PES UNIVERSITY	**PES University, Bangalore** (Established under Karnataka Act 16 of 2013)	Original UE18CV101

END SEMESTER ASSESSMENT (ESA) B. Tech., I SEMESTER – DEC' 2018

UE18CV101 – Engineering Mechanics

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

1.a.	**Explain the terms a) Free Vector b) Sliding Vector c) Fixed Vector**	6
1.b.	The lower lumbar region A of the spine is the part of the spinal column most susceptible to abuse while resisting excessive bending caused by the moment about A of a force F as shown in figure 1.b. For given values of F, b, and h, determine the angle Θ which causes the most severe bending strain.	4
1.c.	The 30-N force is applied by the control rod on the sector as shown in figure 1.c. Determine the force couple system at o.	5
1.d.	Under no uniform and slippery road conditions, the four forces as shown in figure 1.d are exerted on the four drive wheels of the all-wheel-drive vehicle. Determine the moment at G and the magnitude only of the resultant of this system.	5

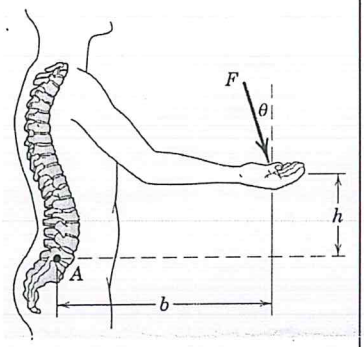

figure 1.b.

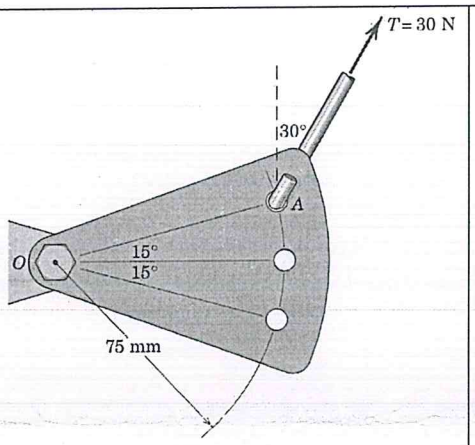

figure 1.c.

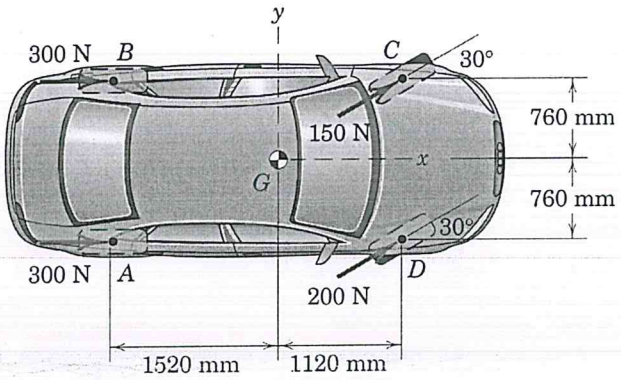

figure 1.d.

2.a.	State and explain the conditions of equilibrium required for a system of coplanar, non- concurrent forces.	5
2.b.	The pin A, which connects the 200-kg steel beam with center of gravity at G to the vertical column, is welded both to the beam and to the column. To test the weld, the 80-kg man loads the beam by exerting a 300-N force on the rope which passes through a hole in the beam as shown in figure 2.b. Calculate the torque (couple) M supported by the pin.	8
2.c.	A portion of the shifter mechanism for a manual car transmission is shown in the figure 2.c. For the 8-N force exerted on the shift knob, determine the corresponding force P exerted by the shift link BC on the transmission (not shown). Neglect friction in the ball-and-socket joint at O, in the joint at B, and in the slip tube near support D. Note that a soft rubber bushing at D allows the slip tube to self-align with link BC.	7

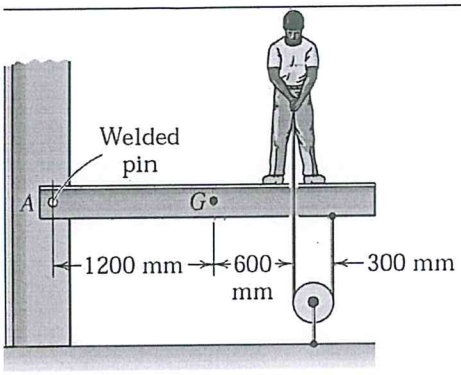

Figure 2.b.

