INDIAN MARITIME UNIVERSITY
B Tech (ME) Arrear Examinations
September/October 2020 Time Bound Assignment
Mechanics of Machines II

UG11T3403

Time: 3 Hours	Max. Marks: 70
Date: 24.09.2020	Pass Marks: 35

Part – A (compulsory)
Answer the following (10x2=20 Marks)

1. Define the 'Semi-definite systems' which are also called 'Degenerate systems' with respect to vibrations.

2. Describe 'Equivalent length of simple pendulum' in case of a compound pendulum and state its significance.

3. Explain the 'Degree of freedom (DOF)' and state how it is related to the total number of natural frequencies of the vibrating system.

4. Describe Dunkerly's method used to determine the natural frequency of transverse vibrations.

5. A body is subjected simultaneously by two harmonic motions. They are $\mathbf{x_1 = 15 \sin (\omega t + \pi/6)}$; $\mathbf{x_2 = 8 \cos (\omega t + \pi/3)}$. Determine the amplitude and phase angle of resultant harmonic motion.

6. Explain zero-node or Imaginary node, one-node, two-node frequencies in Torsional vibrations with simple sketch.

7. Describe how you achieve would complete primary balance of high speed multi-cylinder-engine. Explain with simple sketch.

8. Describe the Whirling speed of the shaft.

9. Explain 'Critical speed range' or 'Barred speed range' as applied to a ship.

10. Show the fluctuation of primary inertia forces and secondary inertia forces due to reciprocating parts of an engine in one crank rotation with simple sketch.

Part – B

Answer any 5 out of 7 questions (5 x 10= 50 marks)

11. The camshaft of high speed pump consists of a parallel shaft 25 mm diameter and 480 mm long. It carries three eccentrics, each of diameter 60 mm and a uniform thickness of 18 mm. The assembly is symmetrical as shown in Fig. 1 and the bearings are at A and B. The angle between the eccentrics is 120° and the eccentricity of each is 12.5 mm. The material density is 7000 kg/m^3, and the speed of rotation is 1430 r.p.m
Find:
1. Dynamic load on each bearing due to the out-of-balance couple;
2. Kinetic energy of the complete assembly. **[10 Marks]**

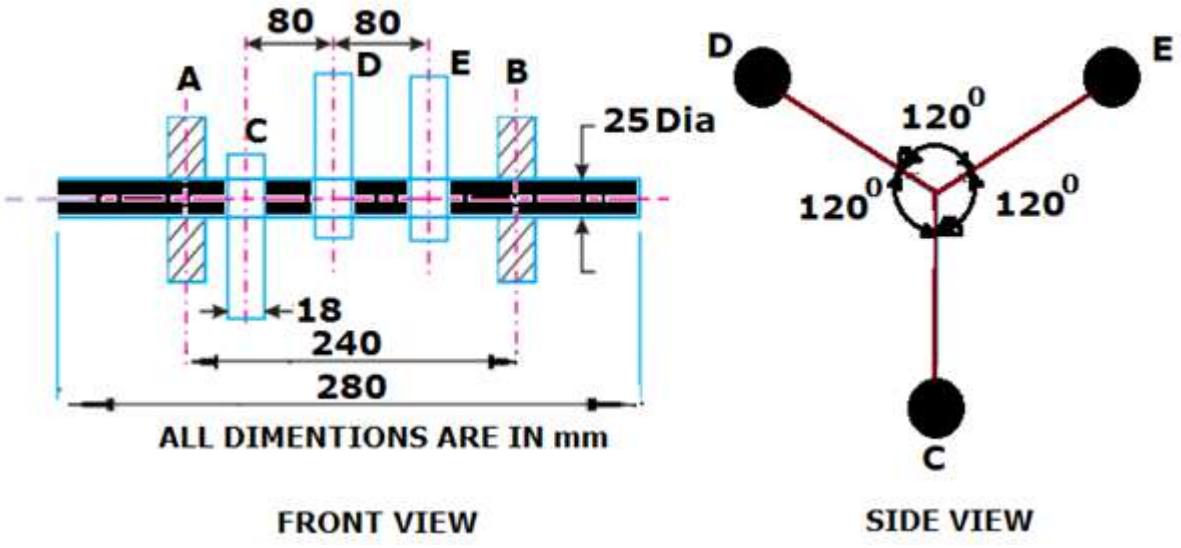

Fig.1

12. A cylinder of radius 'r' is displaced slightly from its equilibrium Position and released on a concave surface of radius 'R'. Develop the governing equation or differential equation of motion either by D'Alembert principle or by Conservation of energy principle. Also determine the natural frequency and period of oscillation. **[10 Marks]**

13. A ship is driven by diesel engine. The diesel engine running at 450 rpm is to drive the propeller of ship at 100 rpm through a reduction gear drive. The mass moment of inertia of the engine and propeller, pinion, gear are 2400 kg-m^2 and 6000 kg-m^2, 60 kg-m^2, 250 kg-m^2 respectively. The shaft connecting the engine with the pinion has a diameter of 0.32 m and length of 4 m. The shaft connecting the Gear with the propeller is hollow for the length of 5 .2 m with outer diameter of 0.46 m and inner diameter of 0.31 m. Assume G = 84 X 10^9 N/ m^2. Determine the natural frequencies and position of nodes considering the inertia of the gears. **[10 Marks]**

14. A shock absorber is to be designed for a motor cycle of mass 250 kg such that during a road bump, the damped period of vibration is to be limited to 3 seconds and the amplitude of vibration should reduce to one eighteenth in one cycle. Find
i) The stiffness of the spring required;
ii) The damping coefficient of the shock absorber. **[10 Marks]**

15. (a) A Flywheel weighing of 58.86 N is mounted midway on a simply supported shaft of diameter 10 mm and length 400 mm. The center of gravity of rotor is 0.02 mm away from the geometric center of rotor. If the Flywheel rotates at 2500 rpm find the critical speed or whirling speed, the amplitude of steady state vibrations. Assume for the shaft material E = 200 GPa **[5 Marks]**

(b) A shaft is simply supported at the ends and carries three masses of 90 kg, 140 kg, 60 kg at the distances of .8 m, 1.5 m, 2 m from Left end support. The shaft has 40 mm diameter and 2.5 m length and is subjected to UDL (Uniformly distributed load) of 15 kg/m for entire length of 2.5 m. Find the lowest natural frequency of transverse vibrations by Dunkerley's method. Assume E=200 GPa **[5 Marks]**

16. A Reciprocating engine mechanism supported on 4 symmetrically placed springs has a mass of 80 kg. The mass of reciprocating parts is 2.2 kg which moves through a vertical stroke of 100 mm with SHM. The engine crank shaft rotates at 800 rpm. If the damping is introduced in to the system reduces the amplitudes of successive vibrations by 30%. The force transmitted to the foundation is 1/20 of the impressed force.
Find

i) The stiffness of each spring if in the absence of damping
ii) Force transmitted to the foundation at 800 rpm **[10 Marks]**

17. A four stroke five cylinder in-line Engine is required to be examined for static and dynamic balance. It has a firing order of **1-4-5-3-2-1.** The distance between centre lines is 150 mm and the reciprocating mass for each cylinder is 1.5 kg, the engine stroke length is 100 mm and the connecting rod length is 175 mm. The engine runs at 600 rpm. Examine the engine for balance and determine primary and secondary unbalance couples. Determine the angle when maximum value of primary couple would occur.
[10 Marks]

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