Code No: **R1641033** **R16** **Set No. 1**

IV B.Tech I Semester Regular/Supplementary Examinations, Jan/Feb - 2022

FINITE ELEMENT METHODS

(Common to Mechanical Engineering and Automobile Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

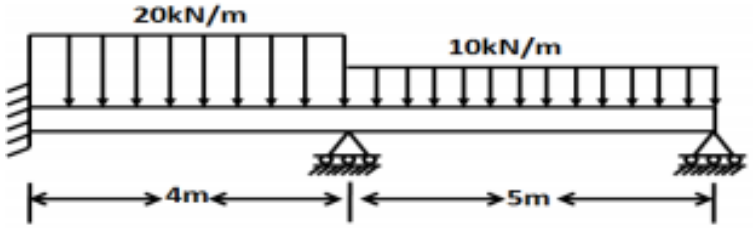
1. a) Write the advantages of finite element methods. [3]
   b) What is band width of a matrix? [2]
   c) Derive an element stress equation for a truss element. [2]
   d) Write the [D] matrix for an axisymmetric body. [3]
   e) What are isoparametric elements? [2]
   f) What is an eigen vector? [2]

PART–B *(4x14 = 56 Marks)*

2. a) Discuss about Galerkin weighted residual method. [5]
   b) Derive an expression for element stiffness matrix for 2- nodded 1-D element using potential energy approach. [9]

3. a) Explain the factors to be considered in selecting interpolation function [5]
   b) Differentiate between the natural and essential boundary conditions. [4]
   c) Discuss about band width and node numbering [5]

4. For the beam shown in Figure, compute slope at the hinged support points. Take E=200GPa, I= 4 X 10^{-6} m^4. Use two beam elements.



[14]

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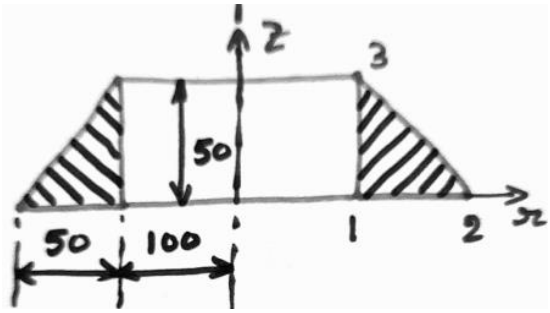
5. a) An axisymmetric ring (triangular element) is shown in the figure. Derive the [B] and [D] matrices. Take E = 20 x 10^4 N/mm^2 and $\upsilon = 0.33$ [10]



b) Derive the shape functions of CST element. [4]

6. a) Determine the shape functions for a quadrilateral isoparametric element. [6]

b) Evaluate the following integral using one point and two point gaussian quadrature formulae and compare the results with exact solution.

$$\int_{-1}^{1} (2x^3 + 5x^2 + 6)\, dx$$ [5]

c) Derive the shape functions of 1D quadratic element. [3]

7. a) Find the temperature distribution in 1D rectangular cross section fin with 8 cm long, 4 cm wide, 1 cm thick. Assume that convective heat loss occurs from the end of the fin. Take K= 3 W/cm-K, h=0.1 W/cm^2-K and T_α= 20ºC. Tip temperature is 100ºC. [8]

b) Derive the consistent mass matrix of 2 node beam element [6]