USN ☐☐☐☐☐☐☐☐☐☐   **18ME53**

Fifth Semester B.E. Degree Examination, July/August 2022
Dynamics of Machines

Time: 3 hrs.   Max. Marks: 100

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

Module-1

1 a. State the condition for static equilibrium of a body subjected to a system of
i) 2 Forces   ii) 3 Forces   iii) Member with two forces and torque.   **(06 Marks)**

b. For the mechanism shown in Fig.Q1(b), find the required input torque for the static equilibrium. The length OA = 250mm, AB = 650mm, F = 500N.
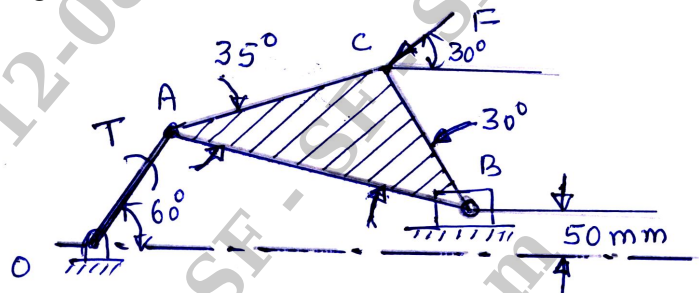

Fig.Q1(b)   **(14 Marks)**

OR

2 a. Explain in brief 'D'Almert's principle.   **(05 Marks)**

b. Derive an expression for the velocity and acceleration of piston and also the angular acceleration of the connecting rod of a reciprocating engine.   **(15 Marks)**

Module-2

3 a. What do you mean by static and dynamic balancing?   **(04 Marks)**

b. Four masses are attached to a shaft of planes A, B, C and D at equal radii. The distance of the planes B, C and D from A are 400mm, 50mm and 1200mm respectively. The masses at A, B and C are 60kg, 45kg and 70kg respectively. If the system is in complete balance, determine the mass at D and the position of masses B, C and D with respect to A.   **(16 Marks)**

OR

4 A 5 cylinder inline engine running at 500r/min has successive cranks at 144° apart. The distance between the cylinder centre line is 300mm. Piston stroke = 240mm, Length of connecting rod is 480mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum value of these and position of central crank at which these maximum value occur. The reciprocating mass for each cylinder is 150N.   **(20 Marks)**

Module-3

5 a. Define the following with respect to the working of governors. i) Sensitiveness ii) Isochronism   iii) Effort of a governor   iv) Stability of a governor.   **(08 Marks)**

b. The arms of a porter governor are each 300mm long and are hinged on the axis of rotation. The mass of each ball is 5kg and mass of the sleeve is 15kg. The radius of rotation of the ball is 200mm when the governor beings to lift and 250mm when the governor is at the maximum speed. Determine :
i) Range is speed neglecting the sleeve friction
ii) Range of speed if the frictional force at the sleeve is 30N.   **(12 Marks)**

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6 a. Explain in brief :
   i) Angular momentum   ii) Spin motion   iii) Processional motion.   **(06 Marks)**

   b. A rail car has a total weight of 39240N, there are two axles, each which together with wheels has moment of inertia of 30kg-m². The centre distance between the two wheels on an axle is 1.5m and each wheel is of 370.5mm radius. Each axle is driven by a motor and its speed is 3 times the speed of wheel. Each motor has a moment of inertia of 15kg-m² and runs opposite to the of axle. The centre of gravity of 1050mm above rails. Determine the limiting speed when it is negotiating a curve of 240m radius such that no wheel leaves the rail.   **(14 Marks)**

Module-4

7 a. Find the natural frequency of a spring mass system, the mass of the spring can be taken into account by adding one-third of its mass to the main mass.   **(10 Marks)**

   b. The cylinder of mass m, radius r rolls without slipping on a cylindrical surface of radius R. Determine the natural frequency for small oscillations about the lowest point.   **(10 Marks)**

OR

8 a. Obtain the response of viscous damped system for critically damped case.   **(10 Marks)**

   b. Find the equation of motion for the system shown in Fig.Q8(b) when $\xi = 2$. If the mass m is displaced by a distance of 3cm and released.
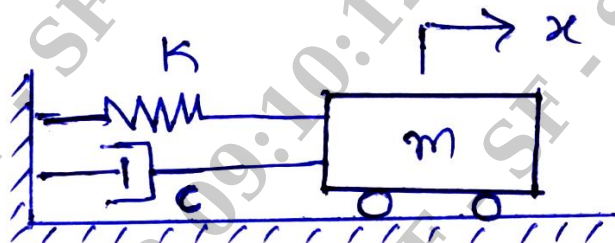

Fig.Q8(b)   **(10 Marks)**

Module-5

9 a. What is magnification factor? Derive an expression for the same and discuss its variation with frequency ratio.   **(10 Marks)**

   b. A 75kg machine is mounted on springs of stiffness K = 11.76×10^5N/m with damper of $\xi = 0.2$. A 2kg piston within the machine has reciprocating motion with stroke of 0.08m and a speed of 3000r/min. Assuming the motion of the piston to be harmonic, determine the amplitude of vibration of the machine.   **(10 Marks)**

OR

10 a. A shaft 40mm diameter and 2.5m long has a mass of 15kg per meter length. It is simply supported at the ends and carrier 3 masses 90kg, 140kg and 60kg at 0.8m, 1.5m and 2m respectively from the left support. Taking E = 200G N/m². Find the frequency of transverse vibration.   **(10 Marks)**

   b. Derive an expression for the critical speed of light shaft having single disc with damping.   **(10 Marks)**

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