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Question Paper Code	11561

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV/DEC 2022

Fifth Semester

Mechanical Engineering

ME8594 - DYNAMICS OF MACHINES

(Regulations 2017)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	Sketch the turning moment diagram for a single cylinder four stroke IC engine.	*2,K1,CO1*
2.	List the sufficient conditions of static equilibrium of a body.	*2,K2,CO1*
3.	Mention the purpose of balancing the reciprocating mass.	*2,K2,CO2*
4.	State the effect of centrifugal force on the rotating system.	*2,K2,CO2*
5.	Write the expression for natural frequency of a transverse vibration.	*2,K1,CO3*
6.	Mention the types of vibratory motion.	*2,K2,CO3*
7.	Illustrate vibration isolation.	*2,K1,CO4*
8.	Mention different types of forced vibration.	*2,K1,CO4*
9.	Identify the effects of gyroscopic couple on rolling of ship.	*2,K2,CO5*
10.	Generalize the differences between stable governors and isochronous governors.	*2,K2,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	Derive the expression for the velocity and acceleration of the piston and connecting rod in a reciprocating engine.	*13,K3,CO1*
		OR	
	b)	A punching press pierces 35 holes per minute in a plate using 10 kN-m of energy per hole during each revolution. Each piercing takes 40% of the time needed to make one revolution. A cast iron flywheel used with the punching machine is driven by a constant torque electric motor. The flywheel rotates at a mean speed of 210rpm and the fluctuation of speed is not to exceed ±1 per cent of the mean speed. Find : (i) Power of the electric motor (ii) Mass of the flywheel (iii) Cross-sectional dimensions of the rim when the width is twice its thickness. Take hoop stress for cast iron = 4MPa and density of cast iron = 7200 kg/m^3.	*13,K3,CO1*

12. a) A, B, C and D are four masses carried by a rotating shaft at radii 100 mm, 150 mm, 150 mm and 200 mm respectively. The planes in which the masses rotate are spaced at 500 mm apart and the magnitude of the masses B, C and D are 9 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. *13,K3,CO2*

OR

b) The reciprocating masses of the first three cylinders of a four cylinder engine are 4.1, 6.2 and 7.4 tonnes respectively. The centre lines of the three cylinders are 5.2 m, 3.2 m and 1.2 m from the fourth cylinder. If the cranks for all the cylinders are equal, determine the reciprocating mass of the fourth cylinder and the angular position of the cranks such that the system is completely balanced for the primary force and couple. If the cranks are 0.8 m long, the connecting rods 3.8 m, and the speed of the engine 75rpm ; find the maximum unbalanced secondary force and the crank angle at which it occurs *13,K3,CO2*

13. a) Deduce the expression for the free longitudinal vibration in terms of spring stiffness, its inertia effect and suspended mass. *13,K3,CO3*

OR

b) Explain with sketches for different cases of damped vibrations. *13,K3,CO3*

14. a) A mass of 500 kg is mounted on supports having a total stiffness of 100kN/m and which provides viscous damping, the damping ratio being 0.4. The mass is constrained to move vertically and is subjected to a vertical disturbing force of the type F cos (ωt). Determine the frequency at which resonance will occur and the maximum allowable value of 'F' if the amplitude at resonance is to be restricted to 5 mm. *13,K3,CO4*

OR

b) A body of mass of 50 kg is supported by an elastic structure of stiffness 10kN/m. The motion of the body is controlled by a dashpot such that the amplitude of vibration decreases to one-tenth of its original value after two complete vibrations. Determine the following :
(i) the damping force at 1 m/s
(ii) The damping ratio
(iii) the natural frequency of vibration. *13,K3,CO4*

15. a) The turbine rotor of a ship has a mass of 20,000kg and a radius of gyration of 0.75 m. Its speed is 2000rpm. The ship pitches 6° above and below the horizontal position. One complete oscillation takes 18seconds and the motion is simple harmonic. Calculate :
(i) The maximum couple tending to shear the holding down bolts of the turbine *13,K3,CO5*

(ii) the maximum angular acceleration of the ship during pitching
(iii) the direction in which the bow will tend to turn while rising, if the rotation of the rotor is clockwise when looking from rear.

OR

b) A spring controlled governor of the Hartnell type with a central spring under compression has balls each of mass 2 kg. The ball and sleeve arms of the bell crank levers are respectively 100 mm and 60mm long and are at right angles. In the lowest position of the governor sleeve, the radius of rotation of the balls is 80 mm and the ball arms are parallel to the governor axis. Find the initial load on the spring in order that the sleeve may begin to lift at 300rpm. If the stiffness of the spring is 30kN/m, what is the equilibrium speed corresponding to a sleeve lift of 10 mm. *13,K3,CO5*

PART - C (1 × 15 = 15 Marks)

16. a) The flywheel of an engine driving a dynamo has a mass 180 kg and a radius of gyration of 30 mm. The shaft at the flywheel end has an effective length of 250 mm and is 50 mm diameter. The armature mass is 120 kg and its radius of gyration is 22.5 mm. The dynamo shaft is 43mm diameter and 200 mm effective length. Calculate the position of node and frequency of torsional oscillation. C = 83kN/mm^2. *15,K3,CO6*

OR

b) A racing car weighs 20kN. It has a wheel base of 2m, track width 1m and height of C.G. 300mm above the ground level and lies midway between the front and rear axle. The engine flywheel rotates at 3000rpm clockwise when viewed from the front. The moment of inertia of the flywheel is 4 kg-m^2 and moment of inertia of each wheel is 3 kg-m^2. Find the reactions between the wheels and the ground when the car takes a curve of 15 m radius towards right at 30km/h, taking into consideration the gyroscopic and the centrifugal effects. Each wheel radius is 400 mm. *15,K3,CO6*