

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2161901

Date: 10/05/2017

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	Short Questions	14
	1 What all parameters decide the angle between successive cranks in an inline engine?	
	2 Define period and cycle of vibration.	
	3 What is cam dynamics?	
	4 Name any two methods for analysis of multi degree of freedom systems.	
	5 Define resonance.	
	6 What is equivalent spring stiffness?	
	7 Define steady state and transient vibrations.	
	8 Define node in torsional vibration	
	9 Define damping ratio.	
	10 What is meant by dynamic magnifier or magnification factor?	
	11 Define torsional equivalent shaft.	
	12 When do you say a vibrating system is under damped?	
	13 What are the conditions to be satisfied for complete balancing of in-line engine?	
	14 Why radial engines are preferred for high speed applications?	
Q.2	(a) What is meant by critical speed of a shaft? Which are the factors affecting it?	03
	(b) What are the reasons for unbalance in rotating machine elements? Give two practical examples of rotating unbalances in systems.	04
	(c) Explain the method of balancing a number of masses rotating in different planes.	07
	OR	
	(c) What is meant by field balancing? Explain the procedure in detail.	07
Q.3	(a) Explain why the reciprocating masses are partially balanced.	03
	(b) Derive the expressions for primary and secondary unbalanced forces in a V -Engine.	04
	(c) A rotating shaft carries four unbalanced masses A=20 kg, B=15kg, C=18kg and D=12kg. The mass centers are 50, 60, 70 and 60 mm respectively from the axis of the shaft. The second, third and fourth masses rotates in planes 100, 150 and 300 mm respectively measured from the plane of first mass and at angular locations of 60°, 120°, and 280° respectively, measured clockwise from the first mass. The shaft is dynamically balanced by two masses, both located at 50mm radii and revolving in planes midway between those of first and second masses and midway between those of third and fourth masses. Determine the balancing masses and their angular positions.	07
	OR	
Q.3	(a) A statically balanced system need not to be dynamically balanced always. Justify the statement.	03
	(b) A V-twin engine has the cylinder axes at right angles and connecting rod operate a common crank. The reciprocating mass per cylinder is 10 Kg and crank radius is 80mm. The length of connecting rod is 0.4m. Show that the engine may be balanced for primary forces by means of a revolving balance mass. If the engine speed is 600 rpm, what is the value of maximum resultant secondary force?	04

- (c) The cranks and connecting rods of a four cylinder in-line engine running at 2000 rpm are 50mm and 200mm each respectively. The cylinders are spaced 0.2m apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass for each cylinder is 2kg. Determine (i) unbalanced primary and secondary forces, (ii) unbalanced primary and secondary couples with reference to central plane of the engine. **07**
- Q.4** (a) What is meant by lumped parameter modelling? **03**
(b) Derive the differential equation of motion for a free damped vibration. **04**
(c) A pump is supported on a spring and a damper. The spring stiffness is 6000N/m and the damper offers resistance of 480N at 3.5 m/s. The unbalanced mass of 0.6kg rotates at 40 mm radius and total mass of the system is 80 Kg. The pump is running at 500 rpm. Determine: i) damping factor, ii) amplitude of vibration iii) resonant speed and amplitude at resonance. **07**
- OR**
- Q.4** (a) Derive the expression for equivalent damping coefficient, when two dampers with damping coefficients C_1 and C_2 are connected in series and in parallel. **03**
(b) Derive the equation of motion for a disc having mass moment of inertia 'I' suspended on wire of length 'L' with diameter 'd', when the disc was given an angular twist of 'θ'. **04**
(c) Governing equation of motion of an underdamped single degree of freedom system with a mass of 31 kg is given as $d^2x/dt^2 + (3c/7m) dx/dt + (27k/7m)x = 0$. The amplitude of damped vibration reduces from 3mm to 2mm in successive vibrations in a duration of 0.1 seconds. Evaluate: i) frequency of damped vibration, ii) logarithmic decrement iii) damping factor, iv) natural frequency, v) stiffness and vi) damping coefficient. **07**
- Q.5** (a) Develop the equation for undamped response of a force closed cam follower from its lumped parameter model. **03**
(b) Explain, how the following systems can be used for vibration pickups i) LVDT, ii) Piezoelectric accelerometer. **04**
(c) Two identical rotors are attached to the two ends of a stepped shaft as shown in Figure 1. Each rotor weighs 450Kg and has radius of gyration of 0.38m. The diameters of the shaft is 0.75m for first 0.25m length, 0.1m for next 0.1m length and for the remaining length 0.0875 m is the diameter. The total length of the shaft is 0.6m. Find the frequency of free torsional vibrations of the system and position of the node from either masses. Assume modulus of rigidity as $80 \times 10^9 \text{ N/m}^2$. **07**
- OR**
- Q.5** (a) What is meant by vibration isolation and transmissibility? **03**
(b) What is meant by 'Jump' phenomenon in cam dynamics? What can be done to mitigate these? **04**
(c) A rotor has a mass of 10 kg and is mounted on the middle of 22 mm diameter horizontal shaft supported at two bearings. The length of the shaft is 1m. The shaft rotates at 2800 rpm. If the center of mass of the rotor is 0.11 mm eccentric to the geometric center of the rotor. Find the amplitude of steady state vibration and dynamic force transmitted to bearings. $E = 200 \text{ GN/m}^2$. **07**

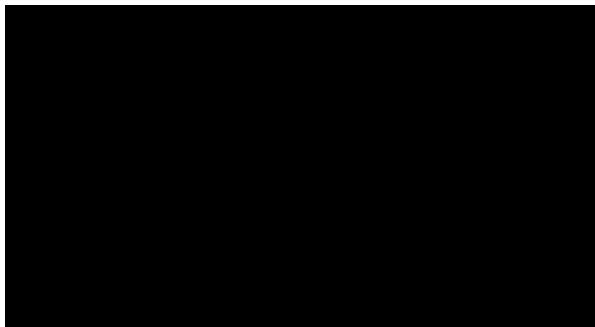


Figure 1