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

N.B:

1. Question No.**1** is compulsory.
2. Attempt any **THREE** questions from the remaining **five** questions.
3. Assume suitable data wherever necessary.
4. Figures to the right indicate full marks.

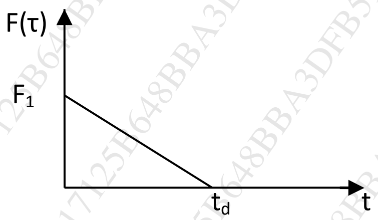
1(a) Explain the terms, magnitude and intensity of earthquake. How it is measured? **4**

(b) What is damping? Explain the various the various types of damping. What are the effects of damping on the structure? **4**

(c) State the different methods of seismic analysis as per IS 1893-2016.Also state under what conditions these methods are used. **4**

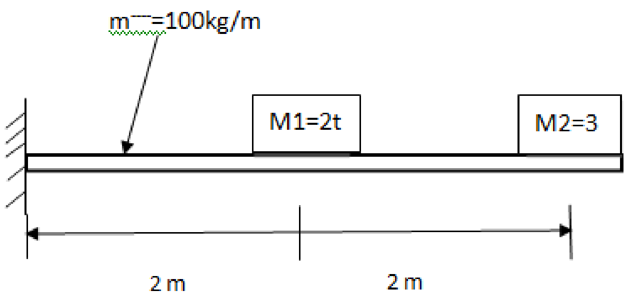
(d) What is transmissibility of a system? Briefly explain how vibration isolation can be achieved. **4**

(e) For the pulse type load shown in figure, derive the expression for DLF. **4**



2 (a) Derive the expression for steady state response of damped SDOF system subjected to harmonic force defined by $P_{(t)} = P_0 \sin \omega t$. **10**

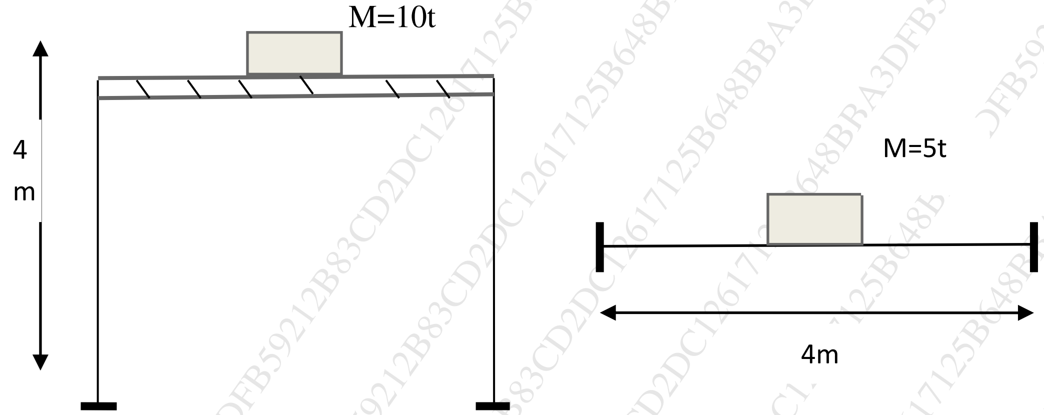
(b) For the beam shown in figure, calculate the fundamental frequency using Rayleigh's method. $E = 2\times10^5$ Mpa , $I = 10\times10^7 mm^4$ **10**



3(a) A three storey single bay frame has same storey height. The storey stiffness are $K_1 = K_2 = K$, $K_3 = K/2$, and the lumped mass on each storey is $m_1 = m_2 = m$ & $m_3 = m/2$.calculate natural frequencies and mode shapes. Also find the normal modes and verify the orthogonality principle. **15**

(b) State and prove orthogonality principle. **5**

4(a) For the structural systems shown in the figure, compute the natural frequency of vibration. **6**
EI= 15000KN.m^2



(b) A machine of 1000 kg mass supported on springs of total stiffness 1000 kN/m and has an unbalanced rotating element which results in a disturbing force of 500 N at a speed of 1200 rpm. Assuming 10% damping, calculate **10**

i. Its amplitude of motion.
ii. Transmissibility and
iii. Force transmitted to foundation.

