Question Paper Code : 21040

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Fifth Semester

Mechanical Engineering

080120026 — DYNAMICS OF MACHINERY

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is function of the fly wheel?

2. Single cylinder engine needs heavier size flywheel. Justify.

3. Why rotating masses are to be dynamically balanced?

4. Define hammer blow.

5. What is the function of the governor?

6. What is gyroscopic effect?

7. What is the value of the angular velocity (ω) such that natural frequency and time period are equal?

8. Define logarithmic decrement.

9. What is the significance of node point in the case of vibration?

10. Define whirling of shaft.

PART B — (5 × 16 = 80 marks)

11. (a) The length of crank and connecting rod of a horizontal reciprocating engine are 250 mm and 1.0 m respectively. The crank is rotating at 500 rpm. When the crank has turned 30° from the inner dead centre, the difference of pressure between the cover end and piston end is 0.4 N/mm^2. If the mass of the reciprocating parts is 100 kg and cylinder bore is 0.4m, then calculate: (i) Inertia, (ii) Force on piston, (iii) Piston effort. (iv) Thrust on the sides of cylinder walls.

Or

(b) A single cylinder, single acting, four stroke cycle gas engine develops 20 kW at 200 rpm. The work done by the gases during the expansion stroke is 3 times the work done on the gases during the compression stroke. The work done on the suction and exhaust strokes may be neglected. If the flywheel has a mass of 1000 kg and has a radius of gyration of 0.6m, find the cyclic fluctuation of energy and the co-efficient of fluctuation of speed.

12. (a) A,B,C and D are four masses are carried by a rotating shaft at same radii of 200 mm. The planes in which the masses revolve are spaced 600 mm apart and the mass of B,C and D are 12 kg, 15 kg and 14 kg respectively. Find the required mass A and the relative angular positions of the four masses so that the shaft shall be in complete balance.

Or

(b) A two cylinder uncoupled locomotive with cranks at 90° has a crank radius of 320 mm. The distance between the centers of driving wheels is 1.4 m. The pitch of cylinders is 0.6 m. The diameter of treads of driving wheels is 1.8m. The radius of centers of gravity of balance masses is 0.65m. The pressure due to dead load on each wheel is 40 kN. The masses of reciprocating and rotating parts per cylinder are 330 kg and 300 kg respectively. The speed of the locomotive is 60 km/h.

Find:

(i) The balancing mass both in magnitude and position required to be placed is the planes of driving wheels to balance whole of the revolving and two-third of the reciprocating masses

(ii) The swaying couple

(iii) The variation in tractive force.

13. (a) The mass of each ball in a Wilson - Hartnell type of governor is 2.5 kg. The length of ball arm of each bell - crank lever is 100 mm where as the length of the sleeve arm of bell - crank lever is 80 mm. The minimum equilibrium speed is 200 rpm when radius of rotation is 100 mm. When the sleeve is lifted to 8 mm, the equilibrium speed is 212 rpm. The stiffness of each of the springs connected to the balls is 200 N/m. The lever for the auxiliary spring is pivoted at the midpoint. Find the stiffness of the auxiliary spring.

Or

(b) A ship is propelled by a turbine rotor which has a mass of 5 tones and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions: The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius. The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds. The ship rolls and at a certain instant it has an angular velocity of 0.02 rad/s clockwise when viewed from stern. Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.

14. (a) A mass of 7.5 kg, hangs from a spring and makes damped oscillations. The time for 60 oscillations is 35 seconds and the ratio of the first and seventh displacement is 2.5. Find (i) the stiffness of the spring, and (ii) the damping resistance in N/m/s. If the oscillations are critically damped, what is the damping resistance required?

Or

(b) A machine supported symmetrically on four springs has mass of 80 kg. The mass of the reciprocating parts is 2.2 kg which move through a vertical stroke of 100 mm with simple harmonic motion. Neglecting damping, determine the combined stiffness of the springs so that the force transmitted to the foundation is 1/20th of the impressed force. The machine crankshaft rotates at 800 rpm. If, under actual working conditions, the damping reduces the amplitudes of successive vibrations by 30% find:

(i) The force transmitted to the foundation at 800 rpm,

(ii) The force transmitted to the foundation at resonance, and the amplitude of vibrations at resonance

15. (a) Calculate the whirling speed of a 20 mm diameter and 0.6 m long shaft carrying a mass of 1kg at its mid point. The density of the shaft material is $40 Mg/m^3$ shaft and Young's modulus is $200 GN/m^2$. Assume that the shaft is freely supported.

Or

(b) The flywheel of an engine driving a dynamo has a mass of 180 kg and a radius of gyration of 25 mm. The shaft at the fly wheel end has an effective length of 250 mm and is 50 mm diameter. The armature mass is 120 kg and its radius of gyration is 22.5 mm. The dynamo shaft has 50 mm diameter and 200 mm effective length. Calculate the position of node and frequency of torsional oscillation. $C = 83 kN/mm^2$.
