Name: Enrolment No:	UPES

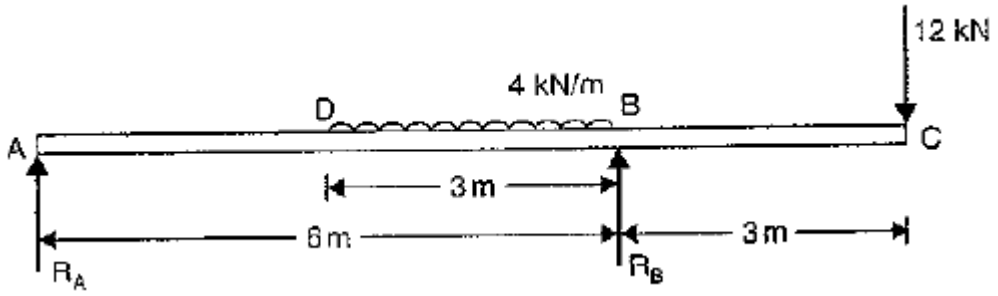
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Programme Name: B.Tech/Mechatronics **Semester : VI**
Course Name : Mechanics of solids **Time : 03 hrs**
Course Code : MECH 5004 **Max. Marks: 100**
Nos. of page(s) : 02
Instructions: Attempt all the questions as directed. Assume suitable data if missing.

SECTION A

S. No.	Statement	Marks	CO
Q 1	Show that the stress induced in case of impact loading is twice that in case of gradual loading.	**5**	**CO1**
Q 2	Derive an expression for strain energy of prismatic bar under its own weight.	**5**	**CO1**
Q 3	Explain the compound bars. Also, discuss the equilibrium and compatibility equations for it.	**5**	**CO2**
Q 4	Derive a relationship between Young's modulus of elasticity (E) and bulk modulus (K).	**5**	**CO2**
SECTION B			
Q 5	A cantilever of 2m length carries a point load of 20 KN at 0.8 m from the fixed end and another point of 5 KN at the free end. In addition, a uniformly distributed load of 15 KN/m is spread over the entire length of the cantilever. Draw the shear force and bending moment.	**10**	**CO2**
Q 6	The maximum allowable shear stress in a hollow shaft of external diameter equal to twice that of internal diameter, is 80 N/mm^2. Determine the diameter of the shaft if it is subjected to a torque of 4×10^6 N-mm and a bending moment of 3×10^6 N-mm.	**10**	**CO3**
Q 7	A cylindrical shell is 3 m long; 1 m in diameter and the thickness of metal is 10 mm. It is subjected to an internal pressure of 150 N/cm^2. Calculate the change in dimensions of the shell and the maximum intensity of shear stress induced. Given E= 200 GPa and Poisson's ratio =0.3.	**10**	**CO3**
Q 8	Starting with the assumption made in theory of simple bending, derive an expression for the following bending equation with usual notations; $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ OR A beam of size 150 mm wide, 250 mm deep carries a uniformly distributed load of w kN/m over entire span of 4 m. A concentrated load 1 kN is acting at a distance of 1.2 m from the left support. If the bending stress at a section 1.8 m from the left support is not to exceed 3.25 N/mm2 find the load w.	**10**	**CO2**

SECTION-C			
Q 9	Calculate the crippling stress, using Euler's formula for a pin-ended 2 m long strut consisting of a tube of 7.5 cm outside diameter and 2.5 cm wall thickness. In compression test, a short length of this tube failed at a load of 315 kN and when tested as a strut with rounded ends, 2 m long, it failed at 174 kN. Find from these data the value of the constant in the Rankine's formula. Take Young's modulus =20 MN/cm^2.	**20**	**CO4**
Q 10	A beam ABC of length 9 m has one support of the left end and other support at a distance of 6 m from the left end. The beam carries a point load of 1 kN at right end and carries a uniformly distributed load of 4 kN/m over a length of 3 m as shown in figure. Determine the slop and deflection at point C.  OR At a point in a bracket, the stress on two mutually perpendicular planes are 80 N/mm^2 (tensile) and 40 N/mm^2 (tensile). The shear stress across the planes is 20 N/mm^2. Find using Mohr stress circle, the magnitude and direction of the resultant stress on plane making an angle of 30^0 with the plane of the first stress. Find also the normal and tangential stresses on this plane. Also, determine the principal stresses and the location of principal planes.	**20**	**CO4**

