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PES UNIVERSITY

PES University, Bangalore

(Established under Karnataka Act 16 of 2013)

UE14CV101

END SEMESTER ASSESSMENT (ESA) B.Tech I SEMESTER- DECEMBER 2014

UE14CV101- ENGINEERING MECHANICS STATICS

Time: 3Hrs | Answer All Questions | Max Marks: 100

1.	a)	State and prove the Varignon's theorem as applied to a concurrent force system.	4
	b)	The two structural members, one of which is in tension and the other in compression, exert indicated forces on the joint O as shown in Figure 1(b). Determine the magnitude of the resultant **R**of the two forces and the angle θ which **R**makes with the positive x-axis.	5
	c)	The 120-N force is applied as shown in Figure 1 (c) to one end of the curved wrench. If α = 30°, calculate the moment of F about the center O of the bolt. Determine the value of α which would maximize the moment about O, state the value of this maximum moment.	7

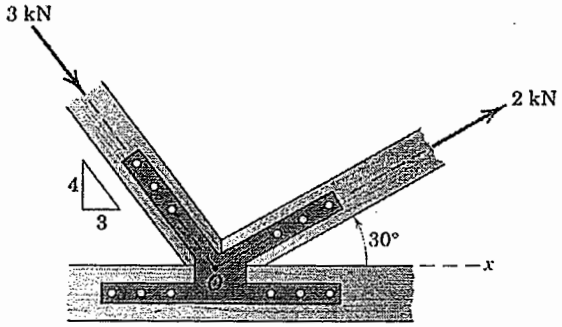

Figure 1(b)

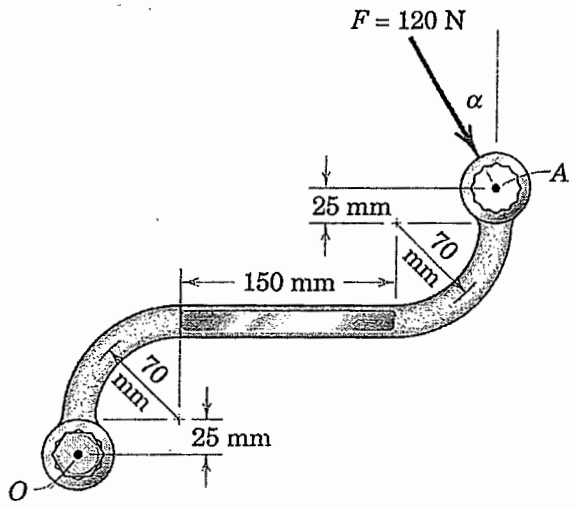

Figure 1(c)

2.	a)	Define the term "Couple" and state its characteristics.	4
	b)	The 30-N force is applied by the control rod on the sector as shown in Figure 2(b). Determine the equivalent force couple system at O.	5
	c)	A rear wheel drive car is stuck in the snow between other parked cars as shown in Figure 2(c). In an attempt to free the car, three students exert forces at points A, B and C while the driver's action results in a forward thrust of 200 N acting parallel to the plane of rotation of each rear wheel. Treating the problem as two dimensional, determine the equivalent force coupe system at the car center of mass G and locate the position x of the point on the car center line through with the resultant passes. Neglect all forces not shown.	7

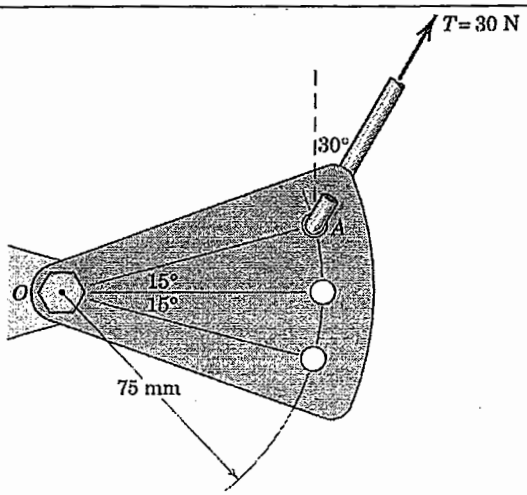

Figure 2(b)

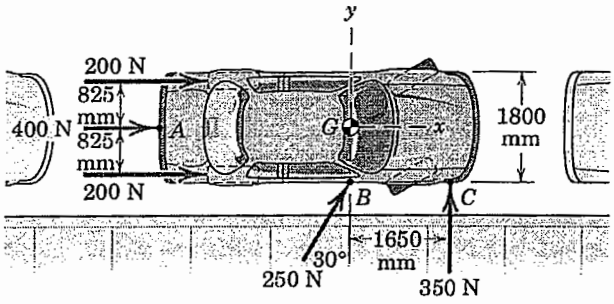

Figure 2(c)

