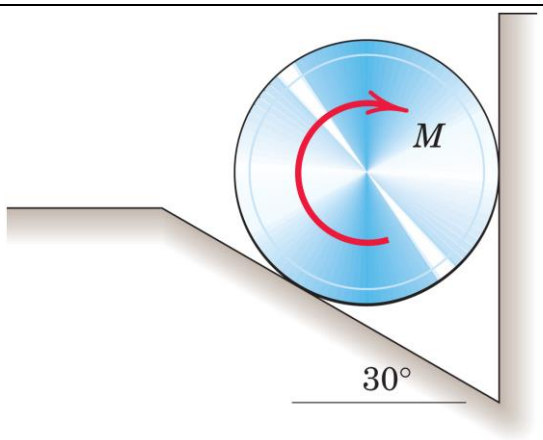

Figure 5. b

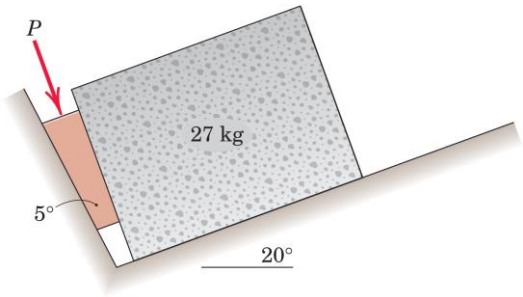

Figure 5. c