Duration: 3hrs **[Max Marks:80]**

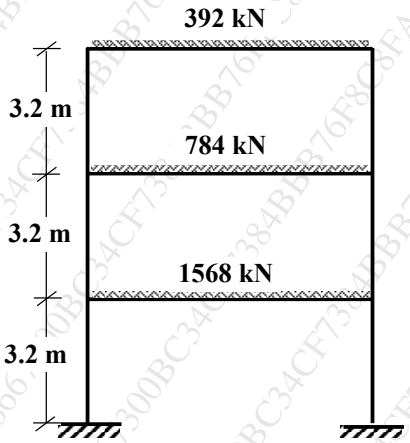
Instructions:
(1) Question No 1 is **Compulsory**.
(2) Attempt any **three** questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.
(5) Use of IS 1893(Part -1)- 2016 is permitted.

1		Attempt any FOUR	
	a	Write a short note on Plate Tectonics theory	**05M**
	b	Explain with diagrams propagation of earthquake waves.	**05M**
	c	Explain the concept of response spectra.	**05M**
	d	What is capacity design concept in earthquake engineering?	**05M**
	e	Write a short note on seismicity of world.	**05M**
2	a	Describe four virtues of EQRD-stiffness, strength, ductility and configurations.	**10M**
	b	Write a detailed note on base isolation and isolating devices.	**10M**
3	a	Explain ground motion and their characteristics. What are the factors affecting ground motion?	**10M**
	b	Explain various types of faults with neat sketches.	**05M**
	c	Write a short note on performance-based design in earthquake engineering	**05M**
4	a	A three storied RC hospital building is located in seismic zone IV, medium stiff soil conditions. Building is designed as special moment resisting frame with the following data. Plan dimensions 24m x 16m No. of bays in X direction = 6. No. of bays in Y direction = 4 Height of each storey = 3.5m Width of bay in each direction = 4m Size of beams = 230mm x 450mm Size of columns = 300mm x 600mm Slab thickness = 150mm Live Load = 4kN/m^2 RC frame with infill walls Calculate the base shear of the building using Seismic coefficient method as per provisions of IS 1893-2016. Also show the distribution of lateral force at each floor level.	**15M**

b Write a detailed note on significance of special confining reinforcement in earthquake resistant building. **05M**

5 a A residential building frame shown in figure founded on soft soil and located in Zone V is designed as special moment resisting frame. determine the seismic forces by dynamic analysis. The free vibration analysis results of the building are: **20M**

Modes	Natural period(sec)	Roof	2nd floor	1st floor
Mode 1	0.883	1.00	0.791	0.250
Mode 2	0.404	1.00	0.000	-1.00
Mode 3	0.302	1.00	-0.791	0.250



6 a Write a short note on origin of earthquakes. **05M**

b What do you understand by earthquake design spectrum and inelastic spectra. **05M**

c Explain in detail time history method. **05M**

d Write a detailed note on accelerograph and accelerogram recording. **05M**

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Time: [3Hours] **Total Marks:[80 marks]**

N.B. **(1)** Question **No. 1** is Compulsory.
(2) Solve **any three** questions out of remaining Five questions.
(3) Assume suitable data wherever required and state them clearly.

