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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S4 (PT) (S) Examination January 2024 (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		Explain the term dynamical equivalent system.	(3)
2		Define the terms: (i) coefficient of fluctuation of energy and (ii) coefficient of fluctuation of speed	(3)
3		Distinguish between longitudinal, transverse and torsional vibrations	(3)
4		Define the term transmissibility ratio and obtain the expression for the same.	(3)
5		Explain the term Principal Coordinates. List their uses.	(3)
6		Derive a relation for the shear stress developed in a shaft, when it is subjected to torsion	(3)
7		Define the terms: (i) Endurance limit, (ii) Size factor, and (iii) Notch sensitivity	(3)
8		What do you understand by the term 'efficiency of a riveted joint'? What is the highest efficiency required of a riveted joint as per IBR?	(3)
9		What is reinforcement in weld? What are its advantages and disadvantages?	(3)
10		With neat sketches, distinguish between closely coiled and open coiled helical springs.	(3)

PART B

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

Module I

11	a)	In a vertical double acting steam engine, the connecting rod is 4.5 times the crank. The weight of the reciprocating part is 110 kg and the stroke of the piston is 420 mm. The engine runs at 275 rpm. If the net load on the piston due to steam pressure is 30kN when the crank turned through an angle of 120^0 from the TDC, Determine:	(10)

(i) The thrust in the connecting rod; (ii) pressure on slide bars (iii)Tangential force on the crank pin (iv) thrust on the bearing (v) Turning moment on the crankshaft.

b) Derive the expression for the angular acceleration of the connecting rod of a reciprocating engine. (4)

OR

12 a) Obtain the expression for the maximum fluctuation of energy in a flywheel. (4)

b) The turning moment curve for an engine is represented by the equation, $T = (15\,000 + 9000 \sin 2\theta - 5000 \cos 2\theta)$ N-m, where θ is the angle moved by the crank from inner dead centre. If the resisting torque is constant, find: (10)
(i). Power developed by the engine
(ii). Moment of inertia of flywheel in kg-m^2, if the total fluctuation of speed is not exceed 1% of mean speed which is 200 rpm.
(iii). Angular acceleration of the flywheel when the crank has turned through 45° from inner dead centre.

Module II

13 a) A cantilever shaft 60 mm diameter and 600 mm long has a disc of mass 150 kg at its free end. The Young's modulus for the shaft material is 210 GN/m^2. Determine the frequency of longitudinal and transverse vibrations of the shaft. (7)

b) The mass of a single degree damped vibrating system is 8 kg and makes 34 free oscillations in 18 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.3 of its initial value after five oscillations. Determine: **1.** stiffness of the spring, **2.** logarithmic decrement, and **3.** damping factor. (7)

OR

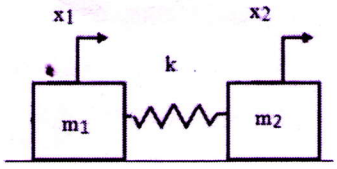
14 a) Define the term critical speed. Obtain the expression or critical speed of a shaft (6)

b) A vibrating body is supported by six isolators, each having a stiffness of 32kN/m and six dashpots having damping factor as 0.4 kN-sec/m. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06mm at 600 rpm. Take m = 30 kg. Determine: (i) amplitude of vibration of the body and (ii) dynamic load on each isolator due to vibration. (8)

Module III

15 a) Explain the term semi-definite systems (6)

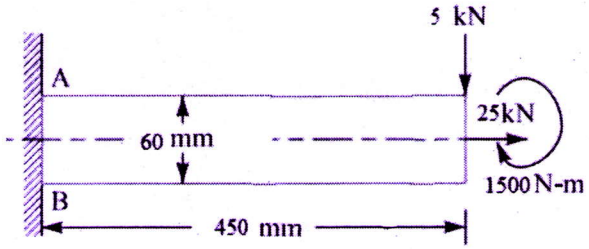
b) Find the natural frequencies and amplitude ratio of the vibration system shown below. Take $m_1 = 15$ kg, $m_2 = 20$ kg and $k = 420$ N/m (8)



OR

16 a) Explain the term Notch Sensitivity. (5)

b) A shaft, as shown in figure is subjected to a bending load of 3 kN, pure torque of 1000 N-m and an axial pulling force of 15 kN. Calculate the stresses at A and B (9)



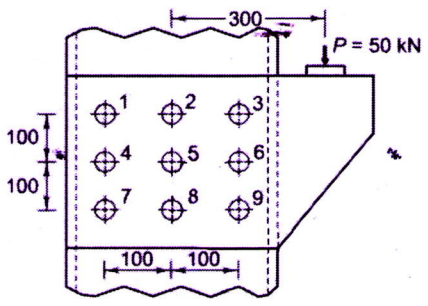
Module IV

17 a) Explain Soderberg's equation. How it is applied to different type of loadings. (6)

b) A simply supported beam has a concentrated load at the centre which fluctuates from a value of P to 4 P. The span of the beam is 500 mm and its cross-section is circular with a diameter of 60 mm. Taking for the beam material an ultimate stress of 700 MPa, a yield stress of 500 MPa, endurance limit of 330 MPa for reversed bending, and a factor of safety of 1.3, calculate the maximum value of P. Take a size factor of 0.85 and a surface finish factor of 0.9. (8)

OR

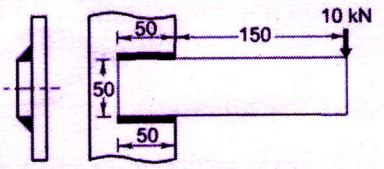
18 A bracket is attached to a steel channel by means of nine identical rivets as shown below. Determine the diameter of rivets, if the permissible shear stress is 60 N/mm^2. (14)



Module V

19 a) Obtain the expression for the strength of a transverse fillet weld joint (4)

b) A welded connection of steel plates, as shown in figure, is subjected to an eccentric force of 10 kN. Determine the throat dimension of the welds, if the permissible shear stress is limited to 95 N/mm^2. Assume static conditions. (10)



OR

20 Design a spring for a balance to measure 0 to 1500 N over a scale of length 100 mm. The spring index is 6. The spring is made of oil hardened and tempered steel wire of SW grade. Design the spring. (14)

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