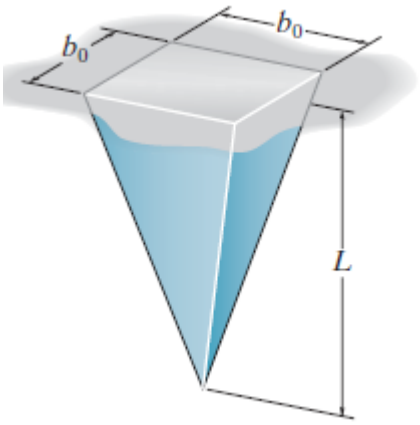
Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course:	**Finite Element Method – CIVL 7014**	**Semester:**	**II**
Program:	**M. Tech Structural Engineering**	**No. of Pages:**	**4**
Time:	**03 hrs.**	**Max. Marks:**	**100**

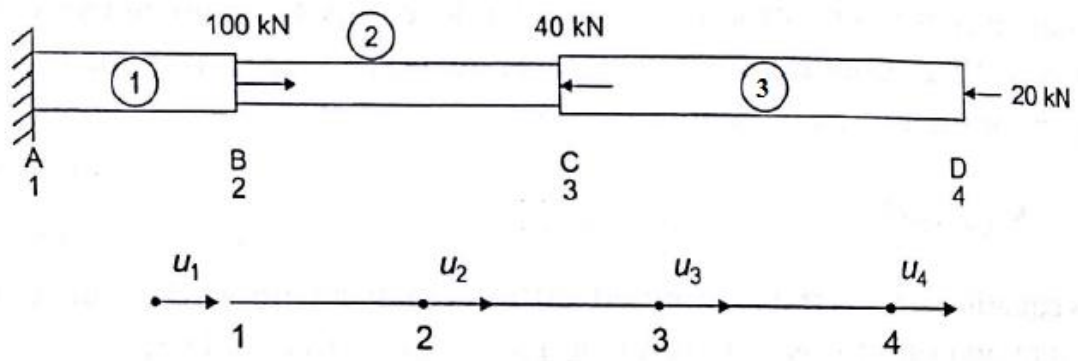
Instructions: **1. Answer all questions of Section A, B & C**
2. Internal choice is given in Section C
3. Useful formulae and tables are given for some questions
(Assume all the necessary data if necessary)

