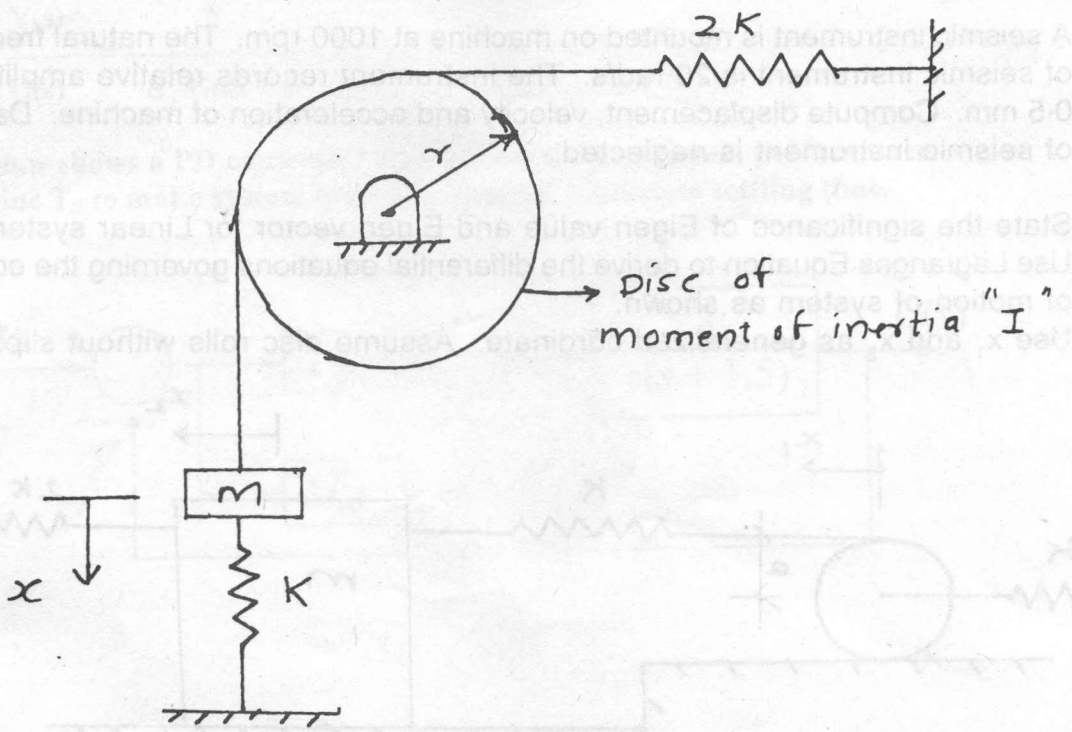
(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six** questions.
(3) Assume **suitable** data, if **required** with **justification**.
(4) **Figures** on **right** side indicate **full** marks.

1. (a) Define Logarithmic decrement. Derive the necessary relation for it in viscous damping. **6**

(b) Determine M_{eq} and K_{eq} for system as shown use 'x' as generalised cordinate measured from equillibrium position. **8**



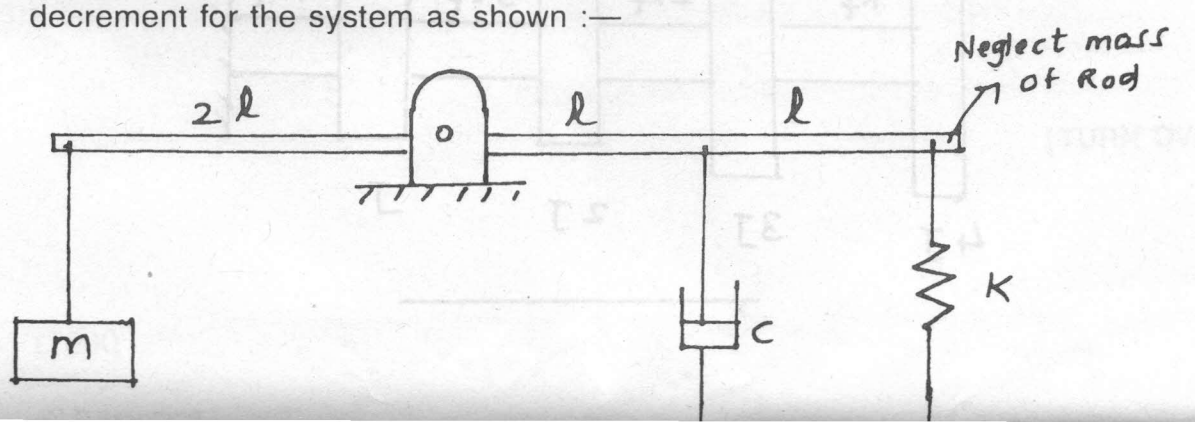
(c) Determine torsional stiffness of 60 cm long annular aluminium shaft [$G = 40 \times 10^9$ N/m^2] of inner radius 25 mm and outer radius 35 mm. **6**

