

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**

**BE - SEMESTER-VI (OLD) - EXAMINATION – SUMMER 2018**

**Subject Code:161901**

**Date:10/05/2018**

**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.

- Q.1** (a) Derive an expression for equation of motion of single degree free underdamped system. **07**
- (b) Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass. **07**

- Q.2** (a) Derive the following expressions, for an uncoupled two cylinder locomotive engine: (i) Variation in tractive force; (ii) Swaying couple; and (iii) Hammer blow. **07**
- (b) A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is 200 GN/m<sup>2</sup>. Determine the frequency of longitudinal and transverse vibrations of the shaft. **07**

**OR**

- (b) An inside cylinder locomotive has its cylinder centre lines 700 mm apart and has a stroke of 600 mm. The rotating masses per cylinder are equivalent to 160 kg at the crank pin, and the reciprocating masses per cylinder to 190 kg. The wheel centre lines are 1500 mm apart. The cranks are at right angles. The whole of the rotating and  $\frac{2}{3}$  of the reciprocating masses are to be balanced by masses placed at a radius of 600 mm. Find the magnitude and direction of the balancing masses. **07**
- Q.3** (a) Derive an expression for torsionally equivalent shaft system **07**
- (b) The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find : i) critical damping coefficient, ii) damping factor, iii) logarithmic decrement, and iv) ratio of two consecutive amplitudes. **07**

**OR**

- Q.3** (a) In a 60° V engine, two connecting rods operate on a common crank pin. Stroke of each piston 80 mm and length of each connecting rod is 160 mm. If the engine speed is 2000 rpm and the mass of reciprocating parts per cylinder is 1 kg; find the values of maximum primary and secondary unbalances. Describe clearly a method by which such forces may be balanced. **07**
- (b) Differentiate between static balancing and dynamic balancing. In case of dynamic balancing system, minimum two balancing masses are required for the balancing of the system. Justify. **07**

- Q.4** (a) What is whirling of shaft? Derive an expression for critical speed of a shaft carrying single rotor and without damping. **07**
- (b) The suspension of a vehicle has a spring constant of 500 KN/m and a damping ratio of 0.5. The vehicle has a speed of 80 kmph. The road surface varies **07**

sinusoidally with amplitude of 10 cm and a wavelength of 5 m. If the mass of a vehicle is 1000 Kg, determine its amplitude of oscillations.

**OR**

**Q.4 (a)** What is force transmissibility? Derive an expression for force transmissibility. **07**

**(b)** A single cylinder vertical petrol engine of total mass 300 kg is mounted upon a steel chassis frame and causes a vertical static deflection of 2 mm. The reciprocating parts of the engine has a mass of 20 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 kN per metre per second. Considering that the steady state of vibration is reached ; determine: i) the amplitude of forced vibrations, when the driving shaft of the engine rotates at 480 r.p.m., and ii) the speed of the driving shaft at which resonance will occur. **07**

**Q.5 (a)** A shaft carries five masses P, Q, R, S and T which revolve at the same radius in planes which are equidistant from one another. The magnitude of the masses in planes P, R and S are 50 kg, 40 kg and 80 kg respectively. The angle between P and R is  $90^\circ$  and that between P and S is  $225^\circ$ . Determine the magnitude of the masses in planes Q and T and their positions to put the shaft in complete rotating balance. **07**

**(b)** A steel bridge structure is deflected at midspan by winching the bridge down and then releasing it. It was observed that the amplitude of frequency decays exponentially from 9 mm to 4 mm at the end of 3 cycles. The frequency of decay is observed to be 1.7 Hz. The test was once again repeated by placing a vehicle of 35000 Kg at midspan and the frequency was observed as 1.52 Hz. Find, i) the damping factor of the structure, ii) the effective mass and stiffness of the structure. **07**

**OR**

**Q.5 (a)** Define and only write the equation of the following terms; **07**  
i) natural frequency, ii) logarithmic decrement, iii) natural frequency of damped vibration, iv) damping factor, v) dynamic magnifier, vi) displacement transmissibility.

**(b)** How vibration measuring instruments are classified? Explain any one frequency measuring instrument with neat sketch. **07**

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