(c) What are the ductility provisions in the RCC buildings as per IS 13920? **4**

5(a) Explain the concept involved in carrying out modal analysis of structure subjected to dynamic loads in MDOF system. **10**

(b) Starting from first principle ,derive the expression for frequency of vibration of a simply supported beam of span L, flexural rigidity EI and uniform mass 'm' kg/m. **10**

6 (a) A three storey frame with the free vibration characteristics are given below is subjected to a suddenly applied constant load of 45 KN at 2nd floor level & 20KN at 3rd floor level, determine maximum displacement of each storey. **15**

Storey Level	Storey Height (m)	Mass No.	Mass (t)	Mode shapes		
				T= 0.3 sec	T= 0.13 sec	T= 0.08 sec
				Mode 1 (Φ1)	Mode 2 (Φ2)	Mode 3 (Φ3)
First	3	1	30	0.404	-0.676	2.959
Second	3	2	30	0.716	-0.526	-2.578
Roof	3	3	20	1.0	1.0	1.0

(b) What is an earthquake? Explain how the earthquakes are classified based on their causes. **5**

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

N.B: (1) Question **No. 1** is compulsory.
(2) Attempt any **three** questions out of remaining five questions.
(3) Assume suitable data wherever required and state it clearly.
(4) Illustrate your answers with neat component sketches wherever required.
(5) IS 1343:1980, IS 3370 and relevant codes require for design are permitted.

1. Design a post tensioned roof girder as a class I structure using following data **32**

Effective span = 40 m
Live load = 9 kN/m
Dead load (excluding self-weight) = 2 kN/m
Load Factors (For dead load = 1.4, for live load 1.6)
Cube strength of concrete, *fcu* = 50 N/mm^2
Cube strength at transfer *fci* = 35 N/mm^2
Tensile strength of concrete *ft* = 1.7 N/mm^2
Modulus of elasticity of concrete Es = 34 kN/mm^2, Loss ratio = 0.85
8 mm diameter high tensile wires having a characteristic tensile strength *fpu* = 1200 N/mm^2 are available for use.
The modulus of elasticity of high tensile wires is 200 kN/mm^2.

OR

Design a post-tensioned pre-stressed concrete slab bridge deck for a national highway crossing to suit the following data:
Materials: M-40 grade concrete, 7 mm diameter high-tensile wires with an ultimate tensile strength of 1500 N/mm^2 housed in cables with 12 wires and anchored by Freyssinst anchorage of 150 mm diameter.

Clear span = 10.2 m
Width of bearing = 400 mm
Clear width of roadway = 7.5 m
Footpath width = 1.0 m on either side
Thickness of wearing coat = 80 mm
Width of kerbs = 600 mm
Assume type of structure as class 1 type
Live load I.R.C Class AA tracked vehicle

For supplementary reinforcement, adopt Fe-415 grade HYSD bars
Compressive strength at transfer *fci* = 35 N/mm^2
Loss ratio = 0.8, Permissible compressive stress at transfer and at working load are *fct* = 15 N/mm^2, *fcw* = 12 N/mm^2, *ftt* = *fcw* = 0

2. (a) What are the advantages of continuous members in prestressed concrete structures? **04**

(b) Design a post-tensioned pre-stressed concrete two-way slab, 6m × 9 m with discontinuous edges, to support an imposed load of 3 kN/m^2. Cables of four wires of 5 mm diameter carrying an effective force of 120 kN are available for use. Design the spacing of cables in the two directions and check for the safety of the slab against collapse and excessive deflection at service loads. Assume (B. M coefficients for short span = 0.089, = 0.056 for long span), fck = 40 N/mm^2, fp = 1500 N/mm^2 and Ec = 38 kN/mm^2 **12**

3. (a) Write deformation characteristics of folded plates. **04**

(b) A cylindrical pre-stressed concrete water tank of internal diameter 30 m is required to store water over a depth of 7.5m. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and the minimum compressive stress under working pressure is 1 N/mm^2. The loss ratio is 0.75. Wires of 5 mm diameter with an initial stress of 1200 N/mm^2 are available for circumferential widening and Freyssinet cables made up of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are to be used for vertical pre-stressing. Deign the tank wall assuming base as fixed. The strength of concrete cube is assumed to be 40 N/mm^2. Draw sectional details. **12**