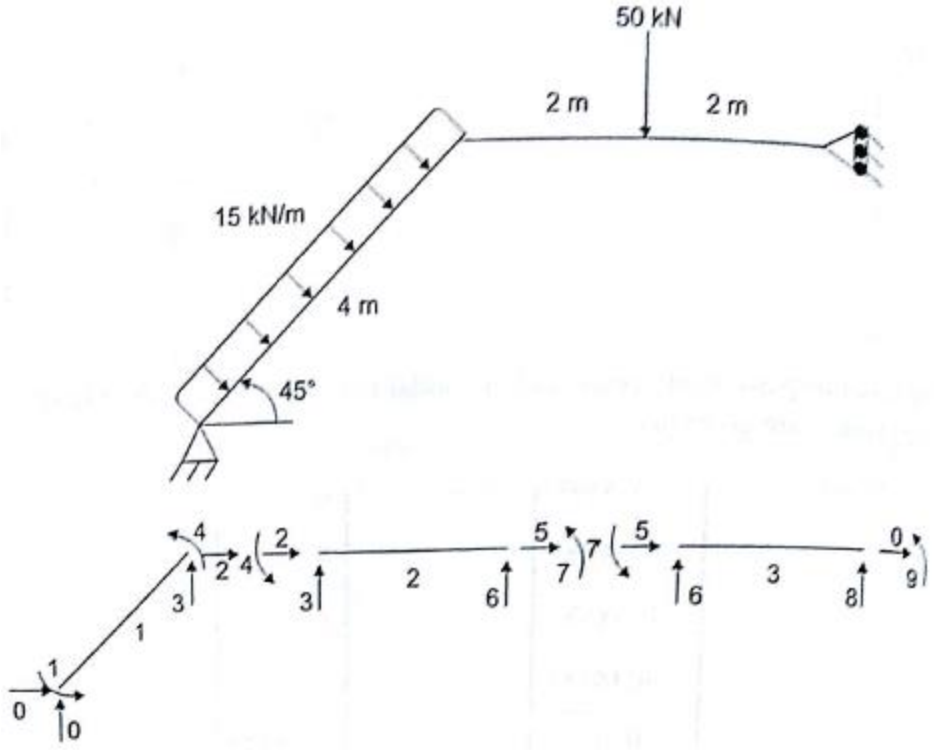
SECTION A

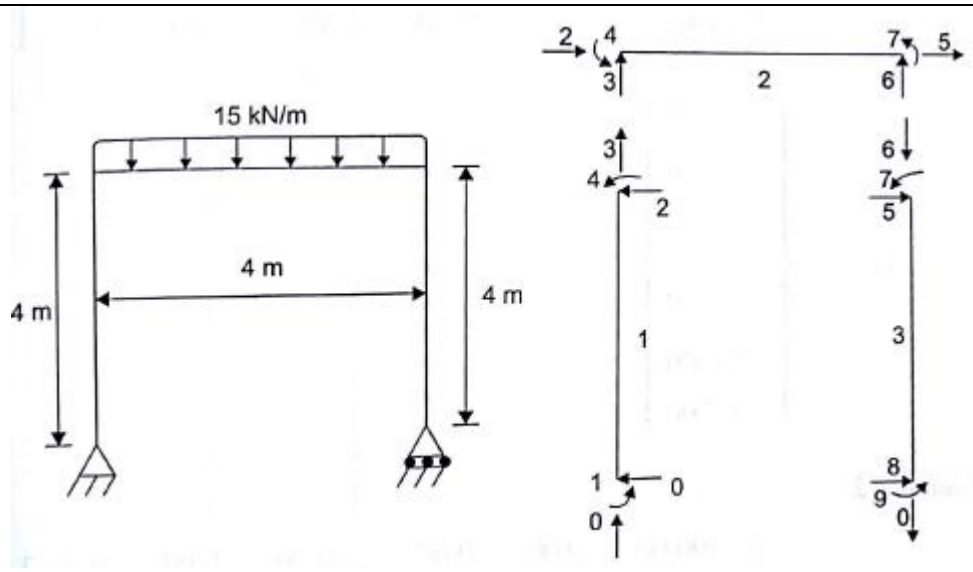
S. No.		Marks	CO
Q 1	What are the weight functions in Least Square method, Collocation method and Galerkin method?	**5**	**CO 2**
Q 2	Write all general Variational identities.	**5**	**CO 2**
Q 3	a. Write potential energy function for the bar with varying cross section is subjected to a concentrated force "P" unit at the free end, axial uniform load "q" unit is applied throughout the length of bar and fixed at the other end having length L. The cross section at fixed end is b_0 X b_0 and linearly going to a point at the free end. The material used in the bar has young's modulus E. b. For the same bar write the boundary conditions and state what type of boundary conditions are these? 	**5 + 5 = 10**	**CO 1, CO 2**

SECTION B

Q 4	Write the differential equation for the bar of uniform section and length L fixed at the left end and free at the other end. It is subjected to varying distributed load along	**4+6+5 =15**	**CO 1, CO 2**

	its length such that the intensity of load is zero at the fixed end and that at the free end is q_0. AE is constant for the bar. Find the identity function by using Rayleigh Ritz Method and verify the same by writing the potential energy function. Find the expression for displacement using second order approximate solution. If the exact solution for the problem is $u(x) = (q_0L^2/6AE)(3(x/L)-(x/L)^3)$, then find the error at at free end.		
Q 5	Write the stiffness matrix for a truss element, beam element and frame element. Also write the force matrix for a frame element subjected to uniformly varying load such that the intensity of load is zero at one end and that at other end is q_0 and length of element is L.	**2+3+3 +2 = 10**	**CO 3**
Q 6	A brass bar of length 3 m is subjected to loads shown in figure. The cross section of bar is a circle. The segment AB is of length 0.5 m and the diameter is 50 mm. The length of segment BC is 1.0 m and diameter is 20 mm. The length of segment CD is 1.5 m and diameter is 30 mm. Given E = 100 GPa compute the stress and strain in the three segments of the bar. 	**15**	**CO 4**
SECTION-C			
Q 7	For a two-node general beam element having two degrees of freedom at each node. Derive the following: 1. Relationship between s and x coordinate system 2. Shape functions and transverse displacement 3. Slope or rotation 4. Bending moment 5. Shear Force	**2+ 6+ 4+ 4+ 4 = 20**	**CO 3, CO 4**

Q 8	A framework comprising of two members is subjected to loads shown in figure. The members have the same area and is equal to 0.06 m^2. The second moment of area is 2 X 10^{-4} m^4 and modulus of elasticity is 200 GPa. The length of the members are equal to 4 m. Determine the assembled stiffness matrix and force matrix for the whole structure.  **OR** A framework comprising of three members is subjected to loads shown in figure. The members have the same area and is equal to 0.06 m^2. The second moment of area is 2 X 10^{-4} m^4 and modulus of elasticity is 200 GPa. The length of the members are equal to 4 m. Determine the assembled stiffness matrix and force matrix for the whole structure.	**20**	**CO 3**


15 kN/m
4 m
4 m
4 m
2
4
7
5
3
2
6
3
4
2
1
1
0
0
6
7
5
3
8
9
0