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

G 1414

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Fourth Semester

Mechanical Engineering

ME 236 — DYNAMICS OF MACHINES

(Common to Mechatronics Engineering)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define D'Alembert's Principle.

2. What is the function of Flywheel?

3. What is meant by Dynamic balancing?

4. Define Hammer blow with respect to locomotives.

5. State the significance of Natural Frequency.

6. List down the various types of damping a vibrating system.

7. Define dynamic magnifier.

8. What is meant by vibration isolation?

9. When is a governor said to be stable?

10. What is gyroscopic couple?

PART B — (5 × 16 = 80 marks)

11. (a) The length of crank and connecting rod of a steam engine are 0.3 m and 1.5 m respectively. The speed of crank is 180 rpm in clockwise direction. Determine the velocity and acceleration of the piston when the crank is at 45° from the inner dead centre position. Also determine the position of the crank for Zero acceleration of the piston.

Or

(b) A vertical double acting steam engine develops 100 kW at 300 rpm. The maximum fluctuation of energy is 30% of the work done per stroke. The maximum and minimum speeds are not to vary more than 1% on either side of the mean speed. Find the mass of the Flywheel required if the radius of gyration is 0.7 m.

12. (a) A shaft supported in bearing 1.6 m apart projects 400 mm beyond bearings at each end. It carries three pulleys one at each end and one at the centre of its length. The masses of the end pulleys are 40 kg and 22 kg and their centres of mass are at 12 mm and 18 mm respectively from the shaft axes. The mass of the centre pulley is 38 kg and its centre of mass is 15 mm from the shaft axis. The pulleys are arranged in a manner that they give static balance. Determine (i) the relative angular positions of the pulleys and (ii) the dynamic forces developed on the bearings when the shaft rotates at 210 rpm.

Or

(b) Two outer cranks of a four cylinder engine are set at 120° to each other with each reciprocating mass as 400 kg. The spacing between the planes of rotation of adjacent cranks are 0.4 m, 0.7 m and 0.5 m. Find the reciprocating mass and the relative angular position for each of the inner cranks, if the length of each crank is 0.35 m, the length of each connecting rod 1.7 m and the engine speed 500 rpm.

13. (a) The following data relate to a damped vibrating system: Mass = 40 kg; Spring stiffness = 50 N/mm: Damping factor 0.25. Determine the time in which the mass would settle down to 1/80th of its initial deflection. Also, what will be the number of oscillations complete to reach this value?

Or

(b) A Gun barrel of mass 600 kg has a recoil spring of stiffness 294 kN/m. If the barrel recoils 1.3 m on firing, determine (i) the initial recoil velocity of the barrel (ii) the critical damping coefficient of the dash pot which is engaged at the end of the recoil stroke (iii) the equation of motion of the gun barrel if the time of recoil is 1/4 of time period.

14. (a) A machine weighing 3.5 kg vibrates in viscous medium. A harmonic exciting force of 40 N acts on the machine and produces resonant amplitude of 18 mm with a period of 0.2 sec. Determine the damping coefficient. If the frequency of the exciting force is changed to 5 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of damper.

Or

(b) A machine supported symmetrically on four springs has a 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 crank shaft 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 the vibrations at resonance.

15. (a) Each arm of a Porter governor is 400 mm long. The upper arms are pivoted on the axis of the sleeve and the lower arms are attached to the sleeve at a distance of 40 mm from the axis. Each ball has a mass of 6 kg and the weight on the sleeve is 50 kg. Find the range of speed of the governor if the extreme radii of rotation of the balls are 260 mm and 300 mm.

Or

(b) A horizontal shaft of 80 mm length supported between the bearings is carrying a disk with radius of gyration 60 mm and a mass of 4 kg centrally. The disk spins at 800 rpm anti-clockwise when viewed from the right hand side bearing. The shaft processes about vertical axis at 50 rpm in the clockwise direction when viewed from above. Determine the resultant reaction at each bearing due to the mass and gyroscopic effect.
