Ref.No.Ex /ME/T/312/2017(S)

BME 3RD YR 1ST SEM SUPPLE EXAM, 2017

(3rd year 1st semester)

SUBJECT DYNAMICS OF MACHINES

Time: Three hours

Full marks: 100

Answer any 5 questions. All questions carry equal marks

Question 1

An electric motor of mass 50 kg is mounted on an isolator block of mass 1200 kg and the natural frequency of the total assembly is 160 cycles per minute with a damping factor of $\xi = 0.10$ (See Figure Q1). If there is an unbalance in the motor that results in a harmonic force $F = 100sin10\pi t$ Newton, determine the amplitude of vibration of the block and the force transmitted to the floor.

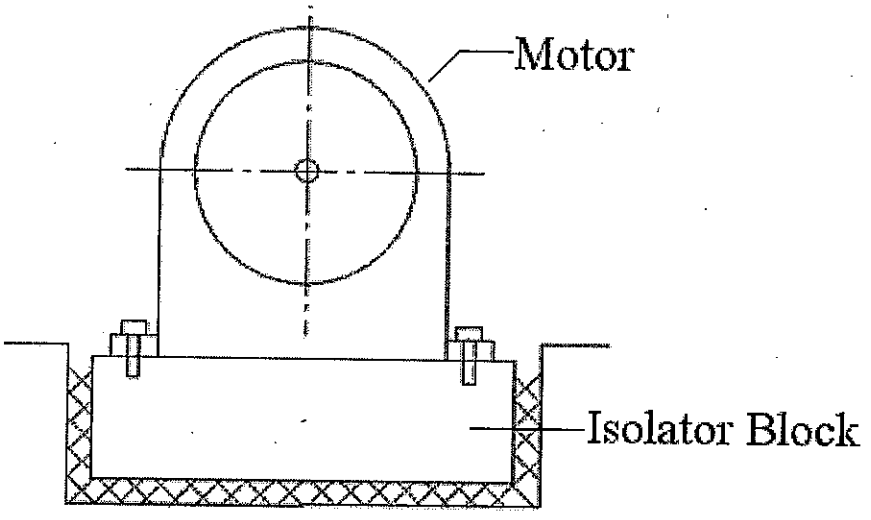

Figure Q1

Question 2

A counter-rotating eccentric mass exciter shown in FigureQ2 is used to determine the vibration characteristics of a structure of mass of 200kg. At a speed of 900rpm, a stroboscope shows the eccentric masses to be at the top at the instant the structure is moving upward through its static equilibrium position, and the corresponding amplitude is 20mm. If the unbalance of each wheel of the exciter is 0.1 kg-meter, determine

a. The natural frequency of the structure
b. The damping factor of the structure
c. The amplitude at 1200rpm
d. The angular position of the eccentric at 1200 rpm when the structure is moving up through its static equilibrium position

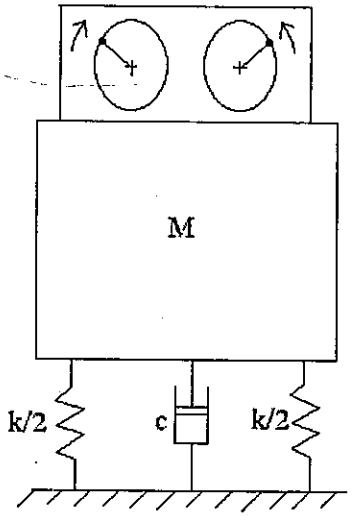

Figure Q2

Question 3

A vibrating system consists of a mass of 4.534kg, a spring of stiffness 35.0N/cm, and a dashpot with a damping coefficient of 0.1243N/cm/s. Find

(a) Natural frequency
(b) The damping factor
(c) The logarithmic decrement and
(d) The ratio of any two consecutive amplitudes
(e) Time after which the amplitude of free vibration becomes half of its initial value

Question 4

Determine the approximate fundamental natural -frequency of the shaft-disc system shown in FigureQ4. Use Rayleigh's method **OR** Dunkerley's equation.

Hint: You may use the relation $y(x) = \frac{Wbx}{6EIl}(l^2 - x^2 - b^2);\ x \leq (l - b)$

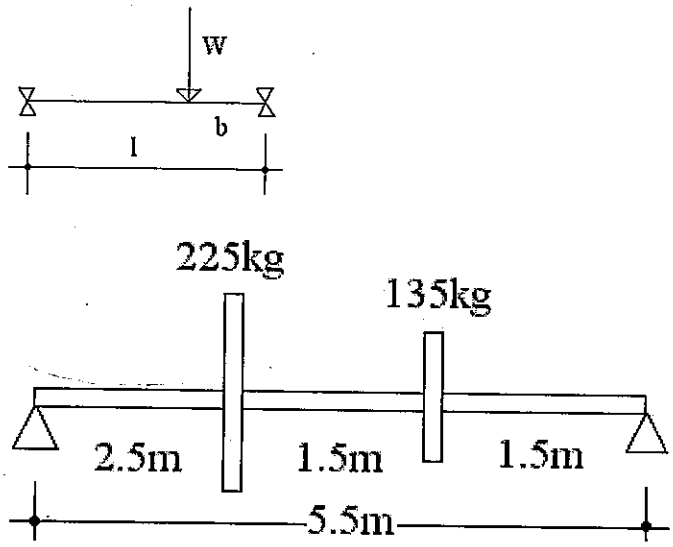

Figure Q4

Question 5

a. Analyze a 5 cylinder radial engine by the method of direct and reverse cranks for primary and secondary unbalance force.

b. Consider a 5 cylinder 2 stroke in-line engine (Fig.Q.5b) with equal angular intervals between cranks and equal distance between cylinders. The firing order is 1-4-3-2-5. Analyze the engine for primary and secondary force and couple balance.

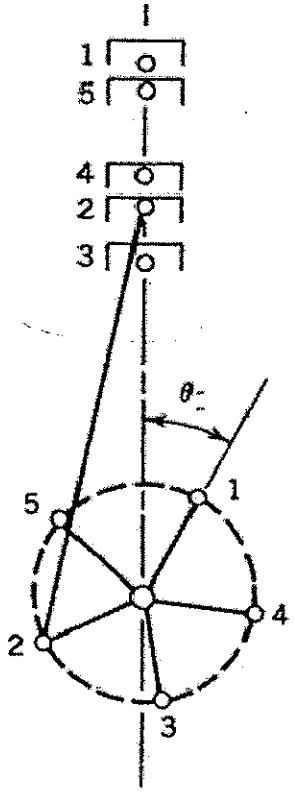

Fig.Q.5b

Question 6

The torque developed by an IC engine is given by

$$T = (100 + 35\ \ sin2\theta - 40\ \ cos2\theta)Nm$$

Where $\theta$is the angle turned by the crank from inner-dead-centre

The engine speed is 300rpm. The mass of the flywheel is 200kg and radius of gyration is 400mm. Determine

a. Power developed by the engine
b. Percentage fluctuation of speed with reference to mean speed
c. Angular acceleration of the flywheel when the crank has rotated $60^o$from IDC
d. Maximum angular acceleration and deceleration of the flywheel

(Hint: Note that the torque repeats after π)