Total No. of Questions : 10] **SEAT No. :**

P3582 **[Total No. of Pages : 4**

[4959]-1052

B.E. (Mechanical-Sandwich) (End Semester)

MECHANICAL VIBRATIONS

(2012 Pattern)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) ***Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Use of scientific calculator is allowed.***
4) ***Assume suitable data wherever necessary.***
5) ***Figures to the right indicate full marks.***

Q1) a) Explain static and dynamic balancing. **[4]**

b) A 3 cylinder radial engine has cylinders located 120º from each other. Reciprocating mass of each cylinder is 1.2 kg. Length of crank is 75 mm and each connecting rod is 250 mm long. Find out maximum primary and secondary unbalance forces, if the engine runs at 2500 rpm. **[6]**

OR

Q2) a) Explain with displacement-time plot, the overdamped, critically damped and underdamped vibratory systems. Give suitable examples. **[4]**

b) A spring mass system has spring stiffness "k" N/m and a mass of "m" kg. It has natural frequency of vibration as 12 Hz. An extra 2 kg mass is coupled to "m" and the natural frequency reduces by 2 Hz. Find the values of k and m. **[6]**

Q3) a) Define the following terms related to vibrations : **[4]**

i) Logarithmic decrement
ii) Damping coefficient
iii) Damping factor
iv) Critical damping coefficient

P.T.O.

b) A gun barrel, weighing 600 kg has a recoil spring of stiffness 345 N/mm. If the barrel recoils 1 m on firing, find : **[6]**

i) The initial recoil velocity of the gun

ii) The critical damping coefficient which is engaged at the end of recoil stroke.

Assume no energy is lost in the recoil of the barrel.

OR

Q4) a) Derive a relation to determine the loss of amplitude per cycle in case of Coulomb damping. **[4]**

b) A flywheel is mounted as shown in following fig.1. If the flywheel mass is 500 kg and radius of gyration is 0.5 m and if the shaft is of 50 mm diameter, find the natural frequency of this system. Assume modulus of rigidity to be 80 GPa. **[6]**

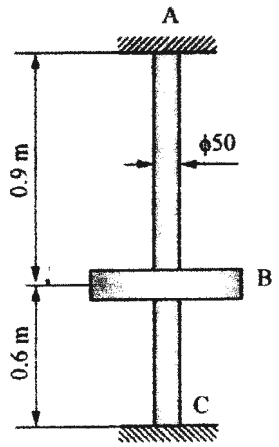

Fig. 1

Q5) a) Explain frequency response curves with neat diagram. **[6]**

b) The rotating machine having total mass of 20 kg. has an eccentric mass of 1.5 kg with eccentricity 25 mm. The machine rotates at 720 rpm. If the amplitude of vibration which is 20 mm, lags the eccentric mass by 90º, determine : **[10]**

i) The natural frequency of the system

ii) The damping factor

iii) The amplitude and phase angle when eccentric mass rotates at 1440 rpm.

OR

Q6) a) Derive an expression of magnification factor in case of steady state forced vibrations. **[6]**

b) A machine part of mass 4 kg vibrates in a viscous fluid. Find the damping coefficient when a harmonic excitation force of 50 N results in a resonant amplitude of 250 mm with a period of 0.4 sec. If the excitation frequency is 2 Hz, find the percentage increase in the amplitude of forced vibration when the damper is removed. **[10]**

Q7) Set up the differential equations of motion for an automobile having the following data and determine the two natural frequencies and principal modes of vibrations of the automobile : **[16]**

Weight of automobile = 2000 N;

Radius of gyration about its CG = 1.1 m

Wheel base = 3 m

Distance between front axle & CG = 1.4 m;

Combined stiffness of front springs = 6×10^6 N/m;

Combined stiffness of rare springs = 6.5×10^6 N/m

OR

Q8) a) Explain following terms : **[4]**

i) Mode shapes

ii) Eigen vector

iii) Eigen value

iv) Mathematical modelling

b) The flywheel of an engine driving a dynamo has mass of 200 kg and has a radius of gyration of 300 mm. The shaft at the flywheel end has an effective length of 250 mm and is 50 mm diameter. The armature mass is 225 kg and has a radius of gyration of 255 mm. The dynamo shaft has a diameter of 43.75 mm and a length of 200 mm. Neglecting the inertia of the shaft and coupling, calculate the frequency of the torsional vibrations and position of node. Take the modulus of rigidity for shaft material as 80 GPa. **[12]**

Q9) a) Explain the ISO standards for vibration measurement. **[4]**

b) Explain the construction and working of piezoelectric accelerometer with neat diagram. **[6]**

c) A machine of one tonne is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping $\zeta = 0.2$ are used. Determine : **[8]**

i) the force transmitted to the foundation

ii) the amplitude of vibration of machine

iii) the phase lag

OR

Q10) a) Explain various methods of vibration control? **[4]**

b) Explain the principle and working of undamped dynamic vibration absorber with neat diagram. **[6]**

c) An instrument of 50 kg mass is located in an airplane cabin which vibrates at 2000 cpm with an amplitude of 0.1 mm. Determine the stiffness of the four steel springs required as supports for the instrument to reduce its amplitude to 0.005 mm. Also calculate the maximum total load for which each spring must be designed. **[8]**