1Q. Explain the following **(any four only)**

	(a)	Plate and Shell action	**5**
	(b)	Twisting moment and Twist of Surface	**5**
	(c)	Surface Revolution	**5**
	(d)	Classification of shells	**5**
	(e)	Ruled Surface	**5**
2Q.	**(a)**	Derive the expression for moment in any direction in a slightly bent plate	**10**
	(b)	A clamped plate of 1.5m diameter is subjected to a concentrated load 'W' at the centre. If the maximum central deflection of plate is 2.5m, find out the value of load 'W'. Assume E= 200kN/mm^2 and v=0.25 for the plate material.	**10**
3Q.	**(a)**	Derive the Navier solution for simply supported rectangular plates and obtain the maximum deflections.	**10**
	(b)	Derive relation between bending moments and Curvature in pure bending of Plates.	**10**
4Q.	**(a)**	Explain the concept of small deflections of laterally loaded plates.	**10**
	(b)	Explain membrane theory of shells and Derive the expression for bending stiffness.	**10**
5Q.	**(a)**	Explain with example i) Singly curved surface ii) Doubly curved surface	**10**
	(b)	Explain about Schorer's theory for shells?	**10**
6Q.	**(a)**	A simply supported rectangular plate subjected to subjected to a uniformly distributed load of 'q_0' (N/mm^2) over a centrally located patch of a size ('q/2' x 'a'), the plate dimensions are (' a' x '2a'). Determine the maximum deflection and bending moment. Use Navier's method.	**10**
	(b)	Derive the differential equation for symmetrical bending of laterally loaded circular plates.	**10**

Time: (3 Hours) **Total Marks : 80**

Note – 1. Question Number 1 is compulsory. Attempt any three out of remaining questions.
2. Figures to the right indicate full marks.
3. Assume any suitable data if needed and justify the same.
4. Draw neat sketches wherever required.

Q.1. Attempt any four.

a) Discuss the procedure of finite element analysis steps by step. 5

b) Convergence and compatibility requirements for Finite Element Analysis. 5

c) Use of transformation matrix in Finite Element Analysis. 5

d) Use of Jacobean Matrix in Finite Element Analysis. 5

e) Use of Pascal's triangle in Finite Element Analysis. 5

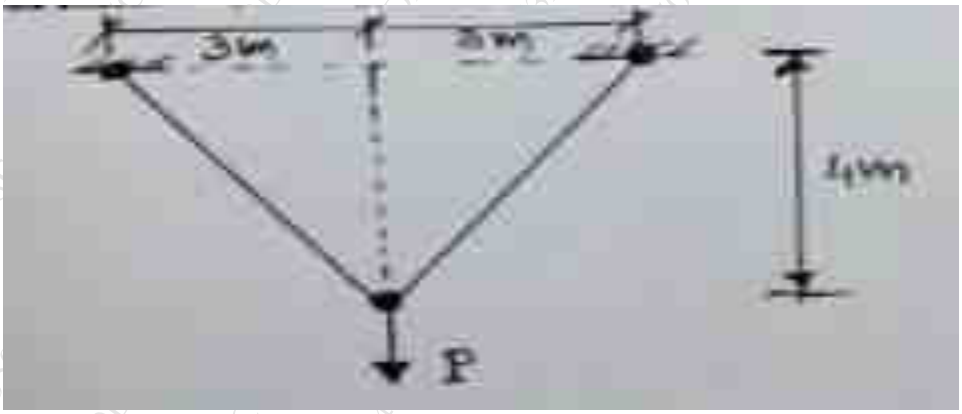
f) Using "serendipity concept", derive shape functions for 4 noded rectangular element. 5

Q.2 (a) Using Lagrange polynomial derive shape functions for a 9 noded, 2-D element

OR

Using Lagrange polynomial derive shape functions for a 5 noded bar element drawing the sketches of their variations. 08

(b) Determine the critical load (Buckling Load) for the pin jointed frame shown in figure below. 12



Q.3

(a) Derive element stiffness matrix for two noded bar element by Variational Approach or by finite element approach. 10

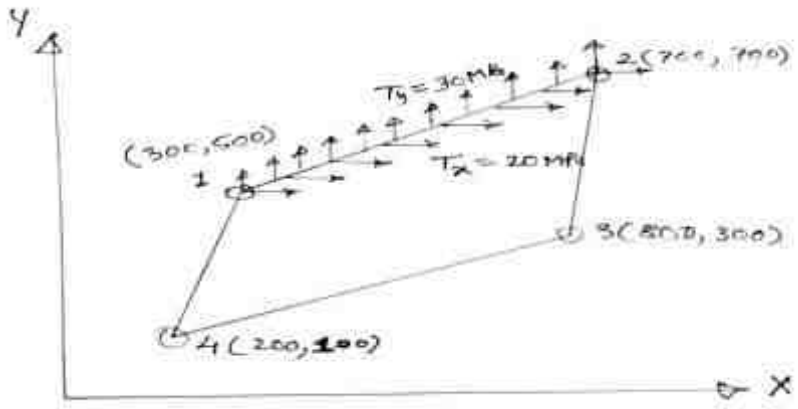
(b) Derive element stiffness matrix for linear triangular element (CST) 10

