# C 3300

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

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 is balancing of rotating parts necessary for high speed engines?

2. Why do you want to find the natural frequency of rotating mass?

3. Why locomotive wheels need be coupled?

4. Why single cylinder engines are not fully balanced?

5. What are the effects of hammer blow and swaying couple?

6. Give an equation of damping factor.

7. What is the need for providing a fly wheel in a punching machine?

8. Define D'Alemberts principle.

9. Mention any four materials that arrest vibration.

10. What is the need for finding the critical speed of the shaft?

PART B — (5 × 16 = 80 marks)

11. (a) A single cylinder vertical engine has a bore of 30 cm and a stroke of 40 cm. The connecting rod is 100 cm long. The mass of the reciprocating parts is 140 kg. On the expansion stroke with the crank at 30° from the top dead centre the gas pressure is 0.7 MPa. If the engine runs at 250 rpm, find

(i) The net force acting on the piston

(ii) Resultant load on the gudgeon pin

(iii) Thrust on the cylinder walls

(iv) The speed above which things remaining same, the gadgeon pin load would be reversed in direction.

Or

(b) A punching press is required to punch 30 mm diameter holes in a plate of 20 mm thick at the rate of 20 holes/min. It requires 6 N – m of energy / $mm^2$ of sheared area. If punching takes place in $\frac{1}{10}$ of a second and the rpm of the flywheel varies from 160 to 140; determine the weight of flywheel having radius of gyration K = 1 m.

12. (a) The camshaft a high speed pump consists of a parallel shaft 2.5 cm diameter and 48 cm long carries three eccentrics, each of diameter 6.0 cm and a uniform thickness of 1.8 cm. The assembly is symmetrical. The angle between the eccentrics is 120° and eccentricity is 1.25 cm. The material weighs of 0.007 kg/$cm^3$, and the speed of rotation is 1430 rpm. Find the dynamic load on each bearing due to out of balance couple. The distance between each eccentric is 8 cm from the centre of the shaft where the second eccentric is fixed. The distance between the bearings is 24 cm and symmetrically placed from the centre.

Or

(b) Prove that the resultant unbalanced force is minimum when half of the reciprocating masses are balanced by rotating masses.

13. (a) Calculate the natural frequency of a shaft diameter 10 cm and length 300 cm carrying two discs of diameters 125 cm and 200 cm respectively at its ends and weighing 480 kg and 900 kg respectively. Modulus of rigidity of the shaft is $2 \times 10^6$ kgf/$cm^2$.

Or

(b) A body of 5 kg is supported on a spring of stiffness 200 N/m and has dashpot connected to it which produces a resistance of 0.002 N at a velocity of 1 cm/sec. In what ratio will the amplitude of vibration be reduced after 5 cycles?

14. (a) A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3 find

(i) The amplitude caused by the unbalance

(ii) The transmissibility

(iii) The actual force transmitted and the phase angle.

Or

(b) A 1000 kg machine is mounted on four identical springs of total spring. Constant k and negligible damping. The machine is subjected to a harmonic external force of amplitude F = 490 N and frequency 180 rpm. Find the amplitude of the motion of machine and maximum force transmitted to the foundation, when $k = 1.96 \times 0^6$ N/m.

15. (a) The marine turbine rotor of inertia 750 $kg\,m^2$ rotates at 3000 rpm clockwise when viewed from left. If the ship pitches with angular SHM with a period of 6 s and amplitude of 0.1 rad, find

(i) The maximum angular velocity of rotor

(ii) Maximum gyroscopic couple

(iii) Gyroscopic effect as the bow dips

Or

(b) The upper arms of poter governor are pivoted on the axis of rotation, their lengths being 30 cm. The lower arms are pivoted on the sleeve at a distance of 3 cm from the axis, then lengths being 27 cm. Mass of each ball is 6 kg and the sleeve mass is 50 kg. Find the equilibrium speed for a radius of rotation of 17 cm and also the effort and power for 1% change of speed.