Reg. No. : | | | | | | | | | | | | |

Question Paper Code: 1014393

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV / DEC 2024
Fourth Semester
Aeronautical Engineering
U20AE403 – MECHANICS OF MACHINES
(Regulation 2020)

Time: Three Hours | Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Differentiate machine and structure.

2. Define degrees of freedom.

3. Find the pitch diameter of a toothed gear having 120 teeth and circular pitch of 16.5 mm.

4. Define interference.

5. State the laws of static friction.

6. What is the function of clutches?

7. Differentiate static and dynamic balancing.

8. List the reasons for unbalance of rotating mass.

9. Define forced vibration.

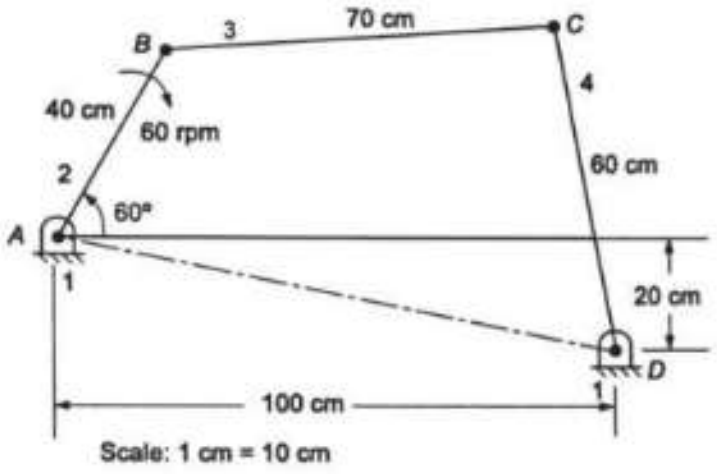
10. What is vibration isolation?

PART – B (5 x 16 = 80 Marks)

11. (a) List the inversions of slider crank mechanism and explain the Whitworth quick-return motion mechanism with neat sketch. (16)

(OR)

(b) The crank AB of a four-bar mechanism shown in figure rotates at 60 rpm clockwise. Determine the relative angular velocities of the coupler to the crank and the lever to the coupler. Find also the rubbing velocities at the surface of pins 25 mm radius at the joints B and C. (16)



12. (a) A gear drive consists of two gears, A and B, and has a velocity ratio of 1.50. Gear A, the smaller of the two gears, revolves at 126 rpm in the clockwise direction, and has 28 teeth. If the gears have a module of 2 mm, determine: (i) The number of teeth on Gear B, (ii) The pitch (reference) diameters for the two gears, (iii) The addendum, (iv) The dedendum, (v) The circular pitch, (vi) The tooth thicknesses, (vii) The speed of Gear B and (viii) The theoretical centre distance of the two gears. (16)

(OR)

(b) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B? (16)

13. (a) The lead screw of a lathe has Acme threads of 50 mm outside diameter and 8 mm pitch. The screw must exert an axial pressure of 2500 N in order to drive the tool carriage. The thrust is carried on a collar 110 mm outside diameter and 55 mm inside diameter and the lead screw rotates at 30 rpm. Determine (a) the power required to drive the screw; and (b) the efficiency of the lead screw. Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar. (16)

(OR)

(b) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 rpm. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2. Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear. (16)

14. (a) A single cylinder reciprocating engine has a reciprocating engine has speed 240 rpm, stroke 300 mm, mass of reciprocating parts 50 kg, mass of revolving parts at 150 mm radius is 37 kg. If two-third of the reciprocating parts and all the revolving parts are to be balanced, Find the balance mass required at a radius of 400 mm and the residual unbalanced force when the crank has rotated 60° from top dead centre. (16)

(OR)

(b) A 4-cylinder in-line engine has crank radius of 60 mm and connecting rod length of 240 mm. The engine crank shaft rotates at 1800 rpm. The centre lines of engine are spaced at 150 mm. If the cylinders are numbered 1 to 4 from one end the cranks appear at intervals of 90^0 in the end view in the order 1-4-2-3. Reciprocating mass in each cylinder is 1.5 kg. Find (a) unbalanced primary and secondary forces, and (b) unbalanced primary and secondary couples with reference to central plane of the engine. (16)

15. (a) A single cylinder vertical petrol engine of total mass 300 kg is mounted upon a steel chassis frame and causes a vertical static deflection of 2 mm. The reciprocating parts of the engine have a mass of 20 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 kN per metre per second. Considering that the steady state of vibration is reached; determine: 1. the amplitude of forced vibrations, when the driving shaft of the engine rotates at 480 rpm, and 2. the speed of the driving shaft at which resonance will occur. (16)

(OR)

(b) The mass of a single degree damped vibrating system is 7.5 kg and makes 24 free oscillations in 14 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine:
(i) Stiffness of the spring,
(ii) Logarithmic decrement,
(iii) Damping factor, i.e. the ratio of the system damping to critical damping. (16)

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