Reg. No. : | | | | | | | | | | | |

C 3377

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Fifth Semester

(Regulation 2004)

Mechanical Engineering

ME 1301 — DYNAMICS OF MACHINERY

(Common to B.E. (Part-Time) – Fourth Semester – Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why flywheel is needed in a punching press?

2. Explain surge and windup.

3. Why rotating masses are to be dynamically balanced?

4. What is partial balancing? Why complete balancing of reciprocating masses is not possible in a single cylinder engine?

5. Which system is nonvibratory in nature and comes to equilibrium in exponential manner?

6. Give an application of critical damping.

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

8. Define node in the case of vibration.

9. Define the meaning of stability of a governor.

10. What is gyroscopic torque?

PART B — (5 × 16 = 80 marks)

11. (a) The length of crank and connecting rod of a horizontal reciprocating engine are 200 mm and 1.0 m respectively. The crank is rotating at 400 r.p.m. 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 0.4 m, then calculate : (i) Inertia (ii) Force on piston (iii) Piston effort (iv) Thrust on the sides of cylinder walls (v) Thrust in the connecting rod.

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 0.6 m, find the cyclic fluctuation of energy and the co-efficient of fluctuation of speed.

12. (a) A two cylinder uncoupled locomotive has inside cylinders 0.6 m apart. The radius of each crank is 300 mm and are at right angles. The revolving mass per cylinder is 250 kg and the reciprocating mass per cylinder is 300 kg. The whole of the revolving and two third of reciprocating masses are to be balanced and the balanced masses are placed, in the planes of rotation of the driving wheels, at a radius of 1 m. The driving wheels are 2 m in diameter and 1.5 m apart. If the speed of the locomotive is 80 km/h. Find the hammer blow, maximum variation in tractive effort and maximum swaying couple.

Or

(b) Write short notes on :

(i) Balancing of machines and Balancing of linkages. (8)

(ii) Derive the expression for unbalanced reciprocating primary and secondary forces in a single cylinder engine, with usual notations. (8)

13. (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 in N/m/s?

Or

(b) The flywheel of an engine driving a dynamo has a mass of 180 kg and a radius of gyration of 30 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 is 50 mm diameter and 200 mm effective length. Calculate the position of node and frequency of torsional oscillation. C = 83 kN/mm^2.

14. (a) A machine of mass 75 kg is mounted on springs of stiffness 1200 kN/m and with an assumed damping factor of 0.2. A piston within the machine of mass 2 kg has a reciprocating motion with a stroke of 80mm and a speed of 3000 cycles/min. Assuming the motion to be simple harmonic,

Find

(i) The amplitude of motion of the machine,

(ii) The phase angle with respect to the existing force,

(iii) The force transmitted to the foundation, and

(iv) The phase angle of transmitted force with respect to the exciting force.

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

(iii) The amplitude of vibrations at resonance.

15. (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 by 8mm, 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 tonnes 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/hr 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 0.03 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.

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