Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree Examination June 2022 (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	State and explain D'Alembert's principle.	(3)
2	Find a relation for the coefficient of fluctuation of speed in terms of maximum fluctuation of energy and the kinetic energy of the flywheel at mean speed.	(3)
3	Find the relation for the natural frequency of torsional vibration of single rotor system.	(3)
4	Define terms i) Magnification factor ii) Transmissibility	(3)
5	What is meant by torsionally equivalent shaft. Explain.	(3)
6	Define the following properties of material i) Toughness ii) Hardness and iii) Malleability	(3)
7	Define endurance limit? List the factors affecting endurance limit	(3)
8	What is meant by caulking and fullering? Explain.	(3)
9	Describe with neat sketches the different types of butt welded joints.	(3)
10	What is surge in spring? How it can be minimised?	(3)

PART B

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

Module I

11	a)	Explain the steps for the dynamic force analysis of four bar mechanism by graphical method.	(4)
	b)	A vertical petrol engine 10cm diameter and 15cm stroke has a connecting rod 26cm long. The mass of the piston is 1.25 kg. The speed is 2000 rpm. On explosion stroke with the crank at 30^0 from the top dead centre the gas pressure is 7.5×10^5 N/m^2. Determine i) Net force on piston ii) The resultant load on gudgeon pin	(10)

iii) The thrust on cylinder walls

iv) The speed above which the other things remaining the same the gudgeon pin load would be reversed in direction.

OR

12 a) Determine the energy released by a flywheel having a mass of 2kN and radius gyration of 1.2 m when its speed decreases from 460 rpm to 435 rpm. (4)

b) For any crank angle θ, the turning moment T is given by the expression $T=750+1000\sin\theta+180\sin2\theta+20\sin3\theta$. If the resisting torque is uniform and mean speed is 150 rpm, find (10)

i. The horse power of the engine

ii. Percentage fluctuation of speed, if the weight of the flywheel is 4000 kg and radius of gyration is 1 m.

iii. Angular acceleration of flywheel at 30^0 and 60^0

Module II

13 a) A circular cylinder of mass 5kg and radius 20 cm is connected by a spring of stiffness 3000 N/m as shown in figure 1. It is free to roll on horizontal surface without friction, determine the natural frequency of vibration. (5)

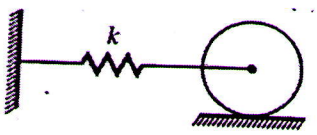


Fig.1

b) In a single –degree damped vibrating system a suspended mass of 10 kg makes 20 oscillations in 14 seconds. The amplitude decreases to 0.35 of the initial value after 5 oscillations. Determine the (9)

i) Stiffness of the spring

ii) Logarithmic decrement

iii) Damping factor

iv) Damping coefficient

OR

14 a) Explain the term 'whirling speed' of a shaft. Prove that the whirling speed for a rotating shaft is the same as the natural frequency of transverse vibration (5)

b) A machine of mass one tonne is acted upon by an external force of 2450 N at frequency of 1500 rpm. To reduce the effects of vibration, an isolator having a static deflection of 2 mm under the machine load and an estimated damping of damping factor 0.2 are used. Determine (9)

i) The force transmitted to the foundation

ii) The amplitude of vibration of machine

iii) The phase lag

Module III

15 A two degree of freedom vibrating system is shown in figure 2. Determine the natural frequencies of vibrations and ratio of amplitudes of motion of m1 and m2 for the two modes of vibration. $m_1 = 3kg$, $m_2 = 2$ kg, $k_1 = 30$ N/m and $k_2 = 15$ N/m (14)

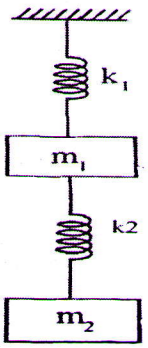


Fig.2

OR

16 a) Differentiate between ductile and brittle behaviour of materials. (6)

b) Find the maximum stress induced in the following cases taking stress concentration into account (8)

i) A rectangular plate 50mm x 10 mm with a hole 10mm diameter is subjected to an axial load of 10 kN.

ii) A stepped shaft has maximum diameter 45mm and minimum diameter 30mm.The fillet radius is 6mm.The shaft is subjected to an axial load of 10 kN

Module IV

17 a) What is meant by fluctuating stress? What are the types of fluctuating stress? Explain. (4)

b) A pulley is keyed to a shaft midway between two bearings. The shaft is made of cold drawn steel for which the ultimate strength is 550 MPa and yield strength is 400 MPa. The bending moment at the pulley varies from -150Nm to +400Nm as the torque on the shaft varies from -50 Nm to +150 Nm. Obtain the diameter of the shaft for an indefinite life. The fatigue stress concentration factors for the keyway at the pulley in bending and in torsion are 1.6 and 1.3 respectively. Take the following values (10)

Factor of safety =1.5

Load correction factors= 1.0 in bending and 0.6 in torsion

Size effect factor =0.85

Surface effect factor =0.88

OR

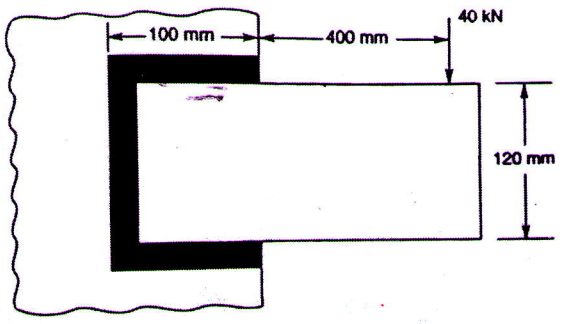
18 A double riveted lap joint with zig-zag riveting is to be designed for 6 mm thick plates. Assume $\sigma_t = 100$ MPa ; $\tau = 70$ MPa ; and $\sigma_c = 130$ MPa (14)

State how the joint will fail and find the efficiency of the joint.

Module V

19 a) Enumerate the importance of throat thickness in the design of welded joints (4)

b) A bracket is welded to a column as shown. Calculate the size of the weld, if the permissible shear stress in the weld is limited to 70MPa. (10)



OR

20 a) What is Wahl's factor ? state its importance in the design of helical springs (4)

b) Design a close coiled helical compression spring for a service load ranging from 2250N to 2750N. The axial deflection of the spring for the load range is 6 mm Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity G=84N/m^2. Neglect the effect of stress concentration. (10)

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