Ref. No. Ex/ME/T/312/2019

Bachelor of Mechanical Engineering

3rd year 1st semester Examination 2019

Dynamics of machines

Time : 3 hours | Full marks : 100

Answer ALL Questions

15 marks

1) The crank effort diagram for an engine is given by T(kgfm)=7850+1500 Sin2θ, where θ is the crank displacement. The crank has a mean speed of 100 rpm and the resisting toque is constant. Find –

(i) HP of the engine

(ii) The weight of the flywheel rim having a mean radius of 4m to limit the speed fluctuation to 2%.

(iii)The angular acceleration when the crank is 30° from the dead centre.

OR

For a slider crank mechanism prove that –

(i) The approx expression for angular velocity and angular acceleration of the connecting rod is $\frac{\omega \cos\theta}{n}$ and $\frac{-\omega^2 \sin\theta}{n}$ respectively.

(ii) The approx expression for corrective torque is - $\frac{-m_{con} a(l-L)\omega^2 \sin 2\theta}{2n^2}$

(iii) Comment on the statement 'Inertia torque can't alter the average torque during a cycle but has effect on torsional oscillation of the crank shaft'

15 marks

2) (a) Discuss the state of balance of 6 cylinder 4 stroke engine with firing order 1-3-5-6-4-2 in the Primary and secondary by evaluating the unbalance forces and moments (about CM).

10 marks

(b) Prove from fundamentals that the primary unbalance of a 90° V-engine can be balanced by a pure rotating mass.

[Turn over

OR (for 2(b))

Investigate the state of primary and secondary balance of a 5 cylinder radial engine using the method of direct and reverse crank.

15 marks

3) Fig Q3 shows a 2 dof system. Deduce its equation of motion. Obtain it's natural frequencies and mode shapes. Plot the mode shapes.

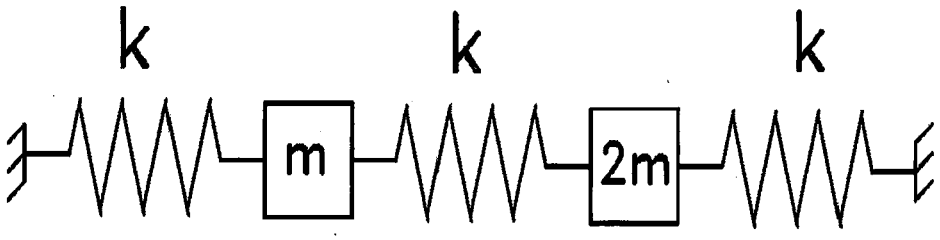

Fig Q3

OR

Deduce the equation of motion of the system shown in fig Q3(OR) in terms of angular displacement of the lever. Hence determine the natural frequency.

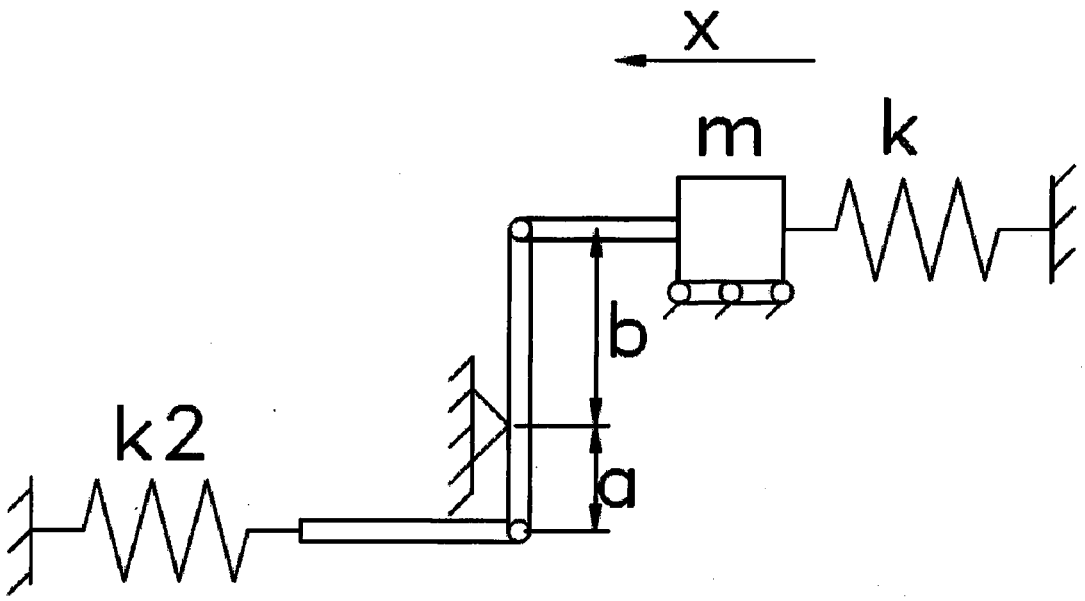

Fig Q3 (OR)

15 marks

4)Obtain the undamped transient response of a single degree of freedom spring mass system subjected to the rectangular pulse shown in fig Q4 using Duhamel's integral.

OR

Deduce the expression for Force transmissibility from fundamental principles. Sketch the plot of the expression. Show the point where transmissibility is 1. Hence, show the zone for safe design of isolator.

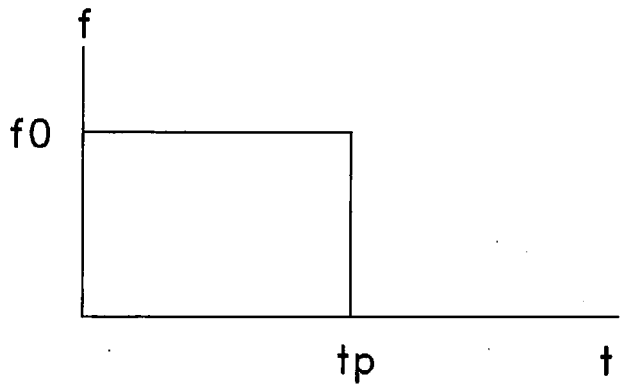

Fig Q4

10 marks

5) (a)Discuss the half power method for determination of damping ratio of a system experimentally. Deduce the relevant expression

OR (for 5(a))

Explain the principle of operation of a piezoelectric accelerometer. Deduce the relevant expression.

5 marks

(b) Explain why at high frequency accelerometer is preferred over displacement sensor.

15 marks

6) A vertical rotor has a disc of mass 10kg at mid span of a shaft of diameter 10mm and length 300mm. Calculate the critical speed of the rotor. The rotor runs at 2560 rpm and has an eccentricity of 0.25 mm. Calculate the maximum dynamic stress on the shaft. Neglect the mass of the shaft. Can the stress be reduced at the same speed of operation by increasing the shaft diameter?