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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R, S) / S4 (PT) (R, S) Examination June 2023 (2019 Scheme)

Course Code: MET304

Course Name: DYNAMICS AND DESIGN OF MACHINERY

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

Instructions

Use of Approved Design Data Book is Permitted

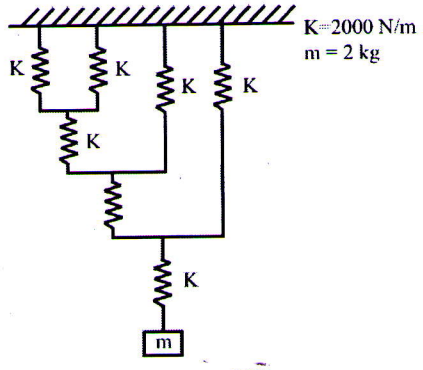
PART A

Answer all questions, each carries 3 marks. Marks

1 What do you mean by dynamic equivalent system? Explain (3)

2 The turning moment diagram for a multi cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm^2. Determine the maximum fluctuation of energy. (3)

3 Determine natural frequency of the system shown in figure (3)



4 What is damping factor and magnification factor? (3)

5 Derive an expression for critical/whirling speed of shaft. (3)

6 Explain using figures methods of reducing the stress concentration. (3)

7 Explain factor of safety. (3)

8 Explain any two modes of failures in riveted joint. (3)

9 Explain using figure Butt weld. (3)

10 What is surge in spring how it can be eliminated. (3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11 The turning moment curve for an engine is represented by the equation, T = (20 000 + 9500 sin 2 θ – 5700 cos 2θ) N-m, where θ is the angle moved by the crank from inner dead center. If the resisting torque is constant, find: 1. Power developed by the engine; 2. Moment of inertia of flywheel in kg-m^2, if the total fluctuation of speed is not exceeding 1% of mean speed which is 180 rpm; and 3. Angular acceleration of the flywheel when the crank has turned through 45° from inner dead center. (14)

OR

12 The dimensions of a four-link mechanism are AB=500mm, BC=660mm and CD = 560mm and AD=1000mm. The link AB has an angular velocity of 10.5rad/sec counter clockwise and an angular retardation of 26 rad/sec2 at the instant when it makes an angle of 600 with AD the fixed link. The mass of the links BC and CD is 4.2kg/m length. The link AB has a mass of 3.54kg, the center of which lies at 200mm from A and a moment of inertia of 88500 Kgmm2. Neglecting gravity and friction effects determine the instantaneous value of the drive torque required to be applied on AB to overcome inertia forces. (14)

Module II

13 a) In a single degree damped vibration system, a suspended mass of 8 Kg makes 30 oscillations in 18 second. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine 1. The stiffness of the spring, 2. Logarithmic decrement, 3. Damping factor and 4. Damping coefficient (9)

b) Derive equation for the natural frequency of undamped free vibration system using Newton method (5)

OR

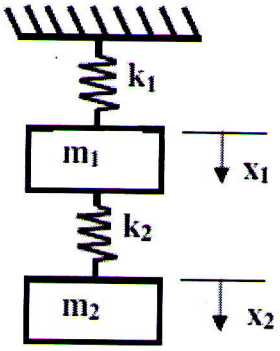
14 a) The mass of an electric motor is 120 kg and it runs at 1500 rpm. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine: 1. stiffness of each spring; 2. (9)

dynamic force transmitted to the base at the operating speed; and 3. natural frequency of the system.

b) Explain vibration isolation and transmissibility (5)

Module III

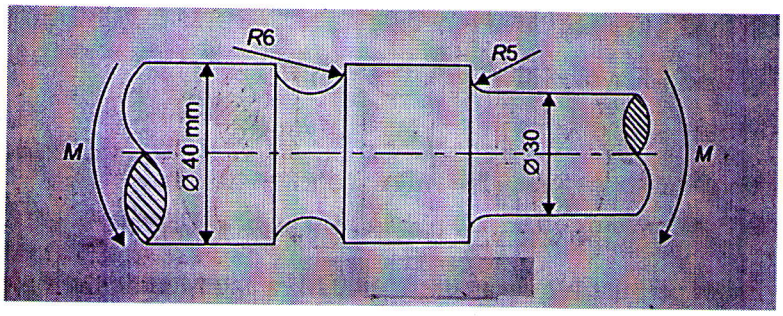
15 a) Obtain the frequency equation for the system shown in the Figure. Also determine the natural frequencies and mode shapes when k1 = 2k, k2 = k, m1 = m and m2 = 2m. (14)



OR

16 a) Explain the steps in design. (5)

b) Determine the maximum stress of the shaft shown in the figure, which is subjected to a bending moment of 550 Nm. (9)



Module IV

17 a) Explain Goodman and Soderberg criteria of failure. (5)

b) A rotating bar made of steel 45C8 (Ultimate tensile strength 630 N/mm^2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm^2. Calculate the fatigue strength of the bar for a life of 90,000 cycles. (9)

OR

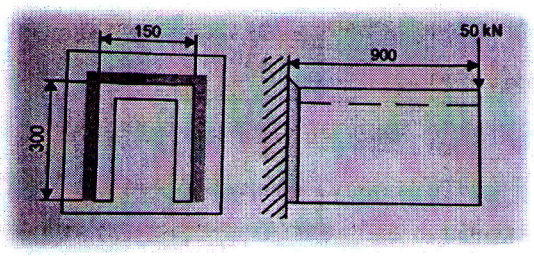
18 a) Explain the efficiency of a riveted joint. (4)

b) Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell of diameter 1.5 meters. The maximum steam pressure in the boiler is 0.95 MPa. Take the allowable stresses in tension, shear and compression as 90 MPa. 56 MPa, and 140 MPa respectively. Assume joint efficiency as 75 %. (10)

Module V

19 a) Derive the expression for the strength of a combined transverse and double parallel fillet welds. (4)

b) Determine the size of the eccentrically loaded weld for the bracket shown below. Take the allowable shear stress as 80 MPa. (10)



OR

20 a) Differentiate between Wahl's stress concentration factor and shear stress concentration factor (4)

b) Design a valve spring of a petrol engine for the following operating conditions: (10)

Spring load when the valve is open = 40 N

Spring load when the valve is closed = 25 N

Maximum inside diameter of spring = 25 mm

Length of the spring when the valve is open = 40 mm

Length of the spring when the valve is closed = 50 mm

Maximum permissible shear stress = 40 MPa and Modulus of rigidity 84 GPa.

Take spring index as 6.

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