

INDIAN MARITIME UNIVERSITY
B Tech (ME) Arrear Examinations
September/October 2020 Time Bound Assignment
Mechanics of Machines II
UG11T2403

Time: 3 Hours
Date: 24.09.2020

Max. Marks: 70
Pass Marks: 35

Part - A (Compulsory)

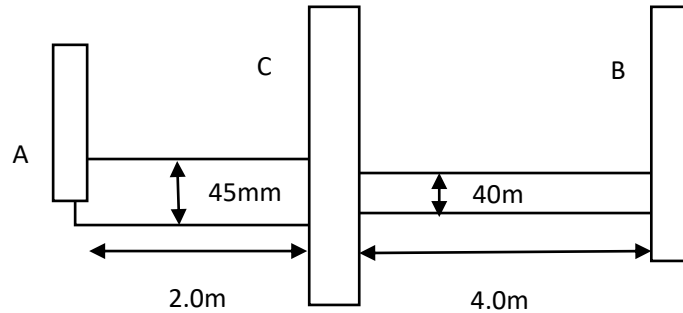
Answer the following(10x2=20Marks)

1. With the help of a sketch show the number of nodes for two rotors and three rotors system in torsional vibration.
2. Draw the sketch of a stepped shaft with rotors at both ends and write the expression of length of a torsionally equivalent shaft.
3. Explain the term 'Critical damping coefficient'. Show that it is related to damping factor.
4. Explain briefly the phenomenon of 'Whirling of Shaft'.
5. Why is balancing of rotating parts necessary for high speed engine?
6. Explain how complete secondary balance of multi-cylinder engine is carried out.
7. Define the term 'hammer blow'.
8. Explain Viscous and Coulomb damping.
9. What is the natural frequency of the longitudinal vibration of two springs of stiffness ' k_1 ' and ' k_2 ' connected in series and a mass ' m ' attached to it?
10. What is 'forced damped vibration'?

Part - B

Answer any 5 out of 7 questions (5x10=50Marks)

11. A torsional system consisting of engine (A), flywheel (C) and propeller (B) having mass moment of inertia 30kgm^2 , 90kgm^2 and 50kgm^2 respectively. The diameter of the shaft between A and C is 45mm and diameter between C and B is 40mm. The length of the shaft between A and C is 2.0m and C and B is 4.0m. Find the frequencies of torsional vibrations and the position of the nodes. Also find the amplitudes of vibrations. Take modulus of rigidity $G=84\times 10^9\text{N/m}^2$.



(10 Marks)

12. a) Derive an expression of frequency of transverse vibration of several loads by Dunkerley's method. (5 Marks)
- b) A shaft 40mm diameter and 2.5m long has a mass of 15kg per meter length. It is simply supported at the ends and carries three masses 90kg, 140kg and 60kg at 0.8m, 1.5m and 2 m respectively from the left support. Taking $E=210\text{GN/m}^2$, find the frequency of transverse vibration, moment of inertia of the beam = $0.1257\times 10^{-6}\text{m}^4$. (5 Marks)
13. a) How the different masses rotating in different planes are balanced? (4 Marks)
- b) The four masses m_1 , m_2 , m_3 and m_4 are 200kg, 300kg, 240kg and 260kg. The corresponding radii of rotation are 20cm, 15cm, 25cm and 30cm and the angles α , β , γ are 45° , 75° and 135° . Find the positional and magnitude of the balance masses required if the radius of rotation is 20cm. (6 Marks)
14. A vertical shaft 1.25cm in diameter rotates in long bearing and a disc of mass 15kg is attached to the mid span of the shaft. The span of the shaft between the bearings is 50cm. The mass center of the disc is 0.05cm from the axis of the shaft, neglecting the mass of the shaft, and taking the deflection as for the beam fixed at both ends, determine the critical speed of rotation. Determine the range of speed over which the stress in the shaft due to bending will exceed 1250bar, Assume $E=2\times 10^6\text{bar}$. (10 Marks)

15. Derive the differential equation of forced damped vibration characterizing the motion of an oscillation system subject to a damper and external exciting force. Also find the amplitude. (10 Marks)
16. What is the difference between:
- (a) Simple and Compound Pendulum?
 - (b) One and Two degree of freedom? (3x2=6 Marks)
 - (c) A light cantilever of length 'l' has a weight W(mg) fixed at the free end. Find the frequency of lateral vibration in the vertical plane. (4 Marks)
17. a) A vibrating system consists of a mass of 50kg a spring of stiffness 30kN/m and a damper. The damping provided is only 20% of critical value. Determine:
(a) the damping factor (b) the natural frequency of Damped vibration (c) the critical damping co-efficient? (5 Marks)
- b) In a single-degree damped vibration system, a suspended mass of 8kg makes 30 oscillations in 18 seconds. Determine the stiffness of the spring. (5 Marks)

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