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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, M.Tech. - Civil Engineering (MCAD)

Semester End Examination; April / May -2021

Computational Structural Mechanics and FEM

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Analyze and find the complexity of the given problem.

CO2: Design efficient algorithm using Divide-and-Conquer Strategy.

CO3: Design and analyze algorithms to optimization problems.

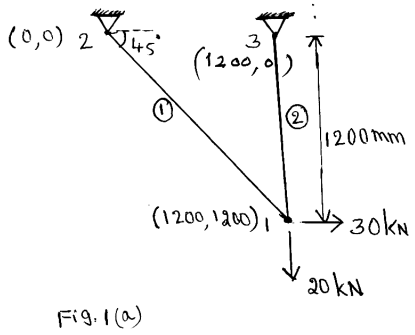
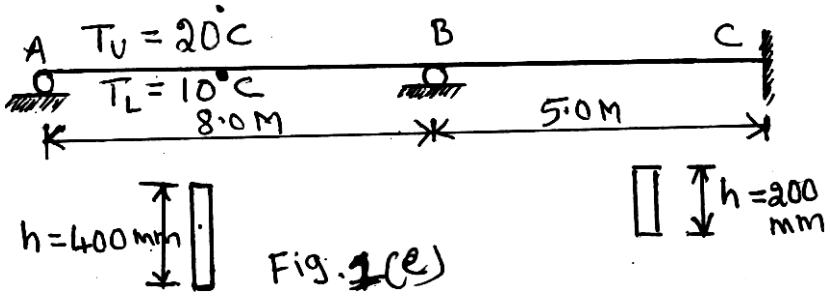
CO4: Compute optimal solution for the problem using approximation algorithms.

CO5: Apply randomized algorithms for the given problem.

***Note**: I) Answer any **FIVE** full questions, selecting **ONE** full question from each unit.*

***II)** Any **THREE** units will have internal choice and remaining **TWO** unit questions are compulsory.*

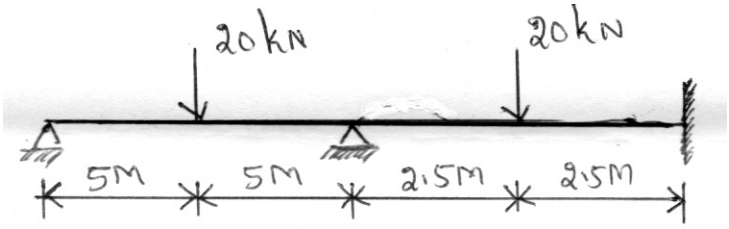
***III)** Each unit carries 20 marks.* ***IV)** Missing data, if any, may suitably be assumed.*

Q. No.	UNIT - I	Marks	BLs	COs	POs
1a.	Analyze the pin jointed truss shown in Fig. 1(a). Using direct stiffness method, determine displacement of joint 1 and forces in members. Take $A = 1000\ mm^2$, $E = 3\times10^5\ N/mm^2$.  Fig. 1(a)	20	L3	CO1	PO2,3
	OR				
1d.	What are the difference between stiffness and flexibility method?	8	L2	CO1	PO1
1e.	The top and bottom surfaces of the continuous beam as shown in Fig.1(e) are heated 20°C and 40°C respectively. Compute the displacement and element stress resultant. Using direct stiffness approach. Take $E = 200\ GPa$, $\alpha = 1.2\times10^{-5}/°C$  Fig. 1(e)	12	L3	CO2	PO2

Contd…2

UNIT - II

2 a. Determine the member forces for the continuous beam shown in Fig. 2(a). Using direct stiffness method. Draw BMD and SFD. Take EI = constant.



20 L3 CO2 PO3

Fig. 2(a)

UNIT - III

3 a. Derive the deflection equation for a simply supported beam subjected to UDL w/unit length using Galerkin's method. Also calculate maximum deflection at the centre and compare the exact value of deflection. 15 L3 CO3 PO2

3 b. Explain the convergence requirements. 5 L2 CO3 PO2

OR

3 d. Discuss briefly the various steps of finite element formation. 12 L2 CO3 PO1

3 e. Explain briefly with example;

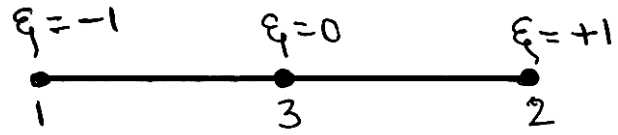
i) Higher order elements and Lower order element

ii) Natural coordinate and Area coordinate

8 L2 CO3 PO1

UNIT - IV

4 a. Derive the shape function [N], strain displacement matrix [B] and element stiffness matrix [k] for a three noded one dimensional bar element with natural coordinate system as shown in Fig. 4(a).

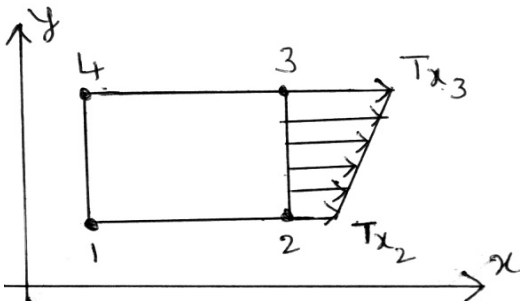


20 L3 CO4 PO2

Fig. 4(a)

OR

4 d. Derive the nodal load vector due to surface traction for the rectangular element as shown in Fig.4(d).



14 L3 CO4 PO2

Contd…3

4 e. Evaluate the shaper function for the CST element as shown in Fig. 4(e) $p(x, y) = p(5,10)$.

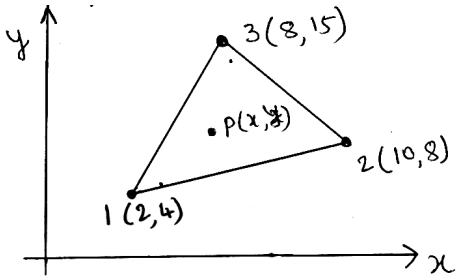


Fig. 4(e)

6 L3 CO4 PO2

UNIT - V

5 a. Derive the shape function for the two noded Euler Bernoulli beam element and plot their shapes. 12 L3 CO4 PO2

5 b. Evaluate the following integral, using Gauss two sampling point formula and verify the exact value. 8 L3 CO4 PO1

$$I = \int_0^1 \frac{1}{(1+x^2)} dx$$

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