Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VI EXAMINATION – SUMMER 2020

Subject Code: 2161901 **Date:29/10/2020**

Subject Name: Dynamics of Machinery

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Explain why the reciprocating masses are partially balanced.	**03**
	(b)	Explain the terms static balancing and dynamic balancing. State the necessary conditions to achieve them.	**04**
	(c)	Four masses A, B, C and D carried by a rotating shaft are at radii 110, 140, 210 and 160 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of B, C and D are 16 kg, 10 kg and 8 kg respectively. Find the required mass 'A' and the relative angular positions of the four masses so that shaft is in complete balance.	**07**
Q.2	**(a)**	What is Hammer blow? Derive an expression for limiting speed required for hammer blow.	**03**
	(b)	Explain the balancing of several masses rotating in same plane by graphical method.	**04**
	(c)	For a twin V-engine the cylinder centerlines are set at 90^0. The mass of reciprocating parts per cylinder is 2 kg. Length of crank is 100 mm and length of connecting rod is 400 mm. Determine the primary and secondary unbalanced forces when the crank bisects the lines of cylinder centerlines. The engine runs at 1000 rpm.	**07**
		OR	
	(c)	A four stroke five cylinder in-line engine has a firing order of 1-4-5-3-2-1. The centres lines of cylinders are spaced at equal intervals of 15 cm, the reciprocating parts per cylinder have a mass of 15 kg, the piston stroke is 10 cm and the connecting rods are 17.5 cm long. The engine rotates at 600 rpm. Determine the values of maximum primary and secondary unbalanced forces and couples about the central plane.	**07**
Q.3	**(a)**	What are the desirable and undesirable effects of vibration?	**03**
	(b)	Define the terms: Natural frequency, Damping, Resonance, and Simple Harmonic Motion.	**04**
	(c)	A pendulum consists of a stiff weightless rod of length 'l' carrying a mass 'm' on its end as shown in Fig. Q.3(c). Two springs each of stiffness 'k' are attached to the rod at a distance 'a' from the upper end. Determine the frequency for small oscillation.	**07**

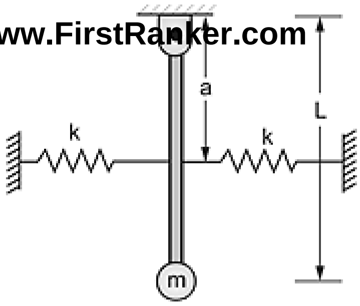

Fig. Q.3(c)

OR

Q.3	**(a)**	Find the equation for natural frequency of a spring mass vibrating system by using equilibrium method.	**03**
	(b)	Explain the terms 'under-damping', 'over-damping' and 'critical damping'	**04**
	(c)	A vibrating system is defined by the following parameters: m = 3 kg, k = 100 N/m, c = 3 N-sec/m. Determine (a) The damping factor (b) the natural frequency of damped vibration (c) logarithmic decrement (d) the ratio of two consecutive amplitudes (e) the number of cycles after which the original amplitude is reduced to 20%.	**07**
Q.4	**(a)**	Draw and explain a plot of magnification factor versus frequency ratio curves	**03**
	(b)	Define and derive an expression for logarithmic decrement	**04**
	(c)	A gun barrel of mass 500 kg has a recoil spring of stiffness 300 KN/m. If the barrel recoils 1.2 meters on firing, determine, (a) initial velocity of the barrel (b) Critical damping coefficient of the dashpot which is engaged at the end of the recoil stroke (c) Time required for the barrel to return to a position 50 mm from the initial position.	**07**

OR

Q.4	**(a)**	Differentiate between viscous damping and coulomb damping.	**03**
	(b)	How does the force transmitted to the base change as the speed of the machine increases? Explain using an equation and the corresponding graph.	**04**
	(c)	A mass of 50 kg is suspended by a spring of stiffness 12KN/m and acted on by a harmonic force of amplitude 40N. The viscous damping coefficient is 100 N-s/m. Find i. Resonant amplitude ii. Peak amplitude iii. Peak frequency iv. Resonant phase angle v. Peak phase angle	**07**
Q.5	**(a)**	What is meant by critical speed of a shaft? Which are the factors affecting it?	**03**
	(b)	Derive an expression for length of torsionally equivalent shaft system	**04**
	(c)	Two rotors A and B are attached to the end of a shaft 50 cm long. Weight of the rotor A is 300 N and its radius of gyration is 30 cm and the corresponding values of B are 500 N and 45 cm respectively. The shaft is 7 cm in diameter for the first 25 cm, 12 cm for the next 10 cm and 10 cm diameter for the remaining of its length. Modulus of rigidity for the shaft material is 8×10^{11} N/m^2. Find: (i) the position of the node (ii) the frequency of torsional vibration.	**07**

OR

Q.5 **(a)** Discuss the Rayleigh's method to obtain the natural frequency of the beam. **03**

(b) What is a continuous system? How does a continuous system differ from a discrete system in the nature of its equations of motion? **04**

(c) A rotor having a mass of 5 kg is mounted midway on a simply supported shaft of diameter 10 mm and length400 mm. Because of manufacturing tolerances, the CG of the rotor is 0.02 mm away from the geometric centre of the rotor. If the rotor rotates at 3000 rpm, find the amplitude of steady state vibrations and the dynamic force transmitted to the bearings. Neglect the effect of damping. Take $E = 2 \times 10^{11}$ N/m^2. **07**

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