

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) EXAMINATION – WINTER 2023

Subject Code:2161901

Date:15-12-2023

Subject Name: Dynamics of Machinery

Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

Q.1 (a) Derive an expression for natural frequency of torsional vibration of a disc connected at the end of the shaft. 03

(b) Why the shape of the crank is made like this  ? 04

(c) The four masses M, N, O and P having their radii of rotation as 100 mm, 120 mm, 250 mm and 300 mm respectively. The angles between the successive masses are 45° , 70° and 140° respectively. Find the position and magnitude of the balancing masses required located at the radius of 350 mm. 07

Q.2 (a) What is Hammer blow? Derive an expression for limiting speed required for hammer blow. 03

(b) If two springs of stiffness K_1 and K_2 are connected in series and mass m is attached to it. Find its natural frequency of the longitudinal vibration. 04

(c) Derive an expression for logarithmic decrement. 07

OR

(c) In an in-line six-cylinder engine working on two stroke cycle, the cylinder center lines are spaced at 600 mm. In the end view, the cranks are 60° apart and in the order 1-4-5-2-3-6. The stroke of each piston is 400 mm and the connecting rod length is 1 meter. The mass of the reciprocating parts is 200 kg per cylinder and that of rotating parts 100 kg per crank. The engine rotates at 300 r.p.m. Examine the engine for the balance of primary and secondary forces and couples. Find the maximum unbalanced forces and couples. 07

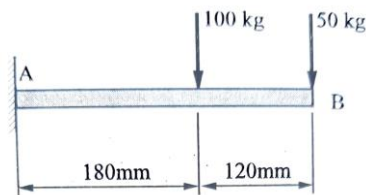
Q.3 (a) Define damping. What are different ways of providing damping? 03

(b) Derive an expression for loss of amplitude per cycle in case of dry friction damping. 04

- (c) A vibrating body of mass 150 Kg supported on springs of total stiffness 1050 KN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, determine (i) the amplitude caused by the unbalance and its phase angle, (ii) the transmissibility. 07

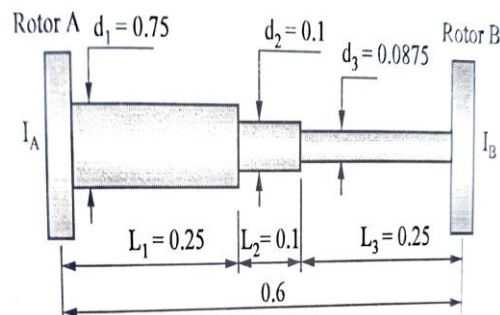
OR

- Q.3** (a) Explain the need of balancing of rotating and reciprocating masses. Explain the effects of unbalancing in rotating and reciprocating masses. 03
- (b) Explain the terms absolute and relative amplitude in vibrations. 04
- (c) In a spring mass system, a mass of 100 kg is attached with the spring of stiffness 30 KN/m. The damping provided is only the 25 % of the critical value. Determine (i) the damping ratio, (ii) the critical damping coefficient, (iii) the natural frequency of damped vibrations, (iv) the logarithmic decrement, (v) the ratio of two successive amplitudes. 07
- Q.4** (a) Justify, “reciprocating masses are partially balanced”. 03
- (b) Explain torsional vibration of geared system. 04
- (c) Using the Dunkerley’s method, find the natural frequency of transverse vibration of the system shown on figure. Given $E = 1.96 \times 10^{11} \text{ N/m}^2$ and $I_x = 4.0 \times 10^{-7} \text{ m}^2$. 07



OR

- Q.4** (a) Define (i) Natural frequency, (ii) free vibrations, (iii) amplitude of vibration 03
- (b) Find the equivalent length of the system given below considering the diameter of equivalent shaft as 0.0875 m. 04



- (c) A vibration measuring device is used to find the displacement, velocity and acceleration of a machine running at 120 rpm. If the natural frequency of the instrument is 5 Hz and it shows 0.004 cm, what are the three readings? Assume no damping. 07

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| Q.5 | (a) | Explain in brief jump phenomenon in cam | 03 |
| | (b) | Write a short note on polydyne cam. | 04 |
| | (c) | Derive an expression for critical speed of shaft carrying a rotor having damping. | 07 |

OR

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|------------|--|---|-----------|
| Q.5 | (a) | Explain types of free vibrations. | 03 |
| | (b) | Explain the working principal of multi-reed tachometer. | 04 |
| | (c) | The following particulars relate to an outside cylinder uncoupled locomotive; | 07 |
| | | Revolving mass per cylinder | 300 Kg |
| | | Reciprocating mass per cylinder | 450 Kg |
| | | Length of each cranks | 350 mm |
| | | Distance between wheels | 1600 mm |
| | | Distance between cylinder centers | 1900 mm |
| | | Diameter of driving wheels | 2000 mm |
| | Radius of balancing mass | 800 mm | |
| | If whole of the revolving and 2/3 of reciprocating masses are to be balanced, determine the magnitude and position of the balancing mass required in the planes of driving wheels. Angle between the cranks of the two cylinders is 90° . | | |
