Total No. of Questions : 12]

SEAT No. :

P3312

[Total No. of Pages : 5

[4959]-33

B.E. (Mechanical Engineering) (Semester - I)

DYNAMICS OF MACHINERY

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer three questions from each section.***
2) ***Answer to the two sections should be written in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables slide rule and electronic pocket calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Why single cylinder engines cannot be balanced completely? Explain. **[4]**

b) Four masses A, B, C and D carried by a rotating shaft at radii 80 mm, 100 mm, 160 mm and 120 mm respectively are completely balanced. Masses B, C and D are 8 kg, 4 kg and 3 kg respectively. Determine the mass A and the relative angular positions of the four masses, if the planes are spaced 500 mm apart. **[12]**

OR

Q2) a) Explain the method of direct and reverse crank to determine the unbalance forces in radial engines. **[4]**

b) The successive cranks of a 5 cylinder inline engine are at 144^{o} apart. The spacing between the cylinder center lines is 400 mm. The length of crank and connecting rod are 100 mm and 450 mm respectively and the reciprocating mass for each cylinder is 20 kg. The engine speed is 630 rpm. Determine the maximum values of the primary and secondary forces and couples and the position of the central crank at which these occur. **[12]**

P.T.O.

Q3) a) Define the following terms with respect to free damped vibrations: **[4]**

i) Logarithmic decrement

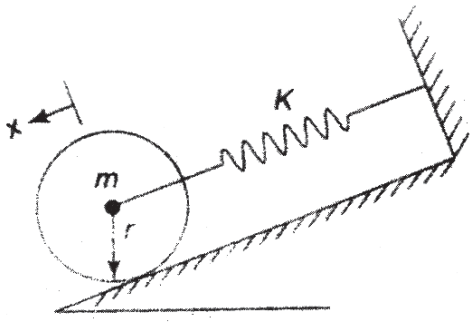
ii) Damping coefficient

iii) Coulomb damping

iv) Damping factor

b) A homogeneous solid cylinder of mass 'm' is linked by a spring of constant 'k' N/m as shown in following fig. If it rolls without slipping, show that frequency of oscillations is **[6]**

$$\omega_n = \left|\frac{\overline{2k}}{3m}\right. rad / \sec$$



c) An under damped shock absorber is to be designed for an automobile. It is required that initial amplitude to be reduced to $1/16^{th}$ in one cycle. The mass of the automobile is 200 kg and damped period of vibration is one sec. Find the necessary stiffness and damping constant of shock absorber. **[8]**

OR

Q4) a) Derive a relation to determine the loss of amplitude per cycle in case of Coulomb damping. **[6]**

b) A spring mass system with mass m kg and stiffness 'k' N/m has a natural frequency of 'f' Hz. Determine the value of stiffness 'k_1' of another spring which when arranged in conjunction with spring of stiffness 'k' in series will lower the natural frequency by 20%. **[6]**

c) A 500 kg vehicle is mounted on springs such that its static deflection is 1.5 mm. What is the damping coefficient of viscous damper to be added to the system in parallel with the springs, such that the system is critically damped? **[6]**

Q5) a) Derive an expression for magnification factor in case of steady state vibration subjected to an external periodic force $F_o \sin(\omega t)$. **[8]**

b) The springs of an automobile trailer are compressed 0.1 mm under its own weight. Find the critical speed when the trailer is passing over a road with a profile of sinewave whose amplitude is 80 mm and the wavelength is 14 m. Find amplitude of vibration at a speed of 60 kmph. **[8]**

OR

Q6) a) The weight of an electric motor is 125 n and it runs at 1500 rpm. The armature weighs 35 N and its CG lies 0.05 cm from the axis of rotation. The motor is mounted on 5 springs of negligible damping so that the force transmitted is $1/11^{th}$ of the impressed force. Assume that the weight of the motor is equally distributed among the 5 springs.

