Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

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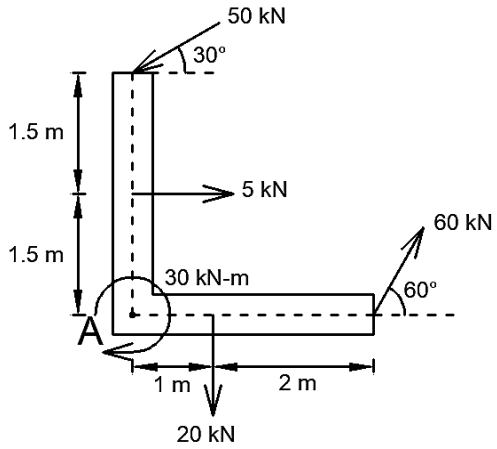
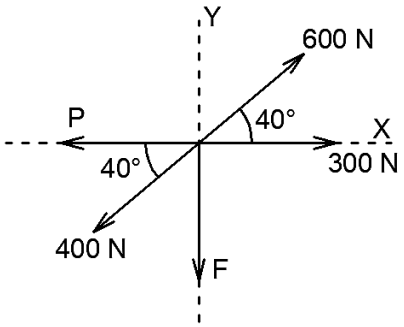
I SEMESTER B.TECH. (ALL BRANCHES)
END SEMESTER EXAMINATIONS, NOV/DEC 2019
SUBJECT: MECHANICS OF SOLIDS [CIE 1051]
REVISED CREDIT SYSTEM
(20/11/2019)

Time: 3 Hours MAX. MARKS:

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

Q. No		M	CO
1A.	Locate the resultant of coplanar non-concurrent force system shown in figure with respect to 'A'. 	**4**	**1**
1B.	The figure shows the concurrent force system acting at a joint of a bridge truss. Determine the values of P and F required to maintain equilibrium of forces. 	**2**	**2**
1C.	A ladder 5m long and 250 N weight is placed against a vertical wall in a position where its inclination to the vertical is 30^0. A man weighing 800 N climbs the ladder. At what position will he induce slipping? Given μ for all contact surface is 0.2.	**4**	**2**
2A.	In a semi-circular lamina a rectangular cut is made as shown in the figure. Determine the dimension 'b' of the rectangle, such that centroid of lamina is at a height of 15 mm from the base.	**3**	**3**

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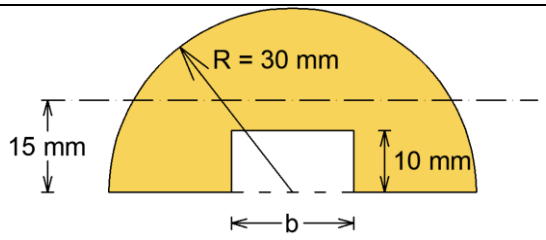
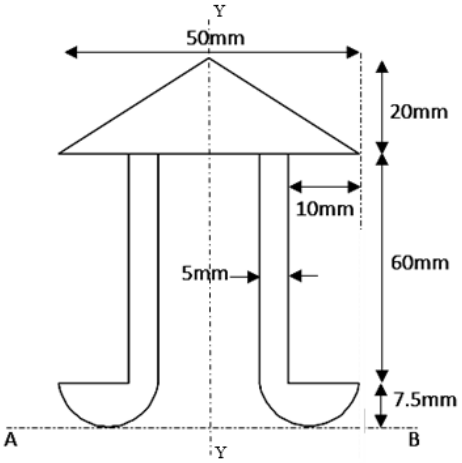
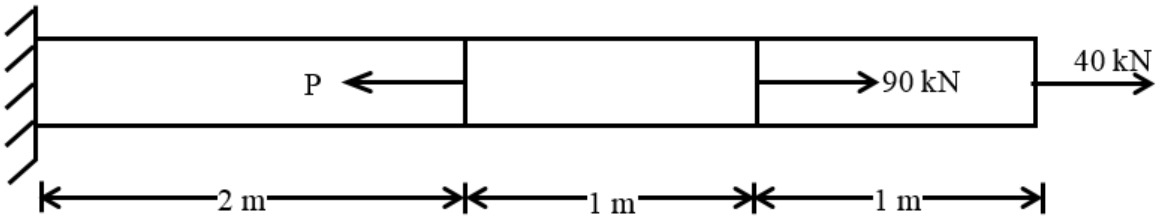
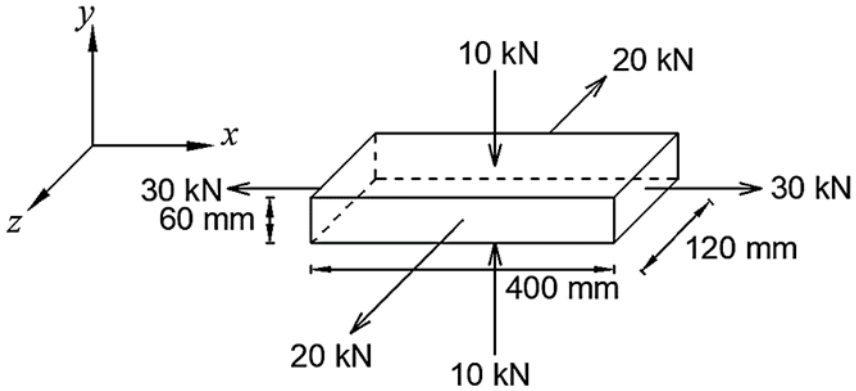
			
