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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023
MECHANICAL ENGINEERING
(2020 SCHEME)

Course Code : 20MET304

Course Name: Dynamics of Machinery and Machine Design

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

Use of approved Design Data Hand Books are premitted

PART A

(Answer all questions. Each question carries 3 marks)

1. State and explain D' Alembert's principle:
2. What do you mean by dynamically equivalent system? Explain.
3. List out the various methods of finding the natural frequency of free longitudinal vibrations:
4. Explain the phenomenon of whirling of shaft.
5. Differentiate 1 dof and 2 dof vibrating system.
6. Define stress concentration factor. How can it be minimized?
7. Explain any three failure modes of riveted joints.
8. What are the advantages of riveted joint over welded joint?
9. Describe the AWS welding symbols.
10. Write short note on surge in springs. How can surge be eliminated?

PART B

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

MODULE I

11. a) What is piston effort? Write the expression: (4)
    b) A steam engine of 200 mm bore, stroke = 300 mm and connecting rod length = 625 mm runs at 250 rpm. Given: The mass of reciprocating parts = 15 kg, The gas pressure = 840 kN/m^2. Find (i) net force on the piston (ii) turning moment on crank shaft and (iii) thrust on the crank shaft bearings, when the crank has turned through 60^0. (10)

OR

12. a) Explain the Turning moment diagram for a 4-stroke IC engine with neat figure: (6)
    b) The turning moment diagram for a petrol engine is drawn to the (8)

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.

MODULE II

13. a) Prove that ratio of amplitudes of two oscillations is constant. Also derive an expression for logarithmic decrement. (6)

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 (8)

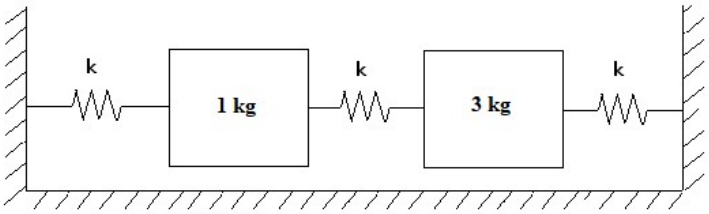
OR

14. a) Define the terms: (i) Vibration Isolation (ii) transmissibility: (6)

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. (8)

MODULE III

15. For the vibrating system shown below, form the equations of motion. Also determine the two natural frequencies and the ratio of amplitudes of both masses for the two modes of vibrations. Take k = 30 N/mm.

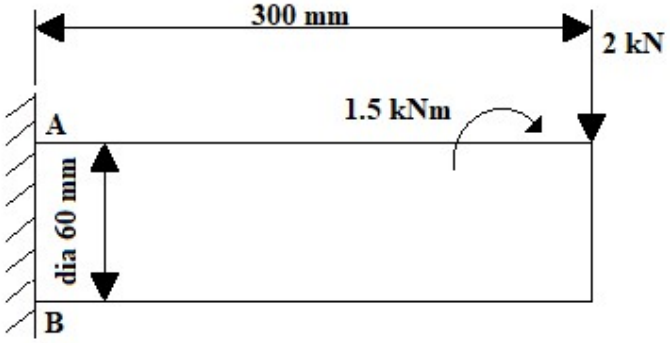


(14)

OR

16. a) Explain the various steps in the design process in detail: (6)

b) Calculate the principal stresses at points A & B of the shafts shown in figure: (8)



MODULE IV

17. a) Explain with neat diagram, Soderberg criteria for fatigue failures: (6)

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. (8)

OR

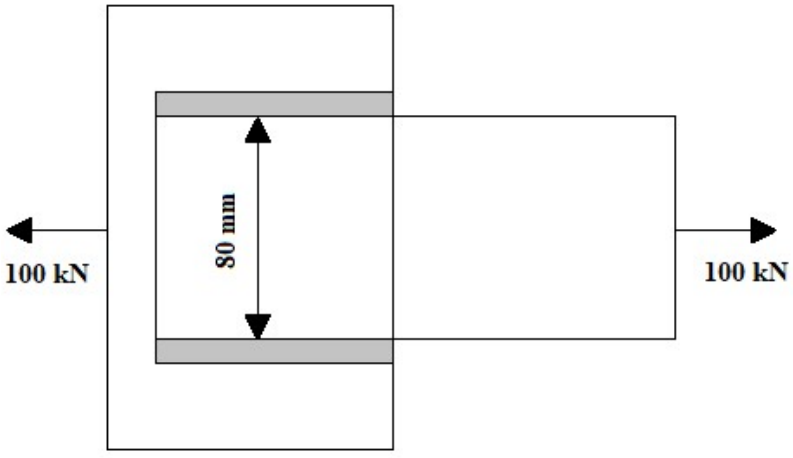
18. a) How efficiency of a riveted joint is defined? Explain: (4)

b) Design a double riveted lap joint with chain riveting for mild steel plates of 25 mm thick taking the allowable value of stress in shear, tension and compression to 50 MPa, 100 MPa, and 130 MPa respectively. (10)

MODULE V

19. a) Describe with neat sketches the different types of welded joints: (6)

b) An 80 mm wide, 12 mm thick plate carrying an axial load of 100 kN is welded to a support as shown in figure.



(8)

The tensile and shear stresses in the weld are 100 MPa and 60 MPa respectively. Find the length of each parallel fillet weld.

OR

20. a) Explain the following terms: (i) Spring rate (ii) Spring Index (4)

b) A railway wagon weighing 3000 kg is moving with a linear velocity of 1 m/s. It is brought to rest by two helical springs by undergoing a compression of 200 mm. The springs may be assumed to have a spring index of 6 and permissible shear strength of 420 MPa. Design the spring and determine the diameter of the wire, mean coil diameter and the length of the spring. Assume modulus of rigidity of the spring material as 80 GPa. (10)

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