ME 312 (R-20)

Total No. of Questions : 10] [Total No.of Pages : 03

III/IV B. Tech. DEGREE EXAMINATIONS, DECEMBER - 2022

First Semester

MECHANICAL ENGINEERING

DYNAMICS OF MACHINES

Time : **Three Hours** Maximum : **60** Marks

Answer ONE question from each Unit.

All questions carry equal marks. 5x12=60 M

UNIT - I

1. a) Derive the expression for the inertia force in the reciprocating parts, neglecting weight of the connecting rod.

   b) Define the following terms :

   (i) Piston effort.

   (ii) crank effort.

   (iii) crank pin effort.

(OR)

2. a) Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels.

   b) The turning moment curve for an engine is represented by the equation, $T = (20\,000 + 9500 \sin 2\theta - 5700 \cos 2\theta)$ N-m, where θ is the angle moved by the crank from inner dead centre. If the resisting torque is constant, find : 1) Power developed by the engine; 2) Moment of inertia of flywheel in kg-m^2, if the total fluctuation of speed is not exceed 1% of mean speed which is 180 r.p.m; and 3) Angular acceleration of the flywheel when the crank has turned through 45^o from inner dead centre.

UNIT - II

3. a) Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn.

   b) Write a short note on Gyroscope and derive an expresion for Gyroscopic couple in standard form.

(OR)

P.T.O.

4. a) State the different methods to determine the equilibrium speed of a Porter Governor.

   b) The following particulars refer to a Wilson-Hartnell governor; Mass of each ball = 2 kg; minimum radius = 125 mm; maximum radius = 175 mm; minimum speed = 240 rpm; maximum speed = 250 rpm; length of the ball arm of each bell crank lever = 150 mm; length of the sleeve arm of each bell crank lever = 100 mm; combined stiffness of the two ball springs = 0.2 kN/m. Find the equivalent stiffness of the auxiliary spring referred to the sleeve.

UNIT - III

5. a) Explain the balancing of a reciprocating mass of a slider-crank mechanism and derive its equation.

   b) The length of each connecting rod of a 60^o V - engine is 220mm and the stroke is 100 mm, the mass of the reciprocating parts is 1.2 kg per cylinder and the crank speed 2400 rpm. Find the values of the primary and secondary forces.

(OR)

6. a) The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 r.p.m. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90^o in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine : (i) Unbalanced primary and secondary forces, if any, and (ii) Unbalanced primary and secondary couples with reference to central plane of the engine.

   b) Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass.

UNIT - IV

7. a) Derive an expression for the natural frequency of undamped free vibration by energy method and also derive an expression.

   b) Explain the various types of dampings with neat sketches.

(OR)

8. a) Establish the expression for the determination of natural frequency of torsional vibration for a two rotor system.

b) For the spring, mass, damper system the characteristic of the dash pot in such that when a constant force of 49N is applied to the piston its velocity is found to be constant at 0.12m/s. Given K = 245 N/m (i) Determine the value of C (ii) Would you expect the complete system to be periodic or aperiodic.

UNIT - V

9. a) Explain the term 'whirling speed' or 'critical speed' of a shaft. Prove that the whirling speed for a rotating shaft is the same as the frequency of natural transverse vibration.

b) Explain the transmissibility and transmitted force for a spring mass damper system.

(OR)

10. a) A machine having a mass of 100 kg and supported of total stiffness 7.8×10^5 N/m has an unbalanced rotating element which results in a disturbing force of 392 N at a speed of 3000 rpm. Assuming the damping factor as 0.2. Determine

(i) Amplitude of motion due to unbalance.

(ii) Transmissibility and

(iii) Force transmitted.

b) Explain the terms transient vibrations and steady-state vibrations.