OR

(b) Starting with shape functions of beam element, derive geometric stiffness matrix for a 2-noded beam element. 10

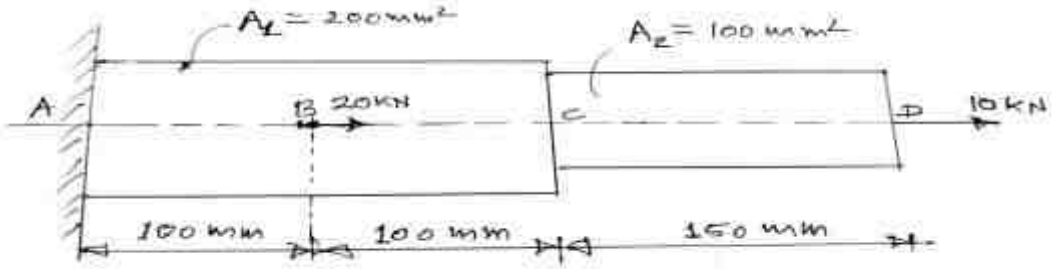
Q.4

(a) The quadrilateral element shown in figure is 20 mm thick and subjected to surface force **T_x = 20 MPa and T_y = 30 Mpa.** Determine the expressions for its equivalent nodal forces. Also find their numerical values. The coordinates of the nodes are 1(300, 500), 2(700,700), 3(800,300) and 4(200,100) as shown in figure below. 10



(b) Determine the nodal displacements, support reaction and stresses in the stepped bar.

E = 200 GPa 10



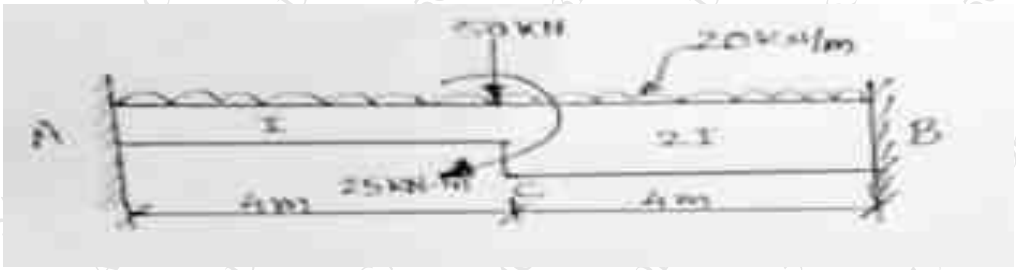
Q. 5

(a) Derive consistent mass matrix for a two noded beam element, starting with strain displacement relationship. 10

(b) Determine fundamental natural frequency of vibration for a beam of length L, clamped at both ends with the help of two noded beam element. 10

Q. 6

A fixed beam AB is loaded with a concentrated load of 50 kN and a couple of 25 kN-m at mid span section C and a uniformly load of intensity 20 kN/m over the entire span. Determine unknown DOF, support reaction and draw shear force and bending moment diagram for a beam shown in figure below, using finite element approach. 20



**********END**********

TIME:4hrs **Marks:80**

N.B. i. Attempt any **four** questions out of total six questions.
ii. **Illustrate** your answers/ design steps with **neat component sketches** wherever necessary though not specifically.
iii. **Assume** any other data needed **suitably**, if not given. However, **justify** the same.
iv. **Use** of relevant IS codes **is permitted**.

