

## B. Construction Engineering 4<sup>th</sup> Year 2<sup>nd</sup> Semester Examination 2019

### STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

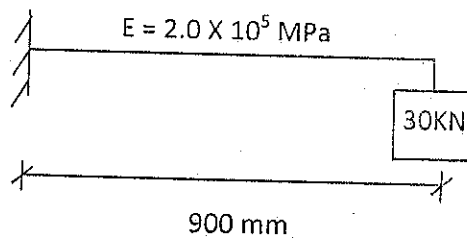
Assume any relevant data not provided, IS: 1893(Pt-I), 2016 is allowed in the Hall

Time : Three hours

Answer any Four Questions

Full Marks : 100

- 1 a) Describe D' Alembert's principle and derive the dynamic equation of equilibrium of a SDOF structural system. 6[CO1]
  - b) Derive the free vibration solution of a SDOF system with initial condition. 12[CO3]
  - c) Discuss the significance of Free Vibration Analysis and Natural Frequency 7[CO2]
- 2 a) What do you mean by Critical Damping? Deduce Logarithmic Decrement Method for evaluating damping. 10 [CO3]
  - b) Calculate natural period, circular frequency of the cantilever beam spanning 0.9 m. The member is made of mild steel round section of diameter 50 mm and subjected to a load of 30 KN at the free end as shown in Fig.1. Neglect the mass of the beam. 6



- c) Find also the damped natural frequency of the system with the spring at the end if the critical damping ratio ( $\xi$ ) is 2 % 3
  - d) If the cantilever is made of square section mild steel of same cross sectional area calculate the change in time period. 3
  - e) If the same cantilever is made with 50 mm diameter round bar made of Aluminium with  $E = 6.9 \times 10^4 \text{ MPa}$ ,  $\xi = 2.5\%$ , calculate the change in frequency of the beam. 3  
- [CO2]
- 3 a) What do you mean by transient phase with respect to force vibration? What will happen in case of an absolute un-damped system? 4[CO4]
  - b) Derive the solution for Steady State Motion of the SDOF system under Forced Vibration of  $M\ddot{x} + C\dot{x} + Kx = F_f \sin w_f t$ . 12[CO4]
  - c) Deduce the expression of Dynamic Load Factor from the above solution 5[CO4]
  - d) Evaluate the D.L.F for tuning factor 0.98 and damping ratio is 5 %. 4 [CO4]

- 4 a) What do you mean by Magnitude & Intensity of Earthquakes? 5 [CO5]  
 b) Compare between Near Field & Far Field effects of Earthquake 6 [CO5]  
 c) Discuss on favourable structural elevation for seismic considerations. 6 [CO5]  
 d) Compare and discuss Static coefficient Method and Response Spectrum Method for Dynamic Analysis of structures. 8[CO5]
- 5 A Four Storied RCC frame office building located in Guwahati, Assam. The plan of the building is shown below in Fig 2.

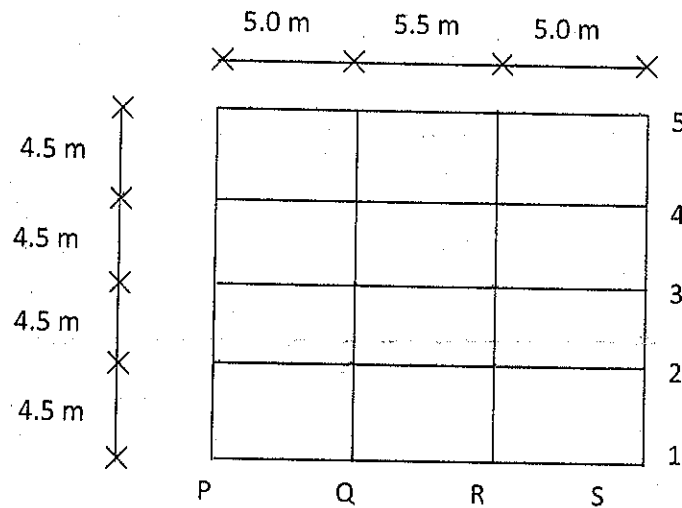


Fig. 2

The soil condition is soft and supported on Raft foundation. The RC frames are in-filled with brick-masonry. The lump weight due to DL is  $12 \text{ KN/m}^2$  on floors and  $10.5 \text{ KN/m}^2$  on roof. The Live load on floors is  $3 \text{ KN/m}^2$ . Determine the Design seismic Force of the frame 3/P-Q-R-S by **dynamic analysis** method. The free vibration analysis dynamic properties are given below.

Natural Period (S)	Mode 1	Mode 2	Mode 3
		1.50	0.965
Floor	Mode Shape		
Roof	1.000	1.000	0.694
3 <sup>rd</sup> Floor	0.787	0.404	-0.783
2 <sup>nd</sup> Floor	0.661	-0.603	-0.496
1 <sup>st</sup> Floor	0.359	-0.816	1.000