Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), MAY 2024
MECHANICAL ENGINEERING
(2020 SCHEME)

Course Code : 20MET304

Course Name: Dynamics of Machinery and Machine Design

Max. Marks : 100 **Duration: 3 Hours**

Use of Approved Machine Design Data Handbook is Permitted

PART A

(Answer all questions. Each question carries 3 marks)

1. Define the terms (i) Coefficient of fluctuation of energy, (ii) Maximum fluctuation of speed, (iii) Coefficient of fluctuation of speed
2. What do you mean by dynamically equivalent system? Explain.
3. List the various methods to find the natural frequency of free longitudinal vibrations.
4. Explain the phenomenon of whirling of shaft.
5. Draw the stress- strain behaviour of the following materials: (i) Ductile (ii) Brittle.
6. Define Toughness, Hardness and Malleability of material.
7. What are the modes of failure of riveted joints?
8. Explain about boiler joints.
9. What is Wahl's stress factor and define spring index.
10. Differentiate between fillet welds subjected to parallel loading and transverse loading.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Describe with a neat sketch the turning moment diagram for a four-stroke internal combustion engine. (4)

    b) A vertical petrol engine 150 mm diameter and 200 mm stroke has a connecting rod 350 mm long. The mass of the piston is 1.6 kg and the speed is 1800 rpm. On the expansion stroke with crank angle 30^0 from top dead centre, the gas pressure is 750 kN/m^2. Determine (i) Net force on the piston (ii) Resultant load on the gudgeon pin (iii) thrust on the cylinder walls (iv) speed above which, other things remaining same, the gudgeon pin load would be (10)

reversed in direction.

OR

12. a) Differentiate between static force analysis and dynamic force analysis (4)

b) The turning moment diagram for a petrol engine is drawn to the following scales: Turning moment, 1mm = 5 N-m and crank angle, 1 mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and areas above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, 270 mm^2. The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 rpm. (10)

MODULE II

13. a) Explain briefly about whirling speed of a shaft. (4)

b) The mass of a single degree damped vibrating system is 10 kg and makes 24 free oscillations in 12 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.20 of its initial value after five oscillations. Determine: (i) Stiffness of the spring (ii) Logarithmic decrement, and (iii) Damping factor (10)

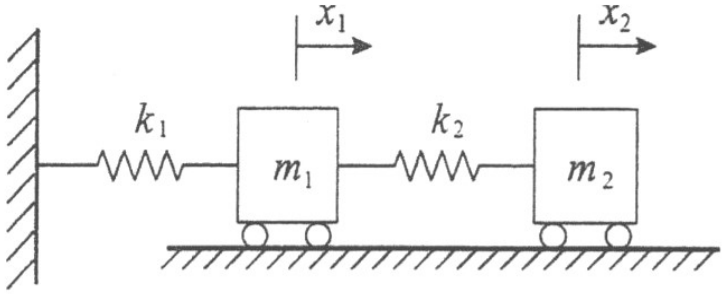
OR

14. a) Define the terms: (i) Vibration Isolation (ii) transmissibility. (4)

b) A machine weighs 20 kg and is supported on springs with effective stiffness 30 N/mm and damping coefficient 0.1 N/mm/s. The system is initially at rest and a velocity of 200 mm/s is imparted to the mass. Determine the displacement and velocity of mass after 1.2 s. (10)

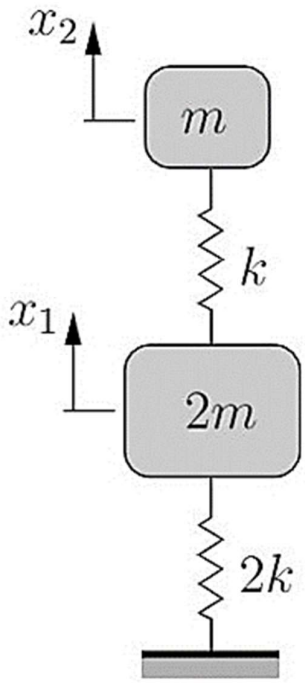
MODULE III

15. A two degree of freedom system is shown below. If $m_1 = 3m$, $m_2 = 2m$, $k_1 = 2k$, $k_2 = 3k$. Find the natural frequencies and the mode shapes. (14)



OR

16. Determine expressions for the natural frequencies and mode shapes for the system shown below



(14)

MODULE IV

17. Design a triple riveted double cover butt joint with unequal cover plates to connect two plates of 20 mm thickness. Assume σ_t = 90 MPa; τ = 60 MPa; and σ_c = 150 MPa (14)

OR

18. a) Define endurance limit. What are the factors affecting it? (4)
    b) A steel rod (σ_{ut} = 1100 MPa, σ_{yt} = 700 MPa, σ_{en} = 450 MPa) is subjected to a tensile load, which varies from 120 kN to 40 kN. Design the safe diameter of the rod using 'Soderberg criteria'. Adopt fos as 2, stress concentration factor as unity and correction factors for load, size and surface as 0.75, 0.85 and 0.91 respectively. (10)

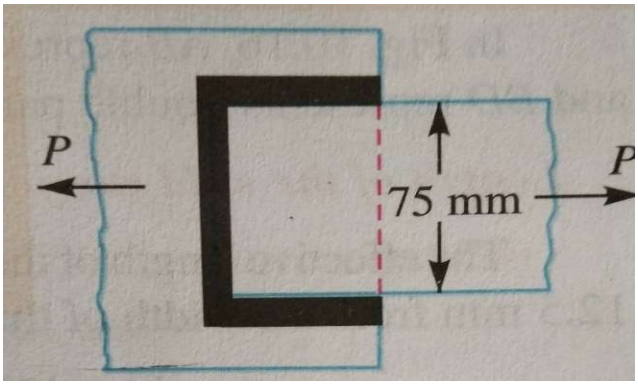
MODULE V

19. a) Explain i) surge ii) resilience and iii) curvature effect of a spring (4)
    b) Design a helical compression spring for a maximum load of 1000 N and for a deflection of 25 mm. The maximum permissible shear stress for the spring wire is 420 N/mm^2, modulus of rigidity is 0.84 $\times$ 10^5 N/mm^2 and the value of spring index is 6. (10)

OR

20. a) Describe the AWS welding symbols. (4)

b) A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig. 10.15. The maximum tensile and shear stresses are 70 MPa and 56 MPa respectively.
Find the length of each parallel fillet weld, if the joint is subjected to both static and fatigue loading.



(10)

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