3.	a)	State and explain the conditions of equilibrium required for a system of coplanar concurrent forces with a neat sketch.	4
	b)	The force P on the handle of the positioning lever produces a vertical compression of 300 N in the coiled spring in the position shown in Figure 3(b). Determine the corresponding force exerted by the pin at O on the lever.	6
	c)	The uniform bar OC of length L pivots freely about a horizontal axis through O. If the spring of modulus k is unstretched when C is coincident with A, determine the tension T required to hold the bar in the 45° position shown in Figure 3(c). The diameter of the small pulley at D is negligible.	7

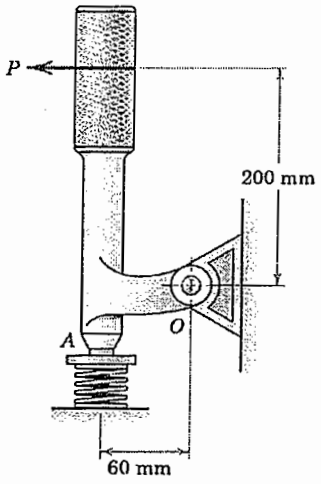

Figure 3(b)

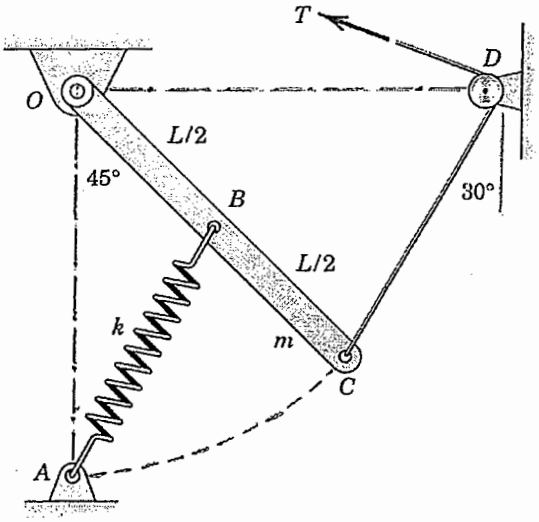

Figure 3(c)

4.	a)	Determine the Centroid for an "area of a circular sector" shown in Figure 4 (a). Use direct integration method.	4
	b)	Locate the centroid of the shaded area shown in Figure 4(b). Use direct integration method.	6
	c)	A drawing bridge is being raised by a cable EI as shown in Figure 4(c). The four joint loadings shown result from the weight of the roadway. Determine the forces in members EF, DE, DF, CD and FG.	7

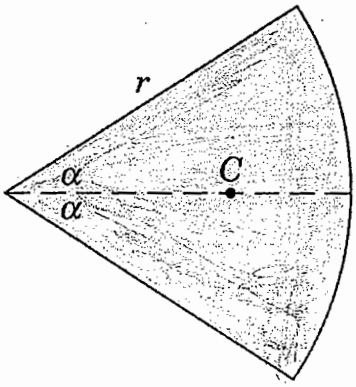

Figure 4(a)

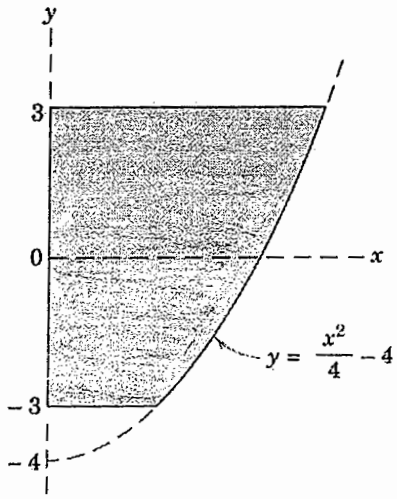

Figure 4(b)