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Nos. of page(s) : 03
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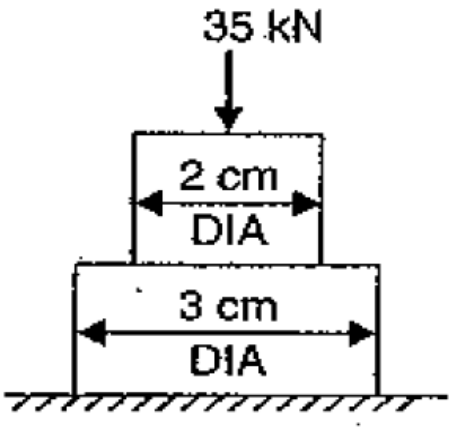
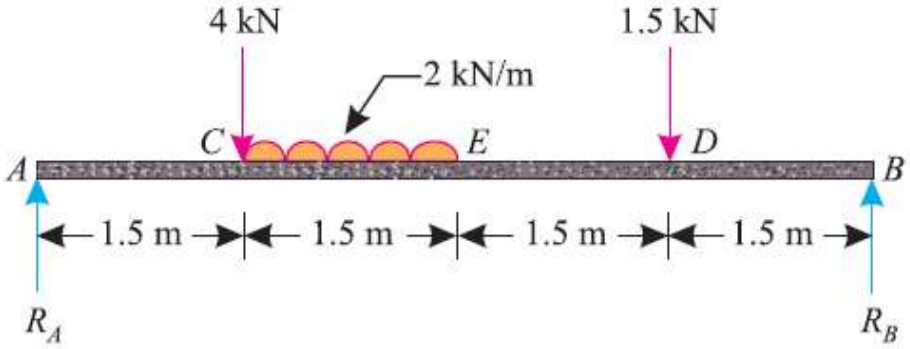
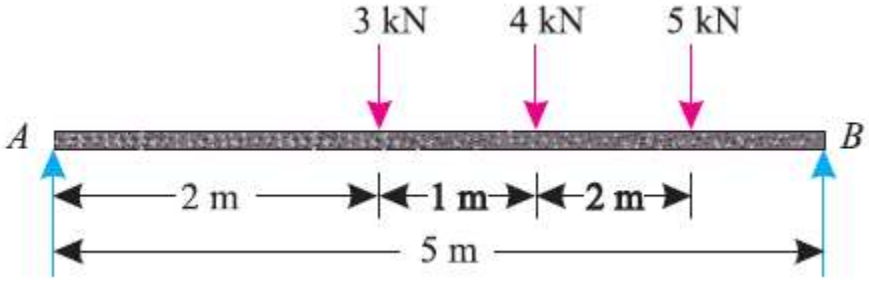
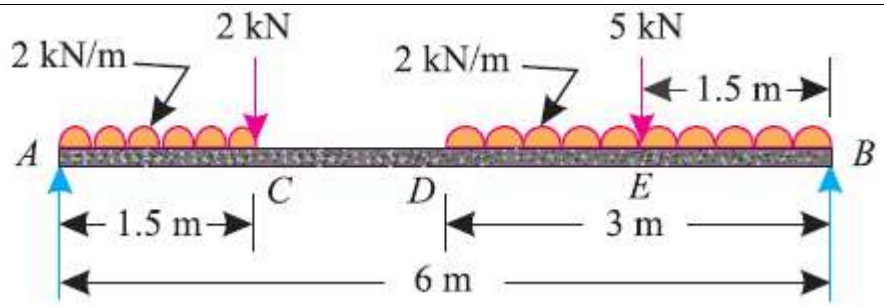
SECTION A

S. No.	Statement	Marks	CO
Q 1	Derive an expression for the stresses induced in case of impact loading.	**5**	**CO1**
Q 2	A stepped bar as shown in figure is subjected to an axially applied load of 35 kN. Find the ratio of maximum and minimum stresses produced. 	**5**	**CO1**
Q 3	Define a composite bar. Also, explain the method of finding the stresses and load carried by each member of a composite bar.	**5**	**CO2**
Q 4	Differentiate between primary shear and secondary shear along with suitable examples.	**5**	**CO2**
SECTION B			
Q 5	Draw the shear force and bending moment for the simply supported beam loaded as shown in figure. Also discuss its' salient features.	**10**	**CO2**

			
Q 6	A solid circular shaft transmits 75 kW power at 200 r.p.m. Calculate the shaft diameter, if the twist in shaft is not to exceed 1 degree in 2 m length of the shaft, and shear stress is limited to 50 N/mm^2. Take G=1x 10^{5}N/mm^2.	**10**	**CO3**
Q 7	A closed cylindrical vessel made of steel plates 6 mm thick with plane ends, carries fluid under pressure of 2.5 N/mm^2 The diameter of the cylinder is 30 cm and length is 70 cm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and Volume of the cylinder. Take E =2.1x10^5 N/mm^2 and poison's ratio = 0.3.	**10**	**CO3**
Q 8	A simply supported beam of a square cross-section of the dimensions 250 mm x 250 mm is loaded as shown in figure. Find the maximum bending stresses developed in the beam.  OR Compare the bending strength of two shafts of same cross-section area, one is circular and other is square in cross-section.	**10**	**CO2**
SECTION-C			
Q 9	A hollow cylindrical cast iron column is 4000 mm long with both the ends fixed. Determine the minimum diameter of the column if it has to carry a safe load of 300 kN with a factor of safety of 4. Take the internal diameter as 0.65 times the external diameter and compressive stress =580 N/mm^2 and α=1/1600.	**20**	**CO4**
Q 10	A beam of length 6 m length is loaded as shown in figure. Determine the slop and deflection at point C and D.	**20**	**CO4**



OR

At a point in a bracket, the stress on two mutually perpendicular planes are 100 N/mm^2 (tensile) and 50 N/mm^2 (tensile). The shear stress across the planes is 30 N/mm^2. Find using Mohr stress circle, the magnitude and direction of the resultant stress on plane making an angle of 20^0 with the plane of the first stress. Find also the normal and tangential stresses on this plane. Also, determine the principal stresses and the location of principal planes.