2. (a) State the Equation of motion for various damped system for single degree freedom system. Plot the displacement versus time curve for each system and discuss its significance. **8**

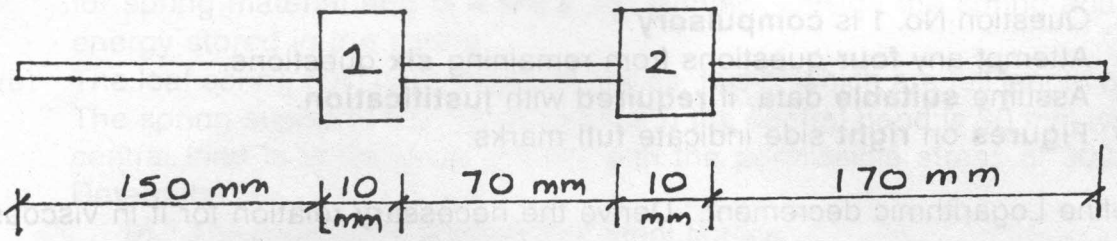
(b) A machine of mass 1000 kg is acted upon by an external force of 3000 N at 1800 rpm. To reduce the effect of vibration, isolators having static deflection of 2 mm under machine weight and damping factor of 0·2 are used. Determine (i) Amplitude of vibration of machine (ii) Force transmitted to the foundation (iii) Phase lag (iv) Phase angle between transmitted force and exiting force. **12**

3. (a) Discuss with neat sketch the characteristics of transmissibility curves. **8**

(b) Determine natural frequency, damped natural frequency, damping ratio, logarithmic decrement for the system as shown :— **12**



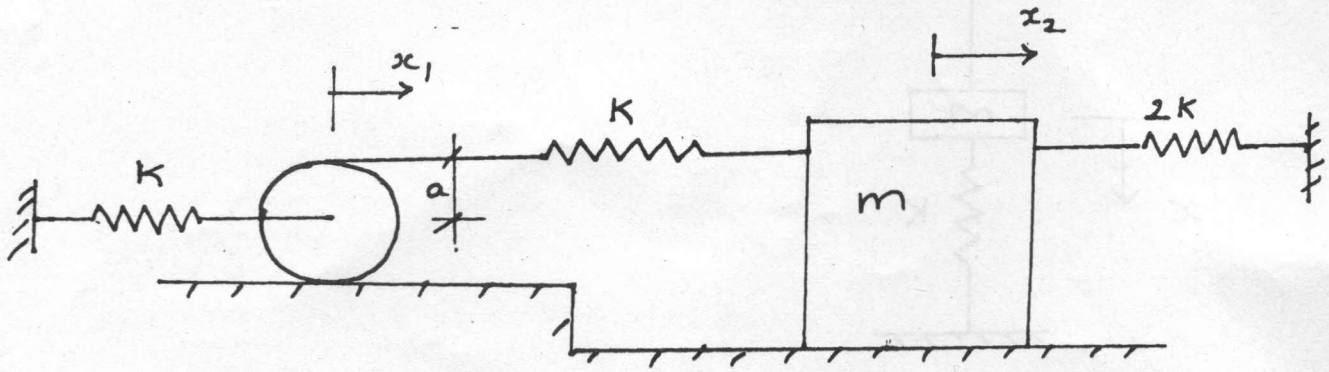
4. (a) Find the Lowest natural frequency of transvrse vibration of system as shown by Raleigh's method. **12**



$E = 196$ GPa $\quad I = 10^{-6}$ m^4 $\quad m_1 = 40$ kg $\quad m_2 = 20$ kg

(b) A seismic instrument is mounted on machine at 1000 rpm. The natural frequency of seismic instrument is 20 rad/s. The instrument records relative amplitude of 0·5 mm. Compute displacement, velocity and acceleration of machine. Damping of seismic instrument is neglected. **8**

5. (a) State the significance of Eigen value and Eigen vector for Linear system. **4**
(b) Use Lagranges Equation to derive the differential equations governing the equation of motion of system as shown. **16**
Use x_1 and x_2 as generalized cordinate. Assume disc rolls without slip.



6. (a) Derive the Expression for critical speed of a shaft.
(b) Five pulleys P, Q, R, S, T are equally spaced on a shaft. If mass of pulleys P, R and S are 10, 08 and 16 kg resp and angular distance between P and R is 90°, between R and S is 135°. Find mass of pulleys Q and T. Also find Angular position of pulleys Q and T.

7. (a) Write a note on cam dynamics. **6**
(b) Using holzer method, determine natural frequency for torsional vibration for 4-degree of freedom system in range of 0 to 1 rad/s. Draw mode shapes for frequency you have found **14**
K_t = 1Nm/rad $\quad$ J = 1 kg-m^2