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

Note:

1. **Question No. 1 is compulsory.**
2. **Attempt any THREE out of the remaining FIVE questions.**
3. **Assume suitable data if necessary.**

Q1 **Solve any four sub-questions from the given sub questions** **5 marks each.**

a Make the difference between under-damped and critically damped system
b Explain coulomb damping in detail
c Write a short note on vibration measuring instrument
d Write a short note on phase plane method
e Write a short note on logarithmic decrement

Q2 **Solve any Two Questions out of Three questions** **10 marks each**

A A vertical spring of stiffness 9800 N/m supports a mass of 40 kg. There is a friction force of 49 N which always resists the vertical displacement whether upwards or downwards. The mass is released from a position in which the total extension of the spring is 126 mm. Determine the final extension of the spring in the position in which system comes to rest.
B Explain the Holzer method in detail.
C Find the natural frequency of a simple spring mass system using Newton and energy method.

Q3 **Solve any Two Questions out of Three questions** **10 marks each**

A The springs of an automobile are compressed 0.1 m under its own weight. Find the critical speed when the trailer is travelling over a road with a profile approximated by a sine wave of amplitude 0.08 m and wavelength of 14 meters. What will be the amplitude of vibration at 60 kmph.
B Write a short note on vibration isolation and transmissibility
C A commercial type vibration pick-up has a natural frequency of 5.75 Hz and a damping factor of 0.65. What is the lowest frequency beyond which the amplitude can be measured within one percent error?

Q4. **Solve any Two Questions out of Three questions** **10 marks each**

A Illustrate with an example, how the perturbation is used to solve non-linear vibration problem.
B Explain non-linear vibration in detail with two examples
C Explain the Rayleigh method in detail.

Q5. **Solve any Two Questions out of Three questions** **10 marks each**

A 20 N at 30 cm, 30 N at 60 cm, 10 N at 100 cm from the fixed end are the loading on the cantilever beam. The deflection under 30 N load due to all the loads is 2mm. What would be the natural frequency of transverse vibration if 20 N is added at 80 cm from the fixed end? Also, find the frequency by dunkerleys method. The deflection at section I due to unit load at section j is given by

$$U_{ij} = U_{ij} = S_i^2 \frac{(3S_j - S_j)}{Constant} \ , \ \ S_j \geq S_i \ \ or \ S_i \ \leq S_j$$

B Prove that for finding the natural frequency of a spring-mass system one third mass of the spring is required to add into the main mass

C Prove that for finding the natural frequency of a disc-rotor system one third mass moment of inertia of the rotor is required to add into the disc inertia

Q6. **Solve any Two Questions out of Three questions** **10 marks each**

A An aircraft radio weighing 118 N is too isolated from the engine vibrations ranging in frequency from 1600 to 2200 rpm. What is the static deflection the isolator must have for 85% isolation?

B An instrument panel of an aircraft is mounted on isolators. The isolator has a negligible amount of damping and it deflects 6mm under the weight of 30 kg. Find the percentage of motion transmitted to the instrument board, if the vibration of the aircraft is at 2400 rpm.

C What is minimum static deflection of an un-damped isolator to provide 75 percent isolation to pump that operated at a speed between 1500 rpm to 2000 rpm?

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