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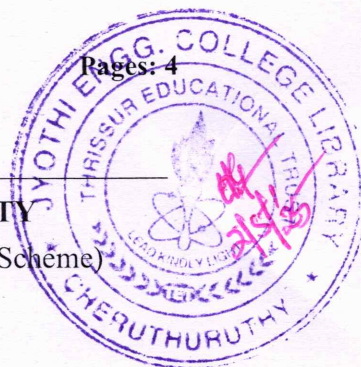
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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R,S) / (WP), S4 (PT) Exam April 2025 (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 in brief the equivalent offset inertia force. | (3) |
| 2 | What are the functions of flywheel? Why flywheels are used in punching machines? | (3) |
| 3 | Define logarithmic decrement. Derive an expression for the same. | (3) |
| 4 | Derive an expression for the natural frequency of a spring mass system using energy method | (3) |
| 5 | Write a short note on vibration isolation. | (3) |
| 6 | Sketch displacement time graph of a vibrating system for various values of damping ratio or damping factor. | (3) |
| 7 | How the stress concentrations affect the strength of a component? Enlist the methods to reduce stress concentration? | (3) |
| 8 | What are the methods to obtain leak proof joints in riveted joints? | (3) |
| 9 | Explain Surge in springs. What are the ways to avoid it? | (3) |
| 10 | List various advantages of welding over riveting. | (3) |

PART B*Answer any one full question from each module, each carries 14 marks.***Module I**

- 11 a) The crank and connecting rod of a vertical petrol engine running at 1800 rpm are 60 mm and 270 mm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating parts is 1.2 kg. During the expansion stroke when the crank has turned 20° from the top dead centre the gas pressure is 650 kN/m². Determine the
- Net force on the piston
 - Net load on Gudgeon pin
 - Thrust on the cylinder walls
- (10)

(d) Speed at which the Gudgeon pin load reversed in direction.

- b) Explain various steps in the dynamic force analysis of a four bar mechanism (4)

OR

- 12 a) Draw the turning moment diagram of a 2- stroke 2 cylinder engine. (4)
- b) The turning moment diagram for a multicylinder engine has been drawn to a vertical scale of 1 mm = 650 N.m and a horizontal scale of 1 mm = 4.5° . The areas above and below the mean torque line are -28, +380, -260, +310, -300, +242, -380, +265 and -229 mm². The fluctuation of speed is limited to 1.8 % of mean speed on the either side which is 400 rpm. The density of the rim material is 7000 kg/m³ and the width of the rim material is 4.5 times its thickness. The centrifugal stress in the rim material is limited to 6 N/mm². Neglecting the effect of the boss and the arms, determine the diameter and the cross section of the flywheel rim. (10)

Module II

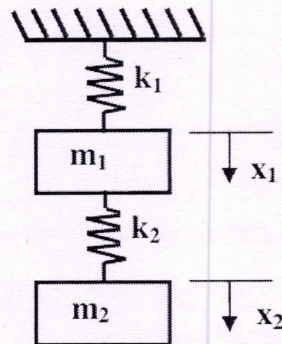
- 13 a) With the help of suitable sketches explain types of free vibrations. (5)
- b) A machine mounted on springs and fitted with a dashpot has a mass of 60 kg. (9)
There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 mm to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine the
- (a) Damping coefficient
- (b) Ratio of frequencies of damped and undamped vibrations
- (c) Periodic time of damped vibrations.

OR

- 14 a) What is whirling? Derive an expression for the critical speed of a shaft (6)
- b) A single cylinder vertical diesel engine has a mass of 400 kg and is mounted on a steel chassis frame. The static deflection owing to the weight of the chassis is 2.4 mm. The reciprocating masses of the engine amount to 18 kg and the stroke of the engine is 160 mm. A dashpot with a damping coefficient of 2 N/mm/s is also used to dampen the vibrations. In the steady state of vibrations, determine the (8)
- (a) Amplitude of vibrations if the driving shaft rotates at 500 rpm
- (b) Speed of the driving shaft when the resonance occurs.

