Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020

Subject Code:3151911 Date:29/01/2021

Subject Name:Dynamics of Machinery

Time:10:30 AM TO 12:30 PM Total Marks: 56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define following terms. i. Degree of freedom ii. Resonance iii. Damping ratio	**03**
	(b)	Differentiate static balancing and dynamic balancing.	**04**
	(c)	A heavy machine, weighing 3000 N, is supported on a resilient foundation. The static deflection of the foundation due to the weight of the machine is found to be 7.5 cm. It is observed that the machine vibrates with an amplitude of 1 cm when the base of the foundation is subjected to harmonic oscillation at the undamped natural frequency of the system with an amplitude of 0.25 cm. Find a. the damping constant of the foundation, b. the dynamic force amplitude on the base, and c. the amplitude of the displacement of the machine relative to the base.	**07**
Q.2	**(a)**	Define inertia force and inertia couple. State D′ Alembert principle.	**03**
	(b)	Classify types of vibration.	**04**
	(c)	The crank and connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The diameter of piston is 80 mm and the mass of the reciprocating parts is 1.2 kg. At a point during the power stroke when the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m^2. Determine i. Net force on the piston ii. Thrust in the connecting rod iii. Thrust on the sides of cylinder walls iv. Engine speed at which the above values are zero.	**07**
Q.3	**(a)**	Define following terms. i. Turning moment diagram ii. Coefficient of fluctuation of energy regarding flywheel iii. Critical or whirling speed of shaft	**03**
	(b)	Explain in what way the gyroscopic couple affects the motion of an aircraft while taking a turn.	**04**
	(c)	Each wheel of a motorcycle is of 600 mm diameter and has a moment of inertia of 1.2 kg.m^2. The total mass of the motorcycle and the rider is 180 kg and the combined center of mass is 580 mm above the ground level when the motorcycle is upright. The moment of inertia of the rotating parts of the engine is 0.2 kg.m^2. The engine speed is 5 times the speed of the wheels and is in the same sense. Determine the angle of heel necessary when the motorcycle takes a	**07**

turn of 35 m radius at a speed of 54 km/hr.

Q.4 **(a)** Define following terms. **03**

i. Over damped system
ii. Logarithmic decrement
iii. Under damped system

(b) Sketch displacement vs time graph showing over damped, critically damped and under damped vibration system. **04**

(c) Derive formula for natural frequency of the system shown in Figure 1. Assume the pulleys to be frictionless and of negligible mass. **07**

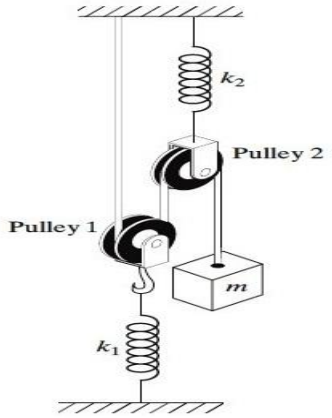

Figure 1 Pulley System.

Q.5 **(a)** Define following terms. **03**

i. Gyroscopic couple
ii. Shaking couple in reciprocating mass Critical damping constant
iii. Secondary accelerating force in reciprocating mass

(b) Discuss effects of partial balancing in locomotives in 300 words. **04**

(c) A vibrating system is defined by the following parameters : m (mass) = 3 kg, k (spring stiffness) = 100 N/m, c (viscous damping coefficient) = 3 N.s/m **07**

Determine :

i. Damping factor
ii. Natural frequency of damped vibration
iii. Logarithmic decrement
iv. Ratio of two consecutive amplitudes
v. Number of cycles after which the original amplitude is reduced to a 20 percent.

Q.6 **(a)** List conditions must be fulfilled for complete balancing of reciprocating parts. **03**

(b) Describe critical speed of shaft carrying single rotor and having no damping in 250 words. **04**

(c) A rotor of mass 4 kg is mounted on 1 cm diameter shaft at a point 10 cm from one end. The 25 cm long shaft is supported by bearings. Calculate the critical speed. If the center of gravity of the disc is 0.03 mm away from the geometric center of rotor, find the deflection of the shaft when its speed of rotation is 5000 r.p.m. Take E = 1.96 x 10^{11} N/m^2. Find critical speed when the rotor is mounted midway on the shaft. **07**

Q.7 **(a)** Illustrate free torsional vibration of two rotor system in 150 words. **03**

(b) Explain critical speed of shaft having multiple rotors in 200 words. **04**

(c) Four masses A, B, C and D carried by a rotating shaft at radii 80 mm, 100 mm, 160 mm and 120 mm respectively are completely balanced. **07**

Masses *B*, *C* and *D* are 8 kg, 4 kg, and 3 kg respectively. Determine the mass *A* and the relative angular position of the four masses if the planes are spaced 500 mm apart. Draw couple polygon, force polygon and diagram shows angular position of masses.

Q.8 **(a)** Define following terms. **03**

i. Amplitude ratio
ii. Transmissibility
iii. Vibrometer

(b) Define balancing machine. Describe any one type of a static balancing machine in 150 words with neat sketch. **04**

(c) Derive equation of motion for mass, spring, viscous damped and harmonic exited forced vibration system for single degree of freedom. Derive general solution of equation of motion. Prove that **07**

$$Magnificaton\ \ Factor = \frac{1}{\sqrt{\left(1-r^2\right)^2 + \left(2\zeta r\right)^2}}$$

where r is frequency ratio and ζ is damping ratio.

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