2B.	Determine the second moment of area for the figure shown below w.r.t given axis AB. 	**5**	**3**
2C.	State any four laws of dry friction.	**2**	**2**
3A.	Determine the magnitude of the load P necessary to produce zero net change in the length of the bar shown in the figure below. Take A=400 mm^2. 	**4**	**4**
3B.	A steel bar of 400 mm x 120 mm x 60 mm is subjected to forces as shown in the figure. Find the change in dimension. Taking E = 200 GPa and μ = 0.25. 	**4**	**4**

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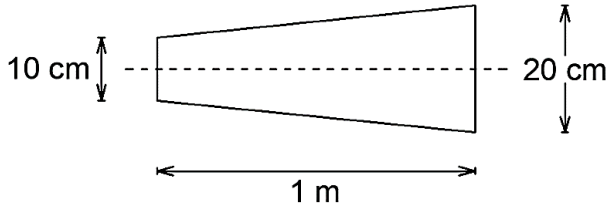
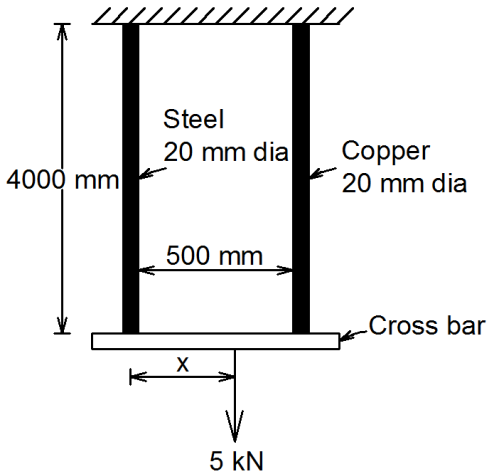
3C.	Distinguish between centroid and centre of gravity.	**2**	**3**
4A.	Show that in a state of simple shear for a square element of unit thickness, the magnitude of shear stress is equal to the magnitude of normal stress along the diagonal.	**3**	**4**
4B.	A cylindrical boiler is 800 mm in diameter and 1 m length. If the permissible tensile stress is 15 N/mm^2, permissible shear stress is 10 N/mm^2 and permissible change in diameter is 0.25 mm, find the pressure to be borne by the cylinder if the thickness of the metal is 10mm. Take E = 90 GPa, and μ = 0.28. Compute the change in length for the pressure determined.	**4**	**4**
4C.	Derive an expression for elongation of a tapered bar of circular cross section subjected to an axial tensile load 'P'. The bar has varying diameter from D_1 to D_2 ($D_1 < D_2$) over length L.	**3**	**4**
5A.	A circular concrete pillar consists of six steel rods of total area 2280 mm^2. Determine the area of concrete required when it has to carry a load of 1000 kN. Take allowable stresses for steel & concrete as 140 MPa & 8 MPa respectively. Take $E_s = 15\ E_c$.	**3**	**5**
5B.	A circular cross-section tapered bar is rigidly fixed between two supports at its ends. If the temperature is raised by 30 °C, calculate the max stress in the bar, if, (i) the supports are perfectly rigid; (ii) each support yields by 0.08 mm. Diameter varies from 10 cm to 20 cm; length is 1 m; E = 200 GN/m^2; $\alpha = 12\times10^{-6}$/ °C. 	**3**	**5**
5C.	Two vertical rods are rigidly fixed as shown in the figure. A cross bar fixed to the rods at the lower end carries a load of 5 kN such that the cross bar remains horizontal even after loading. Determine i) stress in each rod ii) position (X) of the load on the cross bar. Take $E_s = 2 \times 10^5$ N/mm^2 and $E_u = 1 \times 10^5$ N/mm^2. 	**4**	**5**