Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II– EXAMINATION – WINTER - 2016

Subject Code: 2724301 **Date: 18/11/ 2016**

Subject Name: Finite Element Method In Geotechnical Engineering

Time: 2:30 pm to 5:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	List various steps involved in the process of Finite Element method and explain the process of selection of displacement function in detail.	**06**
	(b)	Compute nodal displacement of a stepped bar as shown in ***fig.1***. The thickness of bar is 4 mm. Take two noded elements.	**08**
Q.2	**(a)**	Explain the meaning of convergence and discuss various criteria to satisfy the convergence of problem.	**07**
	(b)	For a spring assemblage shown in ***fig.-2***, calculate displacement at nodes and reactions at supports. Take K=100 kN/m	**07**
		OR	
	(b)	Derive & draw the shape function & its variation, for two nodded and three noded bar element using natural coordinate system.	**07**
Q.3	**(a)**	Derive strain displacement matrix of a CST element and justify the name of CST.	**07**
	(b)	For point P located inside the triangle having nodal coordinates of node 1, 2 and 3 are (1,1), (4,2) and (3,5) respectively. The shape functions N1 and N2 are 0.15 and 0.25 respectively. Determine the x- and y-coordinates of point P.	**07**
		OR	
Q.3		Evaluate the stiffness matrix for the triangle element having nodal coordinates of node 1, 2 and 3 are (25, 25), (100, 50) and (75, 125) in mm respectively. Take plane stress condition, E=210 GPa, μ=0.25, and t=10 mm.	**14**
		OR	
Q.4	**(a)**	Derive shape function for the beam element.	**06**
	(b)	Determine the displacement at the centre of the span of a fixed beam subjected to linearly varying load acting over the whole length using finite element menthod.	**08**
		OR	
Q.4		Derive the coefficient K_{33} of the stiffness matrix of a 4 noded isoparametric quadrilateral element whose nodal coordinates are (0,0), (120,50), (90,90) & (0,90) in mm. Take thickness of element is 10 mm. Take 2x2 point Gauss quadrature.	**14**

Q.5 **(a)** Differentiate between Langragian polynomial and Hermition polynomials with proper illustrations. **06**

(b) Determine Jacobian at centroid of a 4 noded quadrilateral isoparametric element having nodal quardinates (0,0), (100,50), (80,80) & (0,80) in mm and by numerical integration, determine the area of element using 2x2 point Gauss quadrature. **08**

OR

Q.5 For a Coarse gravelly medium of 60 cm thick having fluid head at top is 20 cm & at bottom is 2 cm. Assume cross sectional area 6.25 cm^2. Take Permeability Coefficient 1 cm/sec. **14**

Use two noded – three elements. Determine

(i) The fluid head distribution along the length

(ii) The velocity in each element

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FIGURES

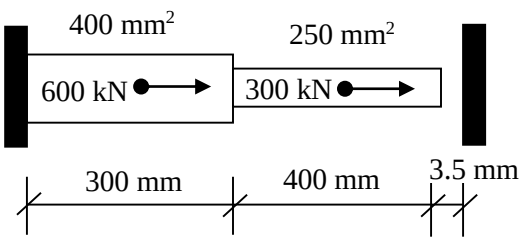

Fig. 1

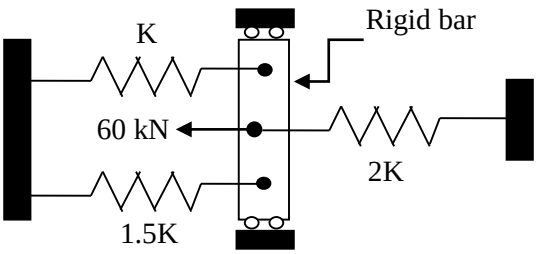

Fig. 2