Total No. of Questions – [6]   Total No. of Printed Pages: 2

G.R. No.	

~~May/August 2021~~ / INSEM+ENDSEM   MAY 2022
F. Y. M. TECH. (MECHANICAL DESIGN ENGINEERING) (SEMESTER – II)
COURSE NAME: FINITE ELEMENT METHOD
**COURSE CODE: MEPA12201**
(PATTERN 2020)

Time: [3 Hours]   [Max. Marks: 60]

(*) Instructions to candidates:
1) **All Questions are compulsory**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data where ever required**

Q.1) The structure shown in Figure is subjected to an increase in temperature **[10]** of 80 0C. Determine nodal displacement and element stresses.
Bronze: Area= 2400 mm², E= 83GPa, α=18.9 x10⁻⁶ per ºC
AL : Area= 1200 mm², E= 70GPa, α=23 x10⁻⁶ per ºC , P = 60 kN,
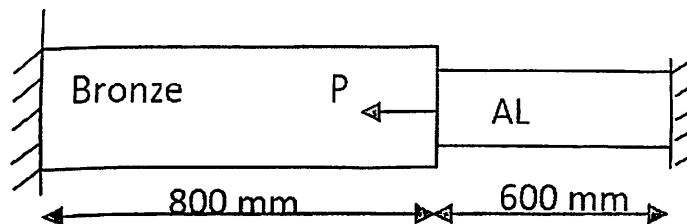
Q.2) a) Illustrate the use of Pascal triangle to determine a shape function for **[4]** 2D elements? Explain with example. Why displacement function should be symmetric about the axis of Pascal triangle?

b) For the triangular element shown, the nodal values of displacement in x **[6]** and y directions respectively are u_1 = 2.0, u_2 = 3.0, u_3 = 5.0 and v_1 = 1.0, v_2 = 2.0, v_3 = 3.0. Find out for plane stress conditions (a) Displacement of point P, (b) Strain-displacement relationship (c) Element stress (d) strains
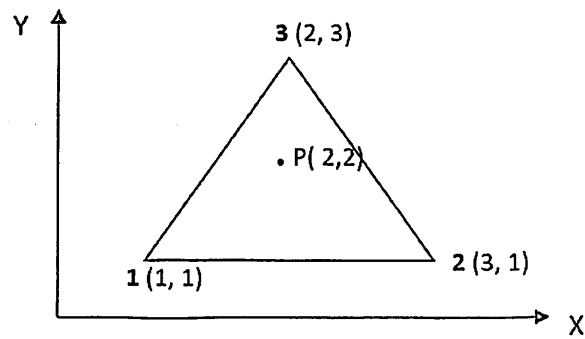
Q.3 a) Obtain shape function for 4 node rectangular element using Lagrange Interpolation formula. Use natural coordinates. **[2]**

b) Evaluate integral using Gaussian Quadrature. **[8]**

$$I = \int_4^6 \int_{-2}^2 (1-x)^2 (4-y)^2 \, dxdy$$

Q.4 a) Find the un-damped natural frequencies of longitudinal vibration of the stepped bar as shown in Figure using lumped mass matrices. Given: Elastic Modulus E = 200 GPa, Area A_1 = 400 mm², A_2 = 200 mm², Density ρ = 800 kg/m³ **[10]**
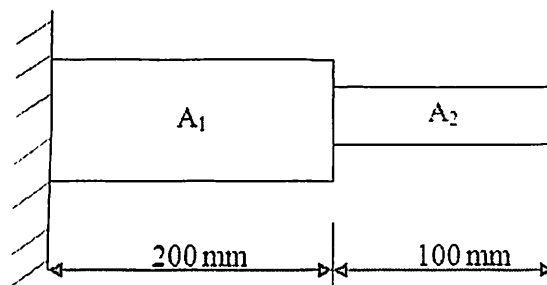
Q.5 a) Illustrate the Material and Geometric Nonlinearity with suitable example **[5]**

b) Elaborate Newton Raphson method and Modified Newton Raphson method to solve non-linear problem using Finite Element Method. **[5]**

Q.6 a) Write finite element approach for any two types of analysis: **[6]**
   i)   Dynamic Analysis
   ii)   Crash Analysis
   iii) Thermal Analysis
   iv)   Buckling Analysis

b) Illustrate patch test **[4]**