Determine : **[8]**

i) Stiffness of each spring

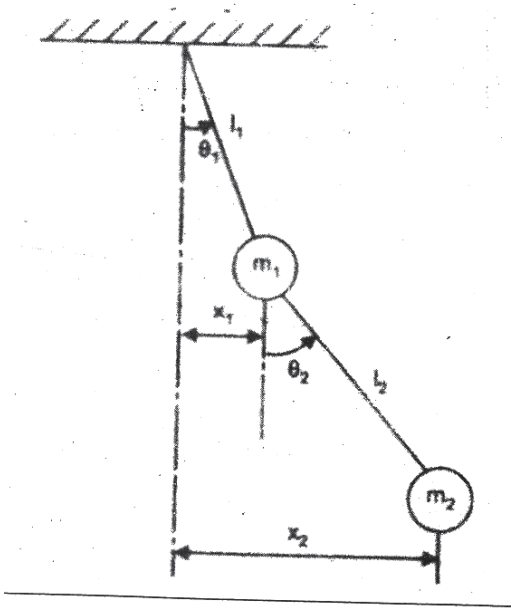
ii) Dynamic force transmitted to the base at operating speed.

iii) Natural frequency of the system.

b) A vertical single stage air compressor having a mass of 500 kg is mounted on springs having stiffness of 1.96×10^5 N/m and $\xi = 0.20$. The rotating parts are completely balanced and the equivalent reciprocating parts weigh 20 kg. The stroke is 0.2 m. Determine the dynamic amplitude of vertical motion and the phase difference between the motion and excitation force, if the compressor is operated at 200 rpm. **[8]**

SECTION - II

Q7) a) Set up the differential equations of motion for the double pendulum shown in following fig., using the coordinates x_1 and x_2 and assuming small amplitudes. Find the natural frequencies and ratios of amplitude, if $m_1 = m_2 = m$ and $1_1 = 1_2$. **[14]**



b) Explain principal modes of vibration with respect to 2DOF translational system. **[4]**

OR

Q8) a) Two rotors A and B are attached to the end of a shaft 500 mm long. Weight of the rotor A is 300 N and its radius of gyration is 300 mm. The corresponding values of rotor B are 500 N and 450 mm respectively. The shaft is 70 mm in diameter for the first 250 mm, 120 mm diameter for the next 100 mm and 100 mm diameter for the remainder of its length. Modulus of rigidity for the shaft material is 8×10^{11} N/m^2 Find : **[12]**

i) the position of the node and

ii) the frequency of torsional vibration.

Draw the mode shapes.

b) Explain the concept of torsionally equivalent shaft and derive the relevant equation for it. **[6]**

Q9) a) Define the following terms : **[4]**

i) Sound power level

ii) Sound pressure level

iii) Sound intensity

iv) Decibel scale

b) Explain human hearing mechanism with a neat sketch. **[6]**

c) A machinist working in a machine shop is operating 5 machines having their sound pressure levels as 95 dB, 90 dB, 92 dB 88 dB and 83 dB respectively. Determine the total sound pressure level when all 5 machines are turned on and when machine 4^{th} & 5^{th} are turned off.**[6]**

OR

Q10) a) Explain the working of microphone. **[4]**

b) What is sound field? What are the various types of sound fields in the vicinity of a sound source? **[6]**

c) What do you understand by sound enclosure? Describe the 2 types of sound enclosures. **[6]**

Q11) a) What do you mean by vibration absorber? Explain the principle of operation of it. **[4]**

b) What do you mean by vibration isolation? What are the various methods of vibration isolation? **[6]**

c) A vibration measuring device is used to find the displacement, velocity and acceleration of a machine running at 120 rpm. If the natural frequency of the instrument is 5 Hz and it shows 0.04 mm. What are the 3 readings? Assume no damping. **[6]**

OR

Q12) Write short notes on the following : **[16]**

a) FFT Analyser

b) Piezo electric accelerometer

c) Stroboscope