4. (a) Explain differential shrinkage and deflection in case of composite section. **04**

(b) A precast pre-tensioned beam of rectangular section has a breadth of 100 mm and a depth of 200 mm. The beam with an effective span of 5 m is pre-stressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 120 kN. The loss of prestress may be assumed to be 15%. The beam is incorporated in a composite T-beam by casting a top flange of breadth 400 mm and thickness 40 mm. If the composite beam supports a live load of 8 kN/m^2, calculate the resultant stresses developed in the precast and in situ cast concrete for the following conditions: **12**

(i) propped during the casting of the slab (ii) un-propped.	For the same modulus of elasticity for concrete in pre-stressed and in situ cast slab

5. (a) Explain maintenance of prestressed concrete **04**

(b) Design a pre-tensioned folded plate roof for the loading bay of a biscuit factory measuring 30 m × 90 m. The live load on the roof may be taken to be 1 kN/m^2. The 8 mm diameter high tensile wires are available for use. The ultimate tensile strength of the wires is 1500 N/mm^2. M-45 grade concrete may be used for the casting of folded plates. The tensile strength of concrete is 1.6 N/mm^2. V-shaped folded plates, 100 mm thick with a depth of 1/15 span, are proposed over a span of 30 m. Draw cross-sectional details. **12**

6. **(a)** A reinforced concrete dome of 30 m base diameter and a rise of 3.75 m is to be designed for a pre-stressed concrete cylindrical tank. The shell dome to be provided with a pre-stressed concrete ring beam. Design the dome and the ring beam for a superimposed load of 1.5 kN/m^2. The 5 mm diameter high tensile wires initially stressed to 1000N/mm^2 are available for pre-stressing the ring beam. The loss ratio is 0.80 and permissible compressive stress in concrete at transfer is 14 N/mm^2. Assume radius of the shell dome = 32 m, thickness of shell = 75 mm, semi central angle $\alpha = 28° 4'$. **12**

(b) Explain various losses in prestressed concrete **04**

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Time: 3Hours **Marks: 80**

N.B:

1. Question No. 1 is compulsory
2. Attempt any Three questions from the remaining questions.
3. Assume any suitable data if required.
4. Figures to the right indicate full marks.
5. Use of relevant IS code is permitted

Q1. a) Enlist the characteristics features of Yield lines. **5**

Q1. b) Derive the expression relating yield line moment and ultimate load intensity wu for simply supported square slab **5**

c) What are the limitation of direct design method for flat slab **5**

d) Explain the behaviour of folded plate roof . **5**

Q.2 Design interior panel of flat slab with panel size 5m x 5 m supported by a column of size 500mm x 500 mm providing suitable drop. take live load as a 4kN /m^2 use M20 grade concrete and Fe415 grade steel **20**

Q.3 Design column , hinged and footing of portal frame given data at service load , Axial force 200 kN , Moment at top 180 kN – m shear force at hinged 50 kN size of column 300 mm x 600 mm SBC of soil 200 kN/m^2 use M20 grade concrete and Fe415 grade steel **20**

Q.4 Design a reinforced concrete combined rectangular slab footing for two columns located 4m apart. The overall size of the columns is 400mmx400mm and they are transferring 800kN load on each column. SBC of soil is 150kN/m^2. Use M20/Fe415 **20**

Q.5 A silo with internal diameter 4m, cylindrical portion height =12 m and central opening with 0.5m is built to store wheat. Design the silo using Jansson's theory for pressure calculations. Take M25/Fe415. Unit weight of the wheat=8kN/m3,Angle of internal friction =30^0 , Angle of wall friction=0.75ϕ while filling and 0.6ϕ while emptying, pressure ratio k=0.5 while filling **20**

Q.6 a) Design a corbel to carry an ultimate load on 800kN at a distance of 250 mm from the face of column of size 400 mm x 400 mm Use M20/Fe415 **10**

b) Coal bunker 3m x 3m with height of 3 m stores 300 kN of coal side wall 180 mm thick depth of hopper bottom 1.2 m with central opening of 0.5m x 0.5 m if the total weight of hopper bottom 60 kN Design the side wall of bunker as as deep beam **10**

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