Bengal Engineering and Science University
1st Semester PG Final Examination, December 2013

Full Marks: 70 **Time 3 hours**

Subject: Advance Structural Analysis (CE-901)

i. Answer any Five Questions ii. All questions carry equal marks

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1. Answer the following (any 3)

(i) Enumerate various properties of a stiffness matrix with their implications.

(ii) Explain penalty approach and elimination approach for incorporation of boundary condition?

(iv) How global stiffness matrix is obtained from the element stiffness matrices of a structure?

(v) Show the dof of: space truss, grillage frame and plane frame. Explain the difference between a plane frame and a grid frame.

(vi) Derive the transformation matrix for a plane frame element

2. Determine the displacements at node 2 of the truss shown in figure Q2. Use the following data: Modulus of Elasticity $E=2\times10^{11}$ N/m^2, cross-section area of member 1-2: 4×10^{-4}m^2, member 2-3: 4×10^{-4}m^2, member 2-4: 6×10^{-4}m^2

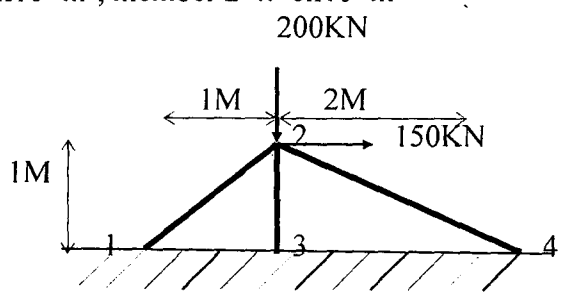

Figure Q2

3. Using two beam elements to model the structure as shown in Figure Q3, find deflection and internal force quantities.

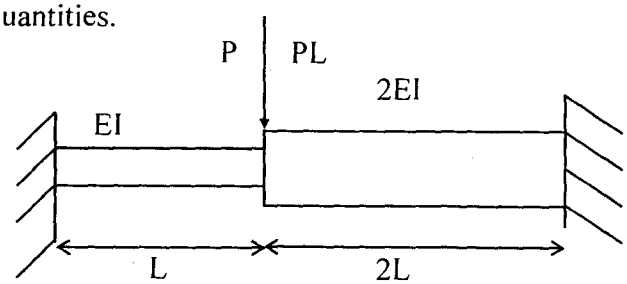

Figure Q3

4. A single degree of freedom system (mass m=9100 Kg) with viscous damping is displaced from its position of rest by a distance u_0=30mm. If the maximum displacement on the return swing is 20mm on 0.5 sec, determine (i) the spring constant and (ii) the damping constant.

5 (a) A steel frame fixed at base consisting of four legs each being a steel flanged section ($I=25.8\times10^{6}mm^4$, $Z=249\times10^{3}mm^3$, Length=3.0m), supports a rigid steel table. A rotating motor with an unbalance mass of 200Kg at an eccentricity of 50mm is mounted on the table. If the total mass of the table and the motor is 2500 Kg, find the range of speed of the motor over which the maximum flexural stress in the leg will exceeds 100Mpa.

(b) A machine of 100Kg mass is supported on spring of total stiffness 700 KN/m and has an unbalanced rotating element, which results in a disturbing force of 350 N at a speed of 300 rev/min. $\xi=0.2$. Determine (a) its amplitude of motion due to unbalance, (b) Transmissibility and transmitted force.

6. A racing car modelled as SDOF system vibrating in vertical direction due to road undulation. The road elevation is assumed to vary sinusoidally; with peak to trough difference of 0.2m and distance between peaks are 70m. Determine the 9i) amplitude of vibration of the racing car at a speed of 12 kmph. Assume system frequency as 2Hz and damping ratio as 0.15.

7. (a) Determine the steady state response for an undamped single degree freedom spring mass system subjected to the forcing function as shown in Figure Q7a.

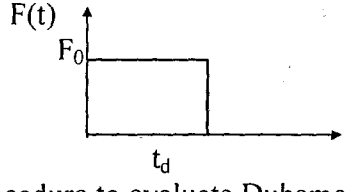

Figure Q7a)

(b) Explain the procedure to evaluate Duhamel Integral numerically.

8. An isotropic square plate of dimension 'a' is subjected to uniformly distributed load q/unit area. The plate is simply supported along the boundary. Find the central deflection of the plate by using the method of finite differences. Use 4x4 grid.

9. A two span continuous beam ABC is of uniform flexural rigidity EI and is simply supported at A, B and C. AB = 6m and BC = 6m. Find the influence line diagram for bending moment at a point P which is 3m away from B on BC.