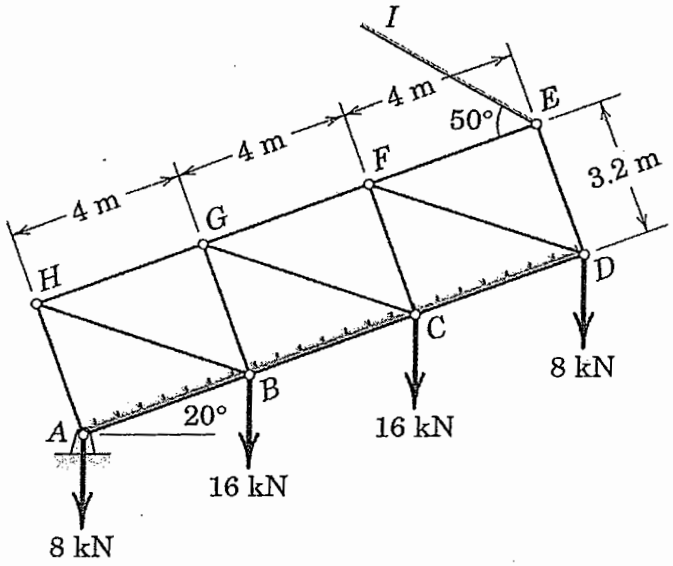

Figure 4 (c)

5.	a)	Explain the different types of loadings on a beam	4
	b)	The cross sectional area of an I beam has the dimensions shown in Figure 5(b). I section is symmetrical about x and y axes. Determine the moment of inertia of this I section about the centroidal x axis. Use composite area method to solve the problem.	6
	c)	A beam is subjected to the variable loading shown in Figure 5 (c). Calculate the support reactions at A and B. Please note that x is measured from the end A.	7

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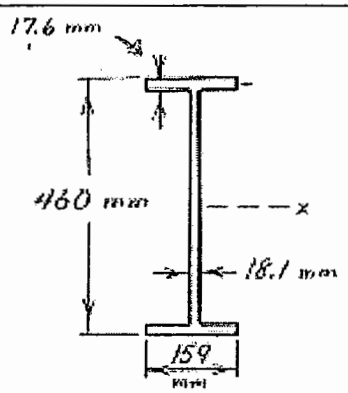

Figure 5(b)

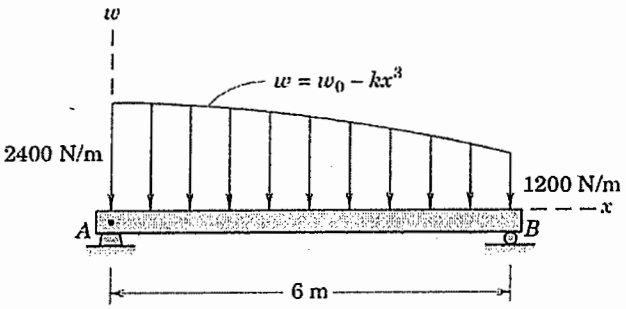

Figure 5 (c)

6.	a)	Derive an expression for Belt Friction.	4
	b)	Determine the distance s to which the 90 kg painter can climb without causing the 4-m ladder to slip at its lower end A shown in Figure 6(b). The top of the 15 kg ladder has a small roller and at the ground the coefficient of static friction is 0.25. The mass center of the plumber is directly above her feet.	6
	c)	Determine the range of cylinder mass m for which the system shown in Figure 6(c) is in equilibrium. The coefficient of friction between the 50 Kg block and the incline is 0.20. The coefficient of friction between the cord and cylindrical support surface is 0.30.	7

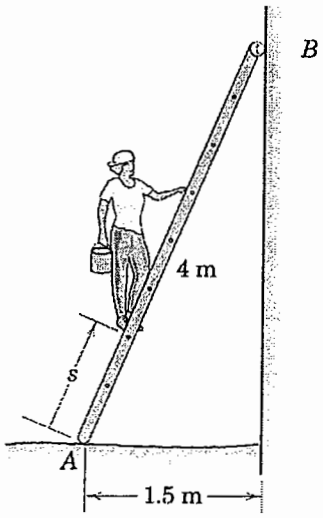

Figure 6(b)

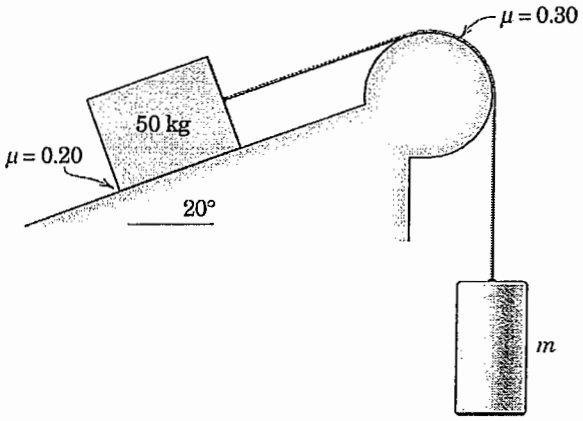

Figure 6(c)