Student Exam No._____

Ganpat University
M.Tech SEM II (CAD/CAM) Mechanical Engineering
Regular Examination July 2013
3ME211 Engineering Analysis and Optimization

Time: 3 HOURS **Total Marks: 70**

Instructions:

1) Assume suitable data if necessary.
2) Write your answer to the point.
3) Draw neat and clean sketch/figure.

SECTION I

Q.1 **[12]**

(a) Explain in brief body force vector, traction force vector in 2D truss.

(b) A plane truss as shown in the figure 1 composed of members with square cross section of 10 x 10 mm and young modulus is of 70 GPa.

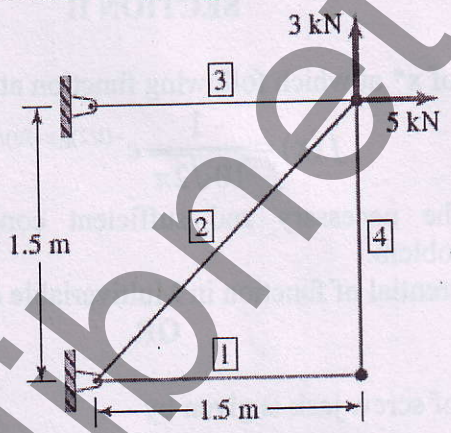


Fig. 1

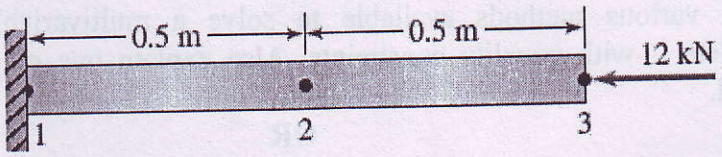
(a) Assemble global stiffness matrices.
(b) Compute nodal displacement.

OR

Q.1 **[12]**

(a) Explain Galerkin's approach to solve engineering problems in FEM.

(b) A steel rod is modeled as two bar elements as shown in Fig. 2. Determine the nodal displacement and axial stress in each of element. What other concern should be examined? If temperature rise of 80 °C is given to rod then what is change of result? Assume suitable coefficient of expansion.



$E = 207$ GPa $A = 500$ mm^2

Fig. 2

Q.2 [11]

(a) What is importance of Jacobian matrix of transformation in CST element?

(b) Derive the shape function of bar element of length L and two nodes.

OR

Q.2 [11]

(a) Derive strain-displacement matrix for CST element.

(b) What is isoparametric representation in FEM? Give correlation between x and y coordinates to ξ and η coordinates in CST element.

Q.3 Attempt **all** questions. [12]

(a) Justify following statement - 'As the number of elements increases in FEM structure more the accurate result we get'

(b) Explain penalty approach for treatment of boundary conditions in FEM.

(c) Write down the properties of global stiffness matrix.

SECTION II

Q.4 [12]

(a) Find the value of x* at which following function attains its maximum :

$$f(x) = \frac{1}{10\sqrt{2\pi}} e^{-(1/2)[(x-50)/10]^2}$$

(b) Write down the necessary and sufficient conditions for multivariable optimization problem.

(c) Explain r^{th} differential of function in Multivariable optimization.

OR

Q.4 [12]

(a) The efficiency of screw jack is given by

$$\eta = \frac{\tan\alpha}{\tan(\alpha+\phi)}$$

Where α lead is angle and ϕ is a constant. Prove that the efficiency of the screw jack will be maximum when $\alpha = 45 - \frac{\phi}{2}$ with $\eta_{max} = \frac{(1-\sin\phi)}{(1+\sin\phi)}$

(b) Explain different types of possible points in design space with figure.

(c) Determine the maximum value of the function $f(x) = x\cos\pi x$ in interval [0, 0.7] up to four iteration using Fibonacci method.

Q.5 [11]

(a) Explain Quasi- Newton method of optimization.

(b) State various methods available to solve a multivariable optimization problem with equality constraints. Also explain one of the methods in detail.

OR

Q.5 [11]

(a) Minimize $f(x) = 0.6 - [0.7/(1+x^2)]$ in interval [0, 3] by the Fibonacci method using n = 4.

(b) The deflection of the beam is inversely proportional to the width and the cube of depth. Find the cross sectional dimensions of a beam, which

corresponds to minimum deflection, that can be cut from a cylindrical log of radius r.

Q.6 Attempt following questions. **[12]**

(a) Write down a short note on Kuhn-Tucker conditions.

(b) Write a short note on Golden Section Method