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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree Supplementary Examination May 2023 (2019 Scheme)

Course Code: MET304

Course Name: DYNAMICS AND DESIGN OF MACHINERY

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

PART A

Answer all questions, each carries 3 marks. Marks

1	Explain D' Alembert's principle?	(3)
2	Derive an expression for the energy stored in a flywheel?	(3)
3	Derive an expression for logarithmic decrement?	(3)
4	What is meant by whirling of shafts?	(3)
5	Explain in brief the method to find the natural frequencies and mode shapes of multi-degree freedom vibrating system?	(3)
6	Define stress concentration factor. Mention the methods to minimize stress concentration?	(3)
7	Explain Soderberg and Goodman criteria?	(3)
8	Describe with neat sketches the types of boiler joints?	(3)
9	Differentiate between welded joints and riveted joints?	(3)
10	Write a short note on surge in spring?	(3)

PART B

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

Module I

11	a)	Determine analytically the various forces acting on the reciprocating parts of an engine, neglecting the weight of the connecting rod.	(7)
	b)	A vertical single cylinder reciprocating engine has a cylinder diameter of 200 mm and stroke length of 460 mm. The reciprocating parts have a mass of 160 kg. The connecting rod length is four times crank radius and the speed is 350 rpm, when the crank has turned through an angle of 45^0 from top dead centre. The net pressure on piston is 1.02 MPa. Calculate the effective turning moment on crankshaft for this position.	(7)

OR

12 a) During forward stroke of the piston of a double acting steam engine, the turning moment has the maximum value of 2000 Nm when the crank makes an angle of 80^0 with the IDC. During the backward stroke, the maximum turning moment is 1500 Nm, when the crank makes 80^0 with the outer dead centre. The turning moment for the engine may be assumed to be represented by two triangles. If the crank makes 120 rpm and radius of gyration of flywheel is 1.8 m, find the coefficient of fluctuation of energy and mass of the flywheel to keep the speed within ± 0.75% of the mean speed. Also determine the crank angle at which speed has its minimum and maximum values? (14)

Module II

13 a) Explain Newton's method and energy method for obtaining the natural frequency of a vibrating system? (6)

b) A rotor has a mass of 15 kg and is mounted midway on a 26 mm diameter horizontal shaft supported at the ends by two bearings located 1.5 m apart. The shaft rotates at 2000 rpm. If the centre of mass of rotor is 0.12 mm away from geometric centre of the rotor due to of certain manufacturing defect find the amplitude of steady state vibration and dynamic force transmitted to the bearing? (8)

OR

14 a) Write a short note on vibration isolation. Derive an expression for the force transmissibility of a vibrating system? (6)

b) An engine of 620 N is mounted on isolators of stiffness 1.2 kN/mm and damping factor of 0.24. The piston of the engine weighing 35 N has a stroke of 84 mm. the engine runs at 2400 rpm. Determine the force transmitted to the foundation? (8)

Module III

15 a) Find the natural frequencies of the two degree of freedom vibrating system as shown in Figure 1. The masses are $m_1 = 2$ kg, $m_2 = 1$ kg and stiffness values are $k_1 = k_3 = 100$ N/m, $k_2 = 200$ N/m. (10)

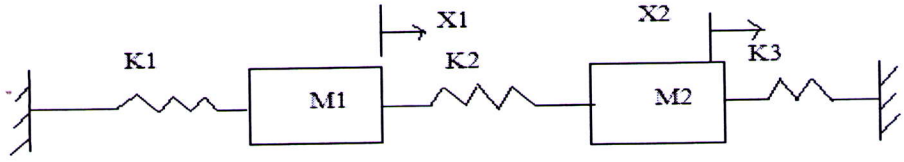

Figure 1

b) Explain the steps in the design process. (4)

OR

16 a) Explain the various consideration in the design of a machine (5)

b) A simply supported beam of rectangular cross-section having depth three times width is subjected to a point load of 25 kN at 200 mm from the left support. The span of the beam is 600 mm. Determine the dimensions of the section if the allowable strength of the material is 220 MPa? (9)

Module IV

17 a) Write a short note on endurance limit. What are the factors affecting it? (4)

b) A circular bar of length 600 mmm is supported at its ends. It is acted upon by a concentrated cyclic load at its centre which varies from 25 kN to 55 kN. If the factor of safety is 1.6, surface finish factor is 0.85, size factor is 0.8, find the diameter of the bar. The ultimate strength of the bar is 650 MPa, yield strength is 525 MPa and endurance strength is 325 MPa. (10)

OR

18 a) Two plates of 12 mm thickness are connected by a double riveted lap joint with zig-zag pattern. Assume tensile stress = 75 MPa, shear stress = 52 MPa, crushing stress = 118 MPa. State how the joint will fail and find its efficiency. (8)

b) Explain the modes of failure in a riveted joint. (6)

Module V

19 a) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load of 50 kN as shown in the Figure 2. Determine the weld-size if the shear stress is not to exceed 150 MPa? (14)

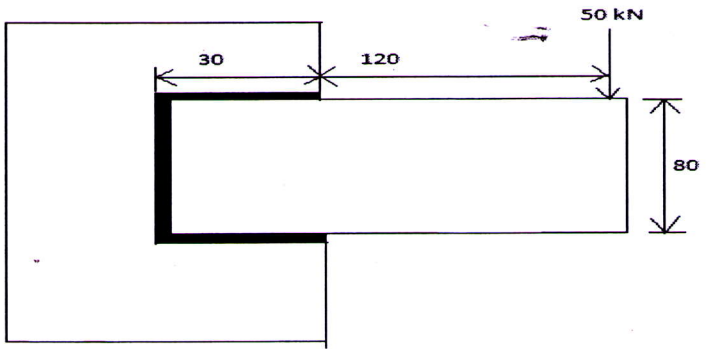

Fig. 2: All dimensions are in mm

OR

20 a) Design a closed coiled helical compression spring for a service load ranging from 2000 to 2500 N. The axial deflection of spring for load range is 6 mm. Assume spring index of 6. The permissible shear stress intensity is 420 MPa and Modulus of rigidity is 84 GPa? (10)

b) Derive an expression for the shear stress developed in a spring wire? (4)

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