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Question Paper Code: U5702

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Fifth Semester

Mechanical Engineering

21UME502-DYNAMICS OF MACHINERY

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. In four stroke combustion engine the crank angle for work done per cycle is CO1-U

   (a) π (b) 2π (c) 3π (d) 4π

2. The reciprocal of the coefficient of fluctuation of speed is CO1-U

   (a) N (b) C_S (c) m (d) C_E

3. If the mass of a rotating balance is 5 kg and the radius is 0.1 m, what is the centrifugal force generated at 1000 rpm? CO2-App

   (a) 31.42 N (b) 62.83 N (c) 125.66 N (d) 50.27 N

4. Which of the following statements is true for static balancing? CO1-U

   (a) Only the centrifugal forces are balanced (b) No forces are balanced

   (c) Only the inertia forces are balanced (d) Both forces are balanced

5. If the damping factor for a vibrating system is unity, then the system will be CO1-U

   (a) Critically damped (b) Without vibrations (c) Over damped (d) Under damped

6. A shaft carrying three rotors will have CO1-U

   (a) No nodes (b) One node (c) Two nodes (d) Three nodes

7. The ratio of any two successive amplitudes on the same side of the mean position is CO1-U

   (a) Amplitude reduction (b) Amplitude increment

   (c) Amplitude Equal (d) None of these

8. Which of the following factors does not affect force transmissibility in a vibrating system? CO1-U

(a) Frequency of forcing (b) Damping ratio

(c) Mass of the system (d) Temperature of the system

9. What is the primary function of a governor in a mechanical system? CO1-U

(a) To increase speed (b) To regulate speed

(c) To provide stability (d) To decrease load

10. The gyroscopic effect in an airplane during a turn helps to CO1-U

(a) Increase lift (b) Maintain orientation

(c) Decrease drag (d) Improve fuel efficiency

PART – B (5 x 2= 10Marks)

11. State D' Alembert's principle CO1-U

12. If the mass of a rotating component is 15 kg and it is offset from the axis by 0.1 m, what is the centrifugal force at 3000 rpm? CO2-App

13. Distinguish between free vibration and forced vibrations. CO1-U

14. Explain transmissibility. CO1-U

15. Explain the function of Governor. CO1-U

PART – C (5 x 16= 80Marks)

16. (a) If the crank and the connecting rod are 300 mm and 1 m long respectively and the crank rotates at a constant speed of 200 r.p.m., determine: 1. The crank angle at which the maximum velocity occurs, and 2. Maximum velocity of the piston. CO2-App (16)

Or

(b) The turning moment diagram for a multicylinder engine has been drawn to a scale of 1 mm =4500 N-m vertically and 1 mm = 2.4° horizontally. The intercepted areas between output torque curve and mean resistance line taken in order from one end are 342, 23, 245, 303, 115, 232, 227, 164 mm^2, when the engine is running at 150 r.p.m. If the mass of the flywheel is 1000 kg and the total fluctuation of speed does not exceed 3% of the mean speed, find the minimum value of the radius of gyration. CO2-App (16)

17. (a) Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotations are 4 cm, 5 cm, 6 cm and 3 cm. The angular position of the masses B, C and D are 60°, 135° and 270° from the mass A. Find the magnitude and position of the balancing mass at a radius of 10 cm. CO2-App (16)

Or

(b) An inside cylinder locomotive has its cylinder centre lines 0.7 m apart and has a stroke of 0.6 m. The rotating masses per cylinder are equivalent to 150 kg at the crank pin, and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5 m apart. The cranks are at right angles. The whole of the rotating and 2/3 of the reciprocating masses are to be balanced by masses placed at a radius of 0.6 m. Find the magnitude and direction of the balancing masses. CO2-App (16)

18. (a) A shaft 50 mm diameter and 3 metres long is simply supported at the ends and carries three loads of 100 kg at 1 m, 2 m and 2.5 m from the left support. The density of the shaft material is 70 Mg/m^3, The Young's modulus for shaft material is 200 GN/m^2. Find the frequency of transverse vibration. CO3-App (16)

Or

(b) The following data are given for a vibratory system with viscous damping: Mass = 2.5 kg; spring constant = 3 N/mm and the amplitude decreases to 0.25 of the initial value after five consecutive cycles. Determine the damping coefficient of the damper in the system. CO3-App (16)

19. (a) A machine has a mass of 125 kg and unbalanced reciprocating parts of mass 3 kg which move through a vertical stroke of 90 mm with SHM. The machine is mounted on five springs. Neglecting damping, calculate the combined stiffness of the spring in order that the force transmitted to the foundation is 1 / 20th of the applied force, when the speed of Rotation of machine crank shaft is 1200 r.p.m. When the machine is actually supported on the springs, it is found that the damping reduces the amplitude of successive free vibrations by 30%. Determine: CO3-App (16)

1. The force transmitted to foundation at 1200 r.p.m.,
2. The force transmitted to the foundation at resonance.

Or

	(b)	A body having a mass of 20 kg is suspended from a spring which deflects 15 mm under weight of mass. What is the viscous damping force needed to make motion aperiodic at a speed of 2 mm/s? If, when damped to this extend a distributing force having a maximum value of 120 N and vibrating at 8 Hz is made to act on body, determine the amplitude of ultimate motion.	CO3-App	(16)
20.	(a)	A Porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor.	CO3-App	(16)
		Or		
	(b)	The mass of the turbine rotor of a ship is 20 tonnes and has a radius of gyration of 0.60 m. Its speed is 2000 r.p.m. The ship pitches 6° above and 6° below the horizontal position. A complete oscillation takes 30 seconds and the motion is simple harmonic. Determine the following: 1.Maximum gyroscopic couple, 2. Maximum angular acceleration of the ship during pitch-ing, and 3. The direction in which the bow will tend to turn when rising, if the rotation of the rotor is clockwise when looking from the left.	CO3-App	(16)