Registration No :

Total Number of Pages : 02

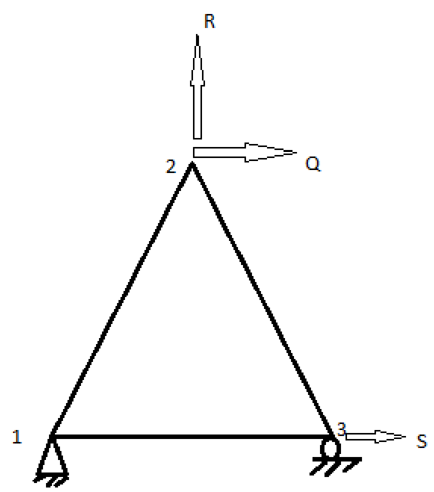
M.Tech.
P2MDCC03

2^{nd} Semester Regular Examination 2017-18
FINITE ELEMENT METHOD
BRANCH : MACHINE DESIGN, MECH. SYSTEM DESIGN, SYSTEM DESIGN
Time : 3 Hours
Max Marks : 100
Q.CODE : C852
Answer Question No.1 which is compulsory and any FOUR from the rest.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Q1 **Answer the following questions :** **(2 x 10)**

- **a)** If the highest derivative of a functional is of the order 'm' , what will be the order of derivative in essential and natural boundary conditions ?
- **b)** What do you mean by variational principle?
- **c)** Prove that stiffness matrix of a bar is positive semi-definite.
- **d)** Express the shape functions of quadratic element in terms of line co-ordinates.
- **e)** Explain finite-element discretization.
- **f)** Define isoparametric element.
- **g)** Write Euler-Lagrange equation for functional of one variable.
- **h)** Write the role of preprocessor and postprocessor in FEM.
- **i)** Draw Pascal's triangle for selection of polynomial in FEM.
- **j)** Compare finite element method and finite difference method.

Q2 **a)** Crossectional area of each side of the truss is $1 cm^2$ and length of each side is 1m, Young's Modulus is $2*10^7 N/cm^2$, Q=150N, R=60N, S=0 N Find out **(15)**
(a) Nodal displacement of nodes where reactions are mentioned
(b) The reaction at the other supports where nodal displacements are zero



b) Find the nodal equivalent loads of a beam of length 'l' having UDL 'P' throughout its entire length. **(5)**

Q3	**a)**	Describe Kirchoff's and Mindlin's plate bending theory with neat sketches. Write the assumptions of each theory. Derive moment-curvature relation for each theory.	**(14)**
	b)	Differentiate between plane stress and plane strain problems. Write stress strain matrix for each one. Give examples for each problem.	**(6)**
Q4	**a)**	Using variational principle find the shape functions and (4x4) stiffness matrix of a 2D Euler beam element.	**(17)**
	b)	Write the combined stiffness matrix of a bar and beam element in 2D. Show the DOFs with neat sketch.	**(3)**
Q5	**a)**	Express the shape shape functions of 8-noded and 9-noded isoparametric elements with neat sketch.	**(10)**
	b)	Solve the following equation using Rayleigh Ritz method. $\int_0^1 \left[\left(\frac{d\varphi}{dx}\right)^2 + \varphi^2\right] dx - 40\varphi_{at\ x=1}$ Such that for domain 0<x<1; At x=0 φ=1; At x=1 $\frac{d\varphi}{dx} = 20$	**(10)**
Q6	**a)**	Explain how the numerical integration is evaluated using one-point formulaand two-point formula.	**(8)**
	b)	A composite wall consists of three materials. The outer temperature is T o = 20°C. Convective heat transfer takes place on the inner surface of the wall with Tα = 800°C and h = 25 w/m 2 °C. Determine he temperature distribution in the wall. Compare with analytical results.	**(12)**
Q7		**Explain :**	**(10 x 2)**
	a)	Galerkin's method	
	b)	Constant strain triangle	