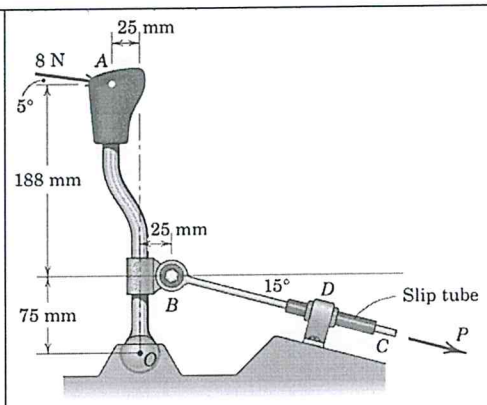

Figure 2.c

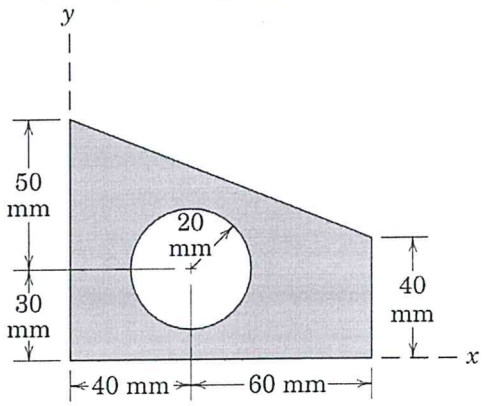

Figure 3.b.

3.a.	Explain with neat sketch Radius of Gyration.	5
3.b.	Determine the x- and y- coordinates of the centroid of the shaded area as shown in figure 3.b.	7
3.c.	In two different ways show that the moments of inertia of the square area of side a about the x- and x'-axes are the same.	8

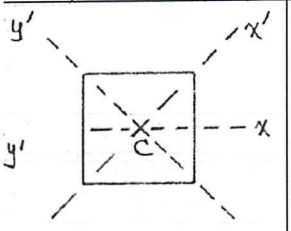

Figure 3.c.

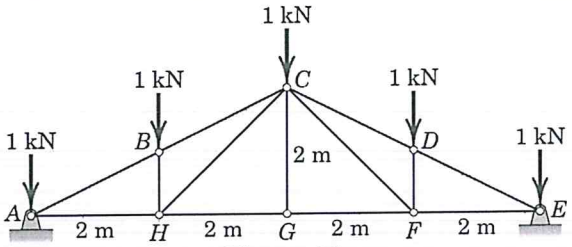

Figure 4.b.

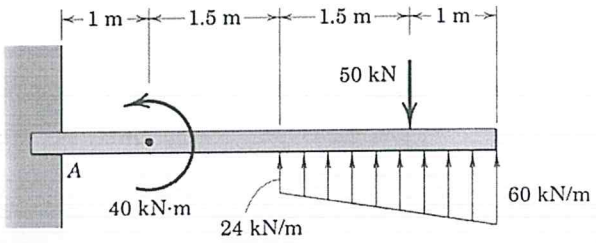

Figure 4.c.

4.a.	Explain any three different types of loadings on a beam.	6
4.b.	A snow load transfers the forces shown in figure 4.b. to the upper joints of a pratt roof truss. Neglect any horizontal reactions at the supports and slove for the forces in all the members.	7
4.c.	Determine the force and moment reactions at A for the beam which is subjected to the load combination shown in figure 4.c.	7
5.a.	Explain the theory of Dry (Coulomb) friction, with the help of sketches.	5
5.b.	Determine the range of mass m for which the 100-kg block is in equilibrium as shown in figure 5.b. All wheels and pulleys have negligible friction.	8
5.c.	A garden hose with a mass of 1.2 kg/m is in full contact with the ground from B to C as shown in figure 5.c. What is the horizontal component Px of the force which the gardener must exert in order to pull the hose around the small cylindrical guard at B? The coefficient of friction between the hose and the ground is 0.50, and that between the hose and the cylinder is 0.40. Assume that the hose does not touch the ground between A and B.	7

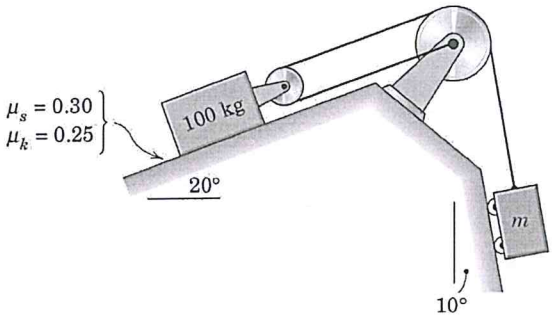

Figure 5.b.

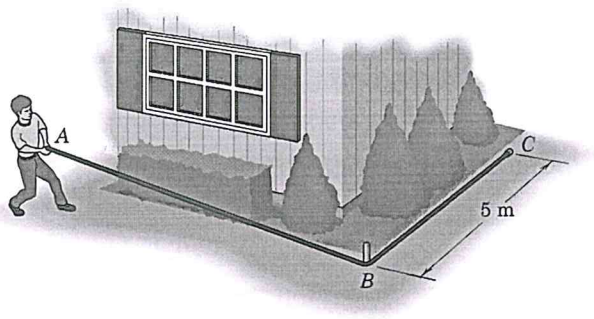

Figure 5.c.