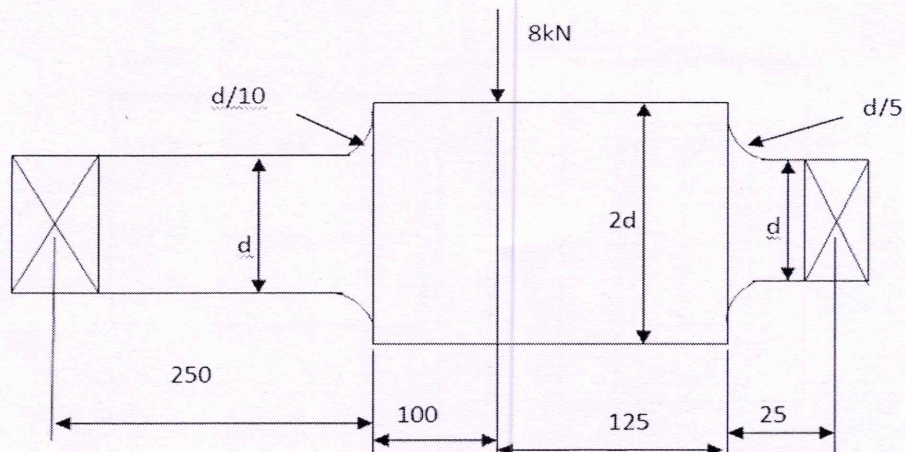
Module III

- 15 a) Obtain the frequency equation for the system shown in Figure below. Also (14)
determine the natural frequencies when $k_1 = 2k$, $k_2 = k$, $m_1 = m$ and $m_2 = 2m$.



OR

- 16 a) A stepped shaft is subjected to a transverse load of 8 kN as shown in fig below. (14)
The shaft is made of steel with ultimate tensile strength of 400 MPa. Determine the diameter of the shaft based on factor of safety of 2.



Module IV

- 17 a) A steel cantilever of circular cross-section is 200 mm long subjected to axial (14)
load which varies from 150 N (compression) to 450 N (tension) and also a
transverse load at its free end which varies from 80 N up to 120 N down. The
diameter of the rod is $2d$ for the first 50 mm and of diameter d for the
remaining length. Determine its diameter taking a factor safety of 2. Assume
the following:

Yield strength = 330 MPa

Endurance limit in reversed loading = 300 MPa

Correction factors = 0.7 in reversed axial loading. 1.0 in reversed bending

Stress concentration factor = 1.44 for bending, 1.64 for axial loading

Size effect factor = 0.85

Surface effect factor = 0.9

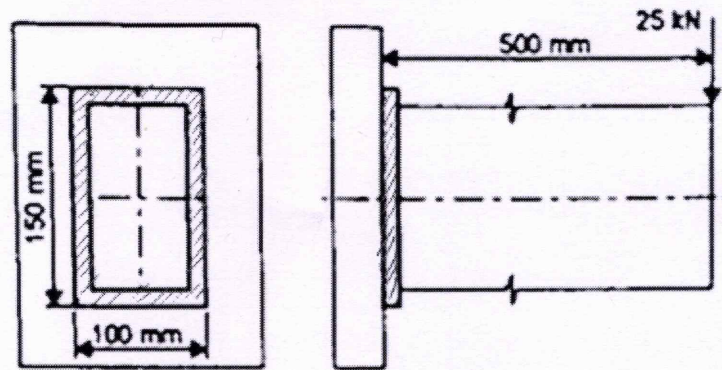
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OR

- 18 a) With neat sketches, describe the modes of failures in riveted joints? (4)
- b) Design and draw a double riveted lap joint with chain riveting for mild steel (10)
plates of 20 mm thick. The allowable value of stress in shear, tension and compression are 60 MPa, 90 MPa and 120 MPa respectively.

Module V

- 19 a) A shaft of rectangular cross section is welded to a support by means of fillet weld as shown in figure. Determine the size of the weld, if the permissible shear stress in the weld is limited to 75 MPa. (14)



OR

- 20 a) Design a helical compression spring for a maximum load of 1000 N and for a deflection of 25 mm. The maximum permissible shear stress for the spring wire is 420 N/mm^2 , modulus of rigidity is $0.84 \times 10^5 \text{ N/mm}^2$ and the value of the spring index is 6. (14)
