CBCS SCHEME

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17ME52

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. What is free body diagram? Explain with simple sketches. **(05 Marks)**

b. In a 4 bar link mechanism shown in Fig Q1(b) the link 4 subjected to a torque $T_4 = 20$N-m. The link length are AD = 800mm, AB = 300mm, BC = 700mm and CD = 400mm. For static equilibrium of the mechanism determine the required input torque T_2 and link 2.

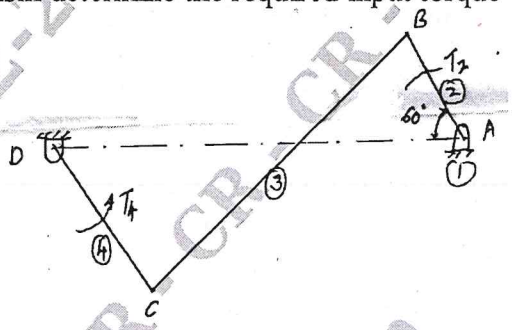

Fig Q1(b) **(15 Marks)**

OR

2 a. State the condition for static equilibrium of a body subjected to a system of i) two forces ii) three forces iii) member with two forces and a torque. **(06 Marks)**

b. A horizontal gas engine running at 210 rpm has a bore of 220mm and a stroke of 440mm. The connecting rod is 924mm long and the reciprocating parts weigh 20kg. When the crank has turned through an angle of 30° from the inner dead centre, the gas pressure on the cover and crank sides are 500kN/m^2 and 60kN/m^2 respectively. Diameter of the piston rod is 40mm. Determine : i) Piston effort ii) thrust in the connecting rod iii) Turning moment on the crank shaft iv) thrust in the bearings. **(14 Marks)**

Module-2

3 a. Briefly explain the static and dynamic balancing. **(04 Marks)**

b. A shaft carries four masses A, B, C and D of magnitude 200kg, 300kg, 400kg and 200kg respectively and revolving at radii 80mm, 70mm, 60mm and 80mm in a planes measured from A at 300mm, 400mm and 700mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes L and M. The distance between the planes A and L is 100mm between L and M is 400mm. If the balancing masses revolve at a radius of 100mm. Find their magnitudes and angular positions. **(16 Marks)**

OR

4 The crank and connecting rods of a 4-cylinder inline engine running at 1800rpm are 60mm and 240mm each respectively and the cylinders are spaced 150mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1 – 4 – 2 – 3. The reciprocating mass in each cylinder is 1.5kg. Determine : i) unbalanced primary and secondary forces if any ii) unbalanced primary and secondary couples with reference to the central plane of the engine. **(20 Marks)**

Module-3

5 a. Define the following terms relative to governors :
i) Sensitiveness ii) Isochronism iii) Stability iv) Power. **(08 Marks)**

b. In a Hartnell governor, the extreme radii of rotation of the balls are 40mm and 60mm and the corresponding speeds are 210rpm and 230rpm. The mass of each ball is 3kg. The lengths of the ball and sleeve arms are equal. Determine: i) Spring load at minimum and maximum speeds ii) Spring stiffness iii) initial compression. **(12 Marks)**

OR

6 a. Derive an expression for gyroscopic couple $C = Iww_p$. **(05 Marks)**

b. The turbine rotor of a ship has a mass of 2200kg and rotates at 1800rpm clockwise. When viewed from the stern. The radius of gyration of rotor is 320mm. Determine the gyroscopic couple and its effect when the
(i) ship turns left at a radius of 250m with a speed of 25kmph
(ii) ship pitches with the bow rising at an angular velocity of 0.8 rad/s
(iii) ship rolls at an angular velocity of 0.1rad/s. **(15 Marks)**

Module-4

7 a. Briefly explain free, forced, damped and undamped vibration. **(08 Marks)**

b. Split the harmonic motion $X = 10 \sin (wt + 30°)$ into two harmonic motions, one having a phase angle of zero degree and the other having phase angle of 45°. Also check the solution by graphically. **(12 Marks)**

OR

8 a. Determine the natural frequency of a spring mass system considering mass of the spring into account. **(10 Marks)**

b. Find the natural frequency of the system shown in Fig Q8(b) by using Newton's method. Where m and r are the mass and radius of the disc.

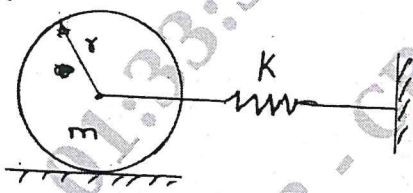

Fig Q8(b) **(10 Marks)**

Module-5

9 a. Define logarithm decrement and derive an expression for the same interms of damping ratio. **(10 Marks)**

b. A vibration system consists of a mass of 50kg, a spring with a stiffness of 30kN/m and a damper. The damping provided is only 20% of the critical value. Determine the i) damping factor ii) critical damping co-efficient iii) natural frequency of damped vibrations iv) logarithmic decrement v) ratio of two consecutive amplitudes. **(10 Marks)**

OR

10 a. Explain the terms :
i) Magnification factor ii) Transmissibility ratio iii) Vibration isolation. **(09 Marks)**

b. A machine of mass 1000kg is acted upon by an external force 2450N at a frequency of 1500rpm. To reduce the effect of vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping factor of 0.2 are used. Determine:
i) Transmissibility ratio ii) Force transmitted to the foundation iii) Amplitude of vibration iv) Phase log of the transmitted force with respect to the external force. **(11 Marks)**