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

Question Paper Code : 31041

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Fifth Semester

Mechanical Engineering

080120026 – DYNAMICS OF MACHINERY

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Note : A3 drawing sheet is to be supplied to the student

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the principle of superposition.

2. How do you perform static force analysis?

3. Why is partial balancing done for reciprocating masses?

4. What do you mean by hammer blow?

5. Derive the expression for height of watt governor.

6. Explain the gyroscopic effects on aircrafts.

7. Explain the terms free vibration and damped free vibration

8. Describe vibration isolation.

9. Explain the phenomenon of the whirling of shafts.

10. Discuss the free torsional vibrations of two-rotor systems.

PART B — (5 × 16 = 80 marks)

11. (a) A certain machine requires a torque of $(1400+200\sin\theta)$N-m to drive it, where θ is the angle of rotation of the shaft measured from some datum. The machine is direct coupled to an engine which produces a torque of $(1400+250\sin 2\theta)$N-m. The flywheel and rotating parts attached to the shaft have a mass of 300 kg and radius of gyration 0.40 m. The mean speed is 150 r.p.m. Calculate :

(i) The Percentage fluctuation of speed.

(ii) The maximum angular acceleration of flywheel.

Or

(b) In a double acting vertical steam engine running at 360 r.p.m., cylinder diameter is 25 cm, stroke is 30cm, diameter of piston rod is 3.75 cm and length of connecting rod is 60 cm. When the crank has moved 120° from top dead centre, the pressure of steam at cover end is 35×104 N/m^2. If the mass of the reciprocating parts is 45 kg; find

(i) piston effort and

(ii) turning moment on the crank shaft for the given crank Position. 0°

12. (a) A rotor has the following properties :

Mass	Magnitude (kg)	Radius (mm)	Angle	Distance from first mass (mm)
1	9	100	0°	
2	7	120	60°	160
3	8	140	135°	320
4	6	120	270°	560

If the shaft is balanced by two counter masses located at 100mm radii and revolving in planes midway of plane 1 and 2 and midway of 3 and 4, determine the magnitudes of the masses and their respective angular Positions.

Or

(b) The following data refer to an inside cylinder locomotive:

Mass of the reciprocating parts per cylinder 360 kg, pitch of cylinders 70 cm; Angle between cranks 90°; Length of each crank 32cm; Distance between planes of driving wheels 180 cm; Load on each wheel 5 tonnes; Diameter of tread of wheels 190 cm. If the driving wheels lift off the rails at a speed of 100 kmph and if the whole of the revolving and a fraction of the reciprocating parts are balanced, what is the value of that fraction?

13. (a) A proell governor has equal arms of length 300 mm. The upper ends of the arms are pivoted on the axis of the governor. The lower arms are pivoted to links of 40 mm from axis of rotation. Extension arms of the lower links are each 80 mm long and parallel to the axis at minimum radius. The radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10kg and the mass of the central load is 100kg. Determine the range of speed of the governor.

Or

(b) The turbine rotor of a ship is of mass 3500 kg. It has a radius of gyration of 0.45 m. and a speed of 3000 r.p.m., 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 100m radius at a speed of 36 km/hr;

(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°.

14. (a) The disc of a torsional pendulum has a moment of inertia of 600 kg-cm^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 10cm diameter and 40cm long. When the pendulum is vibrating, the observed amplitudes on the same side of the rest position for successive cycles are 9°, 6° and 4°. Determine :

(i) Logarithmic decrement

(ii) Damping torque at unit velocity, and

(iii) The periodic time of vibration. Assume for the brass shaft, $G = 4.4 \times 10^{10}$ N/m^2.

Or

(b) The vibrations of the platform of railway station are periodic at the frequency range of 12-50 Hz. A vibration measuring instrument is to be installed on some foundation independent of the platform. The small foundation is supported by four identical springs resting on the platform. The total mass of the instrument and foundation is 50 kg. What is the maximum value of spring stiffness, if the amplitude of transmitted vibration is to be less than 10% of the platform vibration over the given frequency range. Take ε =0.20. System is treated as single degree of freedom.

15. (a) A vertical shaft 1.25cm in diameter rotates in long bearings and a disc of mass 15 kg is attached to the mid span of the shaft. The span of the shaft between bearings is 50 cm. The mass centre of the disc is 0.05 cm from the axis of the shaft. Neglecting the mass of the shaft, and taking the deflection as zero for beam fixed at both ends; determine the critical speed of rotation. Detemine the range of speed over which the stress in the shaft due to bending will exceed 1250 Mpa.

Assume E = 200 Gpa.

Or

(b) Two equal masses of weight 400 kg each and radius of gyration 40 cm are keyed to the opposite ends of a shaft 60cm long. The shaft is 7.5cm diameter for the first 25 cm of its length, 12.5 cm diameter for the next 10cm and 8.5 cm diameter for the remaining of its length. Find the frequency of free torsional vibrations of the system and position of node. Assume G = 84 Gpa.

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