28 APR 2023

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Reg. No.												

Question Paper Code	11827

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023

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.	Define crank pin effort.	*2,K1,CO1*
2.	Write the expression for maximum fluctuation of energy in a flywheel.	*2,K2,CO1*
3.	State the conditions for complete balance of several masses revolving in different planes.	*2,K1,CO2*
4.	Why are the cranks of a locomotive engine with 2 cylinders placed at 90° to each other?	*2,K2,CO2*
5.	Mention any three types of damping.	*2,K1,CO3*
6.	Define critical speed.	*2,K1,CO3*
7.	What is meant by harmonic forcing?	*2,K1,CO4*
8.	Define vibration isolation.	*2,K1,CO4*
9.	What is meant by isochronous governor?	*2,K2,CO5*
10.	What is the gyroscopic effect on stability of two-wheeler when it takes a turn?	*2,K1,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	A Horizontal steam engine running at 240 rpm has a bore of 300 mm and stroke 600 mm. The connecting rod is 1.25 m long and the mass of reciprocating parts is 60 kg. When the crank is 60° past its inner dead centre, the steam pressure on the cover side of the piston is 1.125 N/mm^2 while that on the crank side is 0.125 N/mm^2. Neglecting the area of the piston rod, determine (a) the force on the piston rod and (b) the turning moment on the crankshaft.	*13,K3,CO1*
		OR	
	b)	A shaft fitted with a flywheel rotates at 250 r.p.m. and drives a machine. The torque of machine varies in a cyclic manner over a period of 3 revolutions. The torque rises from 750 N-m to 3000 N-m uniformly during 1/2 revolution and remains constant for the following	*13,K3,CO1*

revolution. It then falls uniformly to 750 N-m during the next 1/2 revolution and remains constant for one revolution, the cycle being repeated thereafter. Determine the power required to drive the machine and percentage fluctuation in speed, if the driving torque applied to the shaft is constant and the mass of the flywheel is 500 kg with radius of gyration of 600 mm.

12. a) Four masses A, B, C and D as shown below are to be completely balanced. *13,K3,CO2*

	A	B	C	D
Mass (kg)	—	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. Find : (i) The magnitude and the angular position of mass A ; and (ii)The position of planes A and D.

OR

b) The following data apply to an outside cylinder uncoupled locomotive: Mass of rotating parts per cylinder = 360 kg ; Mass of reciprocating parts per cylinder = 300 kg ; Angle between cranks = 90° ; Crank radius = 0.3 m ; Cylinder centres = 1.75 m ; Radius of balance masses = 0.75 m ; Wheel centres = 1.45 m. If whole of the rotating and two-thirds of reciprocating parts are to be balanced in planes of the driving wheels, find: (i) Magnitude and angular positions of balance masses, (ii) Speed in kilometres per hour at which the wheel will lift off the rails when the load on each driving wheel is 30 kN and the diameter of tread of driving wheels is 1.8 m, and (iii) Swaying couple at speed arrived in above (ii). *13,K3,CO2*

13. a) A shaft 1.5 m long supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. *13,K3,CO*

OR

b) A Stepped shaft is 0.05 m in diameter for the first 0.6 m length, 0.08 m diameter for the next 1.8 m and 0.03 m diameter for the remaining 0.25 m length. While the 0.05 m diameter end is fixed, the 0.03 m diameter end of the shaft carries a rotor of mass moment of inertia 14.7 kg-m^2. If the modulus of rigidity of the shaft material is 0.83×10^{11} N/m^2. Find the natural frequency of torsional oscillations, neglecting the inertia effect of the shaft. *13,K3,CO3*

14. a) A machine supported symmetrically on five springs, has a mass of 90 kg. The mass of the reciprocating parts is 3 kg which moves through a vertical stroke of 90 mm with SHM. Neglecting damping determine the combined stiffness of the springs so that force transmitted to the foundation is 1/30th of impressed force. The machine crank shaft rotates at 750 rpm. If the under actual working conditions the damping reduces the amplitude of successive vibration by 25%, find: (i) Force transmitted to the foundation at 900 rpm (ii) Force transmitted to the foundation at resonance. (iii) The amplitude of vibration at resonance. *13,K3,CO4*

OR

b) A Mass of 50 kg is supported by an elastic structure of total stiffness 20 kN/m. The damping ratio of the system is 0.2. A simple harmonic disturbing force acts on the mass and at any time t seconds, the force is 60 sin10t newton. Find the amplitude of the vibrations and the phase angle caused by the damping. *13,K3,CO4*

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, range of speed of the governor. *13,K3,CO5*

OR

b) A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of centre of gravity 500 mm above the ground level and lies at 1 metre from the front axle. Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m^2. The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel. *13,K3,CO5*

PART - C (1 × 15 = 15 Marks)

16. a) A gun is so designed that on firing, the barrel recoils against a spring. A dashpot at the end of the recoil, allows the barrel to come back to its initial position within the minimum time without any oscillation. The gun barrel has 500 kg mass and recoil spring of 300 N/mm. The barrel recoils 1m on firing. Determine (i) the initial recoil velocity of the gun barrel (ii) the critical damping coefficient of the dashpot engaged at the end of recoil stroke. *15,K3,CO6*

OR

b) In a spring-loaded governor of the Hartnell type, the mass of each ball is 1kg, length of vertical arm of the bell crank lever is 100 mm and that of the horizontal arm is 50 mm. The distance of fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor. The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5 per cent greater than the minimum equilibrium speed which is 360 r.p.m. Find, neglecting obliquityof arms, initial compression of the spring and equilibrium speed corresponding to the radius of rotation of 100 mm. *15,K3,CO6*