1. A R.C. slab of plan dimensions 6 × 4 m is simply supported on all the edges. The intensity of live load is given to be 4 kN/m^2 and that of floor finishes, 1 kN/m^2. The main reinforcement to be provided in longer direction is 60% of that in the shorter direction. Analyze the slab using yield line theory and design the same using Whitney's approach. An overall load factor of 1.5 may be assumed. The materials comprise the concrete of M-25 grade and steel of grade Fe 415. **20**

Further, if the above slab is continuous in all the directions and amount of top steel provided over the support is such that the moment of resistance is equal to 60% of the moment of resistance at mid span in each direction, determine the area of steel at mid span and supports in two directions. Draw the neat sketch.

2. A hall of 10 m × 60 m is to be covered with R.C.C. slab supported on a rectangular portal frames at 5 m c/c. The clear height of the hall is 4.5 m from the floor level. The plinth height is 0.75 m and the firm soil is available at 1.6 m below the ground level. The structure is single storeyed. Design an intermediate portal frame. **20**
Use Limit State Method. Draw neat sketches showing details of reinforcement in portal frame. The live load may be assumed to be 4.5 kN/m^2 and the floor finishes, 2 kN/m^2. Use concrete of M-25 grade and TOR steel..

3. (a) Explain the difference between the bunkers and silos in the systematic manner w.r.t. various points. **03**

(b) Design the bunker to store 300 kN of wheat for the following data: **17**
- Unit weight of wheat: 7850 /m^3;
- Angle of repose:30°
- The stored wheat is to be surcharged at its angle of repose.

Use M-20 concrete and HYSD steel of grade Fe 415.
Design either square or circular bunker. Draw the neat sketch showing details of the reinforcement.

4. (a) A R.C. column, 350 mm × 350 mm carrying a load of 600 kN is supported on three piles, 350 mm × 350 mm in section. The centre to centre distance between the piles is 1.5 m. Design the pile cap. Use M-25 concrete and HYSD steel of grade Fe 415. **10**

(b) A curved beam AB of uniform cross section is horizontal in plan and in the form of a quadrant of a circle of radius R. The beam is fixed at A and free at B. It carries a uniformly distributed load of w per unit run over the entire length of the beam. Calculate the shear force, bending moment and twisting moment values at A and B. **10**

5. (a) Design an interior panel of a flat slab of size 5m × 5m without providing drop and column head. Size of column if 500 × 500 mm and live load on the panel is 4 kN/m^2. Take floor finishing load as 0.8 kN/m^2. Use M25 concrete and Fe 415 steel. Draw reinforcement details. **10**

(b) Design a corbel to carry an ultimate load of 550 kN at a distance of 260 mm from the face of a column of size 400 mm × 400 mm. The concrete grade M-25 and HYSD steel of grade Fe 415 are to be used. Draw the reinforcement details. Take bearing stress of concrete as 0.8fy. **10**

6. Attempt any **two** of the following:

(a) Deign a typical interior span of a continuous deep beam using the following data: **10**

Span of beam = 9.0 m, Overall depth = 4.5 m, width of supports = 0.9 m, width of beam = 0.4 m, uniformly distributed load = 200 kN/m (including self-weight), Use M20 concrete and Fe 415 Tor steel. Sketch the reinforcement details.

(b) i Draw possible yield line pattern for the following configuration of the slab: **5**

1) Rectangular slab continuous over two adjacent edges and supported over a column at a junction of the adjacent edges on the opposite side.
2) Equilateral triangle with two sides simply supported and one fixed.

ii Explain the difference between plate action and slab action with respect to the analysis of folded plates. **5**

(c) A folded plate with two folds AB and BC is subjected to moments in the plane of the plates. Making use of the following data, calculate the stress in the folded plates. **10**

i. Thickness of plate: 110 mm
ii. Depth of plates: $h_1 = h_2 = 2000$ mm
iii. Moment in plates: $m_1 = m_2 = 300$ kN-m

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