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

Question Paper Code : 53312

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth/Fifth Semester

Mechanical Engineering

ME 6505 — DYNAMICS OF MACHINES

(Common to : Mechanical Engineering (Sandwich)/Mechatronics Engineering)

(Regulation 2013)

(Also common to PTME 6505 — Dynamics of Machines for B.E. (Part-Time) – Fourth Semester – Mechanical Engineering – (Regulation 2014))

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by piston effort?

2. List the uses of turning moment diagrams?

3. A flywheel has an unbalanced mass of 0.15 kg at a radius of 0.4 m from the axis of rotation. Calculate the unbalanced force if the shaft rotates at 200 rpm.

4. What is hammer blow in locomotives?

5. Differentiate node and antinode with respect torsional vibrations.

6. What is damping?

7. What is the phase difference between the transmitted force and the disturbing force system if $\omega / \omega_n > 1$.

8. Write the equation of motion for the forced damped vibration.

9. Write short note on "hunting of governors".

10. The engine of an aeroplane rotates in clockwise direction when seen from the tail end and the aeroplane takes a turn to the left. What will be the effect of gyroscopic couple on the aeroplane?

PART B — (5 × 13 = 65 marks)

11. (a) The lengths of crank and connecting rod of a horizontal engine are 200 mm and 1 m respectively. The crank is rotating at 400 rpm. When the crank has turned through 30° from the inner dead centre, the difference of pressure between cover and piston rod 0.4 N/mm². If the mass of the reciprocating parts is 100 kg cylinder bore is 0.4 m, then calculate, the inertia force, force on piston, piston effort, thrust on the sides of the cylinder walls, the thrust in the connecting rod, and the crank effort. (2 + 2 + 2 + 2 + 2 + 3)

Or

(b) In a four-link mechanism shown in Fig. 1, torques T_3 and T_4 have magnitudes of 30 Nm and 20 Nm respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. For the static equilibrium of the mechanism, determine the required input torque T_2.

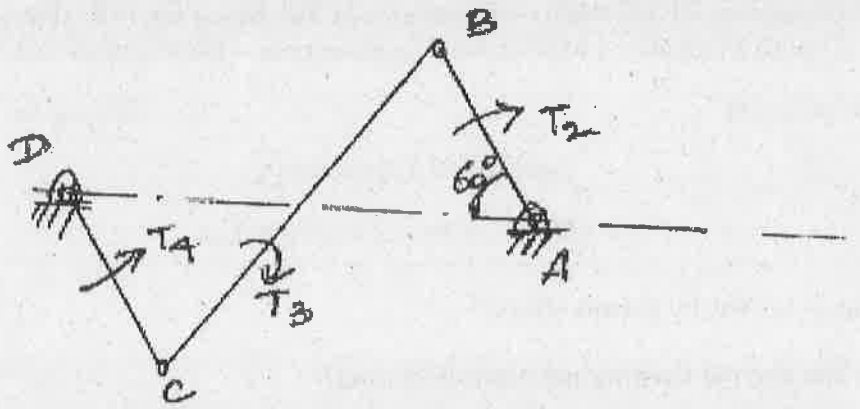

Fig. 1

12. (a) Three masses are attached to a shaft as follows : 10 kg at 90 mm radius; 15 kg at 120 mm radius and 9 kg at 150 mm radius. The masses are to be arranged so that shaft is in static balance. Determine the angular position of masses relative to 10 kg mass. All the masses are in the same plane.

Or

(b) (i) What is meant by Swaying couple? Deduce the expression for its magnitude and explain its influence. (8)

(ii) State the methods of force balancing of linkages by Lowen and Berk method. (5)

13. (a) A gun is so designed that on firing, the barrel recoils against a spring. A dash pot at the end of the recoil, allows the barrel to come back to its initial position within the minimum time without any oscillation. The gun barrel has a mass of 500 kg and a recoil spring of 300 N/mm. The barrel recoils 1 m on firing. Determine:

(i) The initial recoil velocity of the gun barrel, and (6)

(ii) The critical damping co-efficient of the dash pot engaged at the end of the recoil stroke. (7)

Or

(b) The following data relate to a shaft held in long bearings.

Length of the shaft – 1.2 m

Diameter of the shaft – 14 mm

Mass of a rotor at midpoint – 16 kg

Eccentricity of centre of mass of rotor from centre of rotor – 0.4 mm

Modulus of Elasticity of shaft material – 200 GN/mm^2

Permissible stress in shaft material – 70×10^6 N/m^2

Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Assume the shaft to be mass less. (13)

14. (a) A vehicle of mass 1200 kg is travelling on a road, the surface of which varies sinusoidally with an amplitude of 0.05 m and wave length of 6 m. The suspension system has a spring constant of 400 kN/m and a damping factor of 0.5. If the vehicle speed is 100 km/hr, determine the displacement amplitude of the vehicle. (13)

Or

(b) A centrifugal fan of mass 5 kg has a rotating unbalance of 0.25 kg m. When dampers having damping factor of 0.2 are used, specify the springs for mounting such that only 10% of the unbalance force is transmitted to the floor. The fan is running at a constant speed of 1000 rpm. (13)

15. (a) Calculate the minimum speed, maximum speed and range of the speed of a Porter governor, which has equal arms each 200 mm long and pivoted on the axis of rotation. The mass of each ball is 4 kg and the central mass on the sleeve is 20 kg. The radius of rotation of the ball is 100 mm when the governor begins to lift and 130 mm when the governor is at maximum speed. (13)

Or

(b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise, when looking from stern. Determine the gyroscopic couple and its effect upon the ship :

(i) When the ship is steering to the left on a curve of 100 m radius at a speed of 36 kmph. (6)

(ii) When the ship is pitching in a simple harmonic motion the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12°. (7)

PART C — (1 × 15 = 15 marks)

16. (a) The following data refer to the transmission gear of a motor ship :

Moment of inertia of flywheel is 4800 kg.m^2, Moment of inertia of propeller is 3200 kg.m^2, modulus of rigidity of shaft material is 80 GPa, and the equivalent moment of inertia per cylinder is 400 kg.m^2. Assuming the diameter of the torsionally equivalent crankshaft to be 320 mm and treating the arrangement as a three-rotor system, determine the frequency of the free torsional vibrations. (15)

Or

(b) A governor of the Proell type has each arm 250 mm long. The pivots of the upper and lower arms are 25 mm from the axis. The central load acting on the sleeve has a mass of 25 kg and the each rotating ball has a mass of 3.2 kg. When the governor sleeve is in mid-position, the extension link of the lower arm is vertical and the radius of the path of rotation of the masses is 175 mm. The vertical height of the governor is 200 mm. If the governor speed is 160 r.p.m. when in mid-position, find the length of the extension link and the tension in the upper arm. (15)