C 14746 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2010

ME 04 606—DYNAMICS OF MACHINERY

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

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

1. (a) Define and explain the terms : Inertia force and intertia torque.

(b) Write a brief note on force analysis bevel gear and worm gears.

(c) The maximum and minimum speed of a flywheel are 242 r.p.m. and 238 r.p.m. respectively. The mass of flywheel is 2600 kg and radius of gyration is 1.8 m. Find (i) mean speed of flywheel ; (ii) maximum fluctuation of energy.

(d) Define and explain the term 'balancing of rotating masses'. What will be the harm if the rotating parts of a high speed engine are not properly balanced ?

(e) What are the different methods of finding the natural frequency of free longitudinal vibrations ? Explain in details any two methods.

(f) Define and explain the term "torsional vibration".

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

(h) Find the mechanical impedance Z of a mass M which is attached to the ground through a spring K.

(8 × 5 = 40 marks)

II. (a) The dimensions of a four link mechanism are AB = 500 mm, BC = 660 mm, CD = 560 mm and AD = 1000 mm. The link AB has an angular velocity of 10.5 rad/s counter clockwise and an angular retardation of 26 rad/s^2 at the instant when it makes an angle of 60° with AD, the fixed link. The mass of the links BC and CD is 4.2 kg/m length. The link AB has a mass of 3.54 kg. the centre of which lies at 200 mm from A and a moment of inertia of 88500 kg.mm^2. Neglecting gravity and friction effects. Determine the instantaneous value of the drive torque required to be applied on AB to overcome inertia forces.

(15 marks)

Or

(b) The following data relate to the connecting rod of a reciprocating engine mass 50 kg. distance between bearing centres is 900 mm, diameter of big end bearing is 100 mm, and diameter of small end bearing is 80 mm. Time of oscillation when the connecting rod is suspended from big end for 1.7s and small end for 1.85s. Determine : (i) the radius of gyration k of the rod about an axis through centre of mass perpendicular to the plane of oscillation ; (ii) the moment of inertia of the rod about the same axis and (iii) the dynamatically equivalent system of the connecting rod comprising two masses, one at the small end bearing centre.

(15 marks)

III. (a) A constant torque 4 kW motor drives a riveting machine. A flywheel of mass 140 kg and radius of gyration of 0.5 m is fitted to the riveting machine. Each riveting operation takes 1 second and requires 9000 Nm of energy. If the speed of flywheel is 420 r.p.m. before riveting, then find : (i) the fall in speed of the flywheel after the riveting ; (ii) the number of rivets closed per hour.

(15 marks)

Or

(b) The crank of a two cylinder uncoupled inside cylinder locomotive are at right angles and are 300 mm long. The distance between the centre lines of the cylinder is 650 mm. The wheel centre lines are 1.6 m. apart. The reciprocating mass per cylinder is 300 kg. The driving wheel diameter is 1.8 m. If the hammer blow is not to exceed 45 kN at 100 km/hr, determine : (i) the fraction of the reciprocating masses to be balanced ; (ii) the variation in tractive effort ; (iii) the maximum swaying couple.

(15 marks)

IV. (a) Find the frequency of the transverse vibrations of a shaft which is simply supported at the ends and is of 40 mm in diameter and 2.5 m in length. The shaft carries three point loads of masses 30 kg, 70 kg and 45 kg at 0.5 m, 1 m and 1.7 m respectively from the left support. The young's modulus for the material of the shaft is 200 GN/m^2. Neglect the weight of the shaft.

(15 marks)

Or

(b) A shaft of length 1.25 m is 75 mm in diameter for the first 275 mm of its length, 125 mm in diameter for the next 500 mm length, 87.5 mm in diameter for the next 375 mm length and 175 mm in diameter for the remaining 100 mm of its length. The shaft carries two rotors at two ends. The mass moment of inertia of the first rotor is 75 kg m^2 whereas of the second rotor is 50 kg m^2. Find the frequency of natural torsional vibrations of the system. The modulus of the rigidity of shaft material may be taken as 80 GN/m^2.

(15 marks)

V. (a) In a turned dynamic vibration absorber which is connected to a SDOF system having a mass of 90 kg, the mass of the absorber is 4.5 kg and amplitude of disturbing force is 300 N. If the main mass is at rest when the forcing frequency is 100 Hz. Find the amplitude of vibration of the absorber mass and stiffness of the absorber. Also find the stiffness of the SDOF system.

(15 marks)

Or

(b) 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 runs over a road surface consisting of sine waves of 1 in. amplitude (i.e., having 2 in. height difference between crests and valleys) and with distance of 42 ft. between consecutive crests. There are no shock absorbers : (i) Find the critical speed of the car ; (ii) Find the amplitude of vertical vibration of the chassis at a forward speed of 40 m.p.h.

(15 marks)