C 6151 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION JUNE 2010

ME 04 606—DYNAMICS OF MACHINERY

(2004 Admissions)

Time : Three Hours Maximum : 100 Marks

Answer all questions.
Missing data, if any may be suitably assumed.
Clearly mention the assumptions made. Draw neat sketches.
Drawing conventions are to be strictly followed.

I (a) Explain the principle of virtual work.

(b) Define and explain the terms : Gears, Friction wheels, Spur gears, Bevel gears and Helical gears.

(c) Draw the turning moment diagram for the following different types of engines neglecting the effect of inertia of the connecting rod :—

(i) For a single cylinder double acting steam engine.

(ii) For a four stroke cycle I.C.engine and

(iii) For a multi cylinder engine.

(d) What do you meant by static balancing and dynamic balancing ? What are the necessary conditions to achieve them ?

(e) Define and explain the terms : Vibrations, Free vibration, Forced vibration and Damped vibration.

(f) Find an expression for natural frequency of free torsional vibrations when

(i) Effect of inertia of shaft is not considered, and

(ii) Effect of inertia of shaft is considered.

(g) Find the mechanical impedance Z of the top point of a spring k, from which is suspended a mass m.

(h) With the help of equations and graph, differentiate between seismometer and accelerometer.

($8 \times 5 = 40$ marks)

II (a) The following data relate to a horizontal reciprocating engine : the mass of reciprocating parts are 120 kg, crank length is 90 mm, engine speed is 600 rpm, mass of the connecting rod is 90 kg, length between centres is 450 mm, distance of centre of mass from big end centre is 180mm, radius of gyration about an axis through centre of mass is 150 mm. Find the magnitude and the direction of the inertia torque on the crankshaft when the crank has turned 30° from the inner dead centre.

(15 marks)

Or

Turn over

(b) The dimension of a four link mechanism are : AB = 400 mm, BC = 600 mm, CD = 500 mm, AD = 900 mm and angle between DAB is 60°. AD is the fixed link. E is a point on link BC such that BE = 400 mm and CE = 300 mm (BEC clockwise) A force of 150 angle 45° N acts on DC at a distance of 250 mm from D. Another force of magnitude 100 and angle 180° N acts at point E. Find the required input torque on link AB for static equilibrium of the mechanism.

(15 marks)

III (a) A disturbing mass 600 kg is attached to a shaft. The shaft is rotating at a uniform angular velocity ω rad / sec and the distance of the C.G. of the disturbing mass from the axis of rotation is 270 mm. The disturbing mass is to be balanced by two masses in two different planes. The distance of the C.G. of the balancing massesfromthe axis of rotation is 450 mm each. The distances between the two planes of the balancing masses is 1.5 m and the distance between the plane of the disturbing mass and one of the planes of the balancing masses is 300mm. Determine : (i) the distance between the plane of disturbing mass and the plane of the other balancing mass. (ii) magnitude of balancing masses when (1) the planes of balancing masses are on the same side of the plane of the disturbing mass. (2) the planes of the balancing masses are on either side of the plane of the disturbing mass.

(15 marks)

Or

(b) The cranks of a two cylinder uncoupled outside cylinder locomotive are at right angles and are 300mm long. The distance between the centre lines of the cylinder is 1.8 m. The wheel centre lines are 1.4m apart. The rotating mass per cylinder is 350 kg and the mass of the reciprocating parts per cylinder is 285 kg.The whole of the rotating and two third of the reciprocating masses are to be balanced in the plane of the driving wheels at a radius of 800mm. Determine: (i) the magnitude and angular positive of balance masses, (ii) the maximum speed of the locomotive in km/hr.without lifting in wheels from the rails if the dead load on each driving wheel is 28000N and diameter of the driving wheel is 1.8m and (iii) swaying couple at the maximum speed.

(15 marks)

IV (a) In a single degree damped vibrating system, a suspended mass of 3.75kg makes 12 oscillations in 7 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.33 of its initial value after four oscillations. Determine : (i) stiffness of the spring. (ii) logarithmic decrement. (iii) damping factor and (iv) the damping coefficient.

(15 marks)

Or

(b) The moments of inertia of three rotors A,B and C are respectively 0.3, 0.6 and 0.18 kgm^2. The distance A and B is 1.5m and between B and C is 1m. The shaft is 70 mm in diameter and the modulus of rigidity for the shaft material is 84×10^9 N/m^2. Find (i) the frequencies of torsional vibrations, (ii) positions of nodes and (iii) amplitude of vibrations.

(15 marks)

V (a) An automobile has main springs which are compressed 4 in. under the weight of the body. Assume the tires to be infinitely stiff. The car stands on a platform which is first at rest and then is suddenly moved downward with acceleration 2g. Find (i) how far does the platform move before the tires leave it ? (ii) Assuming the car to have a speed of 30 m.p.h., draw the profile of the road which would correspond to the 2g-accelerated platform. This questions has meaning for front wheels only.

(15 marks)

Or

(b) An automobile weighing 4500N has a mass moment of inertia of 2.25×10^6 N/mm^2 about an axis passing through CG. The front and rear suspension can be approximated to springs with 8.1 N/mm stiffness. CG of the vehicle is 750 mm from the front axle. Wheel base is 2000mm. Find the natural frequencies and mode shape.

(15 marks)