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Question Paper Code: 35071

B.E. / B.Tech. DEGREE EXAMINATION, DEC 2021

Fifth Semester

Mechanical Engineering

01UME501 - DYNAMICS OF MACHINERY

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Define applied and constraint force.
2. List few functions of flywheel.
3. What is hammer blow?
4. State the conditions for static and dynamic balancing.
5. What are the different types of vibrations?
6. What is degree of freedom?
7. Define the term damping factor.
8. Define transmissibility.
9. What is gyroscopic torque?
10. Define the term spin, precession and gyroscopic planes.

PART - B (5 x 16 = 80 Marks)

11. (a) A single cylinder double acting steam engine develops 150 *kW* at a mean speed of 80 *r.p.m*. The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 *meter* and the hub and spokes provide 5% of the rotational inertia of the flywheel, find the mass and cross-sectional area of the flywheel rim. Assume the density of the flywheel material (which is cast iron) as 7200 kg/m^3. (16)

Or

(b) A horizontal steam engine running at 120 *rpm*, has a bore of 250 *mm* and stroke of 400 *mm*. The connecting rod is 0.6 *m* and mass of the reciprocating parts is 60 *kg*. When the crank has turned through an angle of 45° from the inner dead centre, the steam pressure on the cover end side is 550 kN/m^2 and that on the crank end side is 70 kN/m^2. Considering the diameter of the piston rod equal to 50 *mm*, determine: turning moment on the crank shaft, thrust on the bearing and acceleration of the flywheel, if the power of the engine is 20 *kW,* mass of the flywheel 60 *kg* and radius of gyration 0.6 *m*. (16)

12. (a) The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 *rpm* 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° in an end view in the order 1 - 4 - 2 – 3. The reciprocating mass corresponding to each cylinder is 1.5 *kg*. Determine unbalance primary and secondary forces, if any. And the unbalanced primary and secondary couples with reference to central plane of the engine. (16)

Or

(b) The stroke of each piston of 6 cylinder 2 stroke inline engine is 320mm and the connecting rod is 800mm long. The cylinder centre lines are spaced at 500mm. the crack are at 60° apart and firing order is 145236. The reciprocating mass per cylinder is 100kg and the rotating parts are 50kg per crank. Determine the out – of – balance force and couples about the mid plane if the engine rotates at 200rpm. (16)

13. (a) A steel shaft 1.5*m* long is 95*mm* in diameter for the first 0.6*m* of its length, 60*mm* in diameter for the next 0.5*m* of the length and 50 *mm* in diameter for the remaining 0.4 *m* of its length. The shaft carries two flywheels at two ends, the first having a mass of 900 *kg* and 0.85 *m* radius of gyration located at the 95 *mm* diameter end and the second having a mass of 700 *kg* and 0.55 *m* radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m^2. (16)

Or

(b) A vertical shaft of 5 mm diameter is 200 mm long and is supported in long bearings at its ends. A disc of mass 50 kg is attached to the centre of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft, find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75% of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. E = 200 GN/m^2. (16)

14. (a) A coil of spring stiffness 4 N/mm supports vertically a mass of 20 kg at the free end. The motion is resisted by the oil dashpot. It is found that the amplitude at the beginning of the fourth cycle is 0.8 times the amplitude of the previous vibration. Determine the damping force per unit velocity. Also find the ratio of the frequency of damped and undamped vibrations. (16)

Or

(b) A mass of 10 *kg* is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10 *N/mm*. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a periodic force of 150 *cos* 50 *t N* is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance? (16)

15.(a) In an engine governor of the porter type, the upper and lower arms are 200*mm* and 250 *mm* respectively and pivoted on the axis of rotation. The mass of the central load is 15 *kg*, the mass of each ball is 2 *kg* and friction of the sleeve together with the resistance of the operating gear is equal to a load of 25 *N* at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, find taking friction into account and range of speed of the governor. (16)

Or

(b) Find the angle of inclination with respect to the vertical of a two wheeler negotiating a turn. Given : combined mass of the vehicle with its rider 250 kg ; moment of inertia of the engine flywheel 0.3 kg-m^2 ; moment of inertia of each road wheel 1 kg-m^2 ; speed of engine flywheel 5 times that of road wheels and in the same direction ; height of centre of gravity of rider with vehicle 0.6 m ; two wheeler speed 90 km/h ; wheel radius 300 mm ; radius of turn 50 m. (16)

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