# INSTITUTE OF AERONAUTICAL ENGINEERING
### (Autonomous)
M.Tech II Semester End Examinations (Regular) - May, 2019
**Regulation: IARE–R18**
## STRUCTURAL DYNAMICS

**Time: 3 Hours**             **(STE)**             **Max Marks: 70**

**Answer ONE Question from each Unit**
**All Questions Carry Equal Marks**
**All parts of the question must be answered in one place only**

## UNIT – I

1. (a) Define the terms (i) Mass (ii) Natural period (iii) Amplitude (iv) Free vibration (v) Damping. **[7M]**

   (b) What do we mean by degree of freedom of a vibratory system? Explain the different types of vibration in detail. **[7M]**

2. (a) Define simple harmonic motion. Derive the solution of equation of motion. **[7M]**

   (b) A harmonic motion has a maximum velocity of 7.5m/s and it has a frequency of 14cps. Determine its amplitude, its period and its maximum acceleration. **[7M]**

## UNIT – II

3. (a) What are different methods of measurement of damping of forced vibration. Deduce logarithmic decrement method. **[7M]**

   (b) A damper resistance 0.08N at a constant velocity 0.06 m/s is used with a spring of stiffness equal to 12N/m. Determine the damping ratio and frequency of the system when the mass of the system is 0.3kg. **[7M]**

4. (a) What is meant by damping in vibratory systems? Deduce the equation of motion for viscous damping. **[7M]**

   (b) A SDOF system shown in Figure 1 is subjected to free vibration with an initial velocity $V_o$ without any displacement initial displacement. Determine the subsequent motion of the system for the three damping ratios. ($\rho = 2.5, 1, 0.1$) **[7M]**
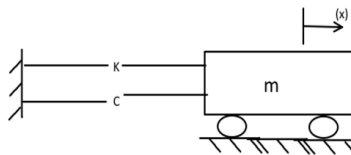


Figure 1

## UNIT – III

5. (a) Give the explanation on virtual work and its application to structural dynamics. Derive Duhamel's Integral. **[7M]**

(b) A 1000kg machine is mounted on four identical springs of total spring constant k and having negligible damping. The machine is subjected to a harmonic external force of amplitude $F_o = 490$N and frequency of 180rpm. Determine the amplitude of motion of the machine of maximum force transmitted to the foundation because of unbalanced force when k = 1.96 X $10^6$ N/m. **[7M]**

6. (a) Define Seismometer and Accelerometer. Differentiate between triangular & rectangular impulse. **[7M]**

(b) An SDOF system consists of a mass of 20 kg, and a spring of stiffness 2200 kN/m and dashpot with a damping coefficient of 60 Ns/m and is subjected to a force of F = 200 sin5t. Find its steady state response and peak amplitude. **[7M]**

## UNIT – IV

7. (a) Write the equation of motion of an un damped MDOF system with free vibration for a 3 DoF system. **[7M]**

(b) Determine the modes of vibration and also the steady state response of the system given in Figure 2. **[7M]**
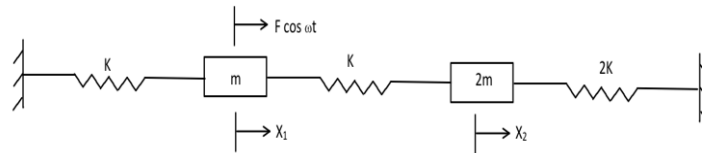


Figure 2

8. (a) Give lumped mass matrix for a 3 DOF system. Derive forced vibration of damped systems. **[7M]**

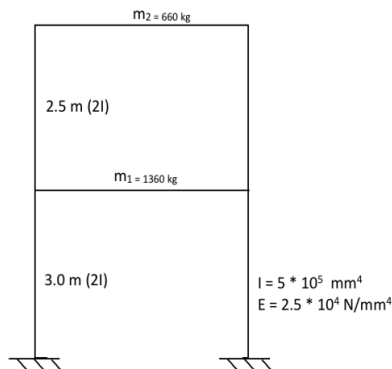(b) Draw the equivalent system for the frame shown in Figure 3 and find the stiffness. **[7M]**



Figure 3

**UNIT – V**

9.  (a) Sketch the mathematical model of a single degree of freedom system. Explain base isolation technique. **[7M]**

    (b) Explain the mechanism of base isolation technique. **[7M]**

10. (a) Explain the design philosophy of foundation for industrial machinery. **[7M]**

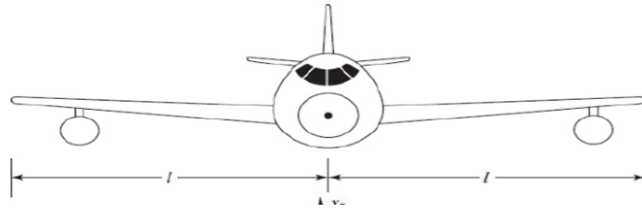    (b) Write the simplified analysis of the vibration of an airplane for Figure 4 **[7M]**



Figure 4

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