B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E.   Semester: V
Branch: Mechanical Engineering   Duration: 3 hrs.
Course Code: 20ME5DCDOM   Max Marks: 100
Course: Dynamics of Machines   Date: 19.09.2023

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) What is the principle of virtual work? Explain.   06

    b) Determine the torque T_2 required to overcome the force F_E along the link 6   14
    for the following dimension AD=3O mm, AB=90 mm.O_4B=60 mm, DE=80
    mm,O_2A=50 mm, $O_2 O_4$=70 mm.
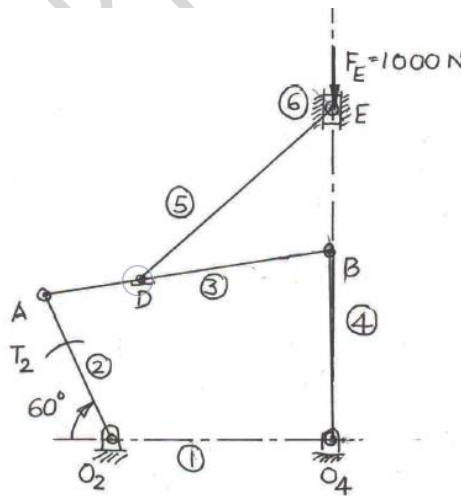
fig(a)

OR

2. a) Explain the function of a flywheel and obtain an expression for the Hoop   08
    stress developed in the rim of a flywheel.

b) The crank effort diagram for a 4 stroke cycle gas engine may be assumed for simplicity to be represented be four rectangles. Areas of which from line of zero pressure are, Power stroke=6000 mm^2 Exhaust stroke = 500 mm^2, Suction stroke =300 mm^2,and **12**

Compression stroke=1500 mm^2. Each sq mm represents 10 Nm. Assuming the resisting torque to be uniform, find,

    i)   Power of the engine

    ii)   Energy to be stored by the flywheel

    iii)   Mass of rim of a flywheel of 1 m radius to limit total fluctuation of speed to 4% of mean speed, which is 150 rpm.

UNIT - II

3. a) Derive an expression for friction torque in a Conical pivot bearing. Assume uniform pressure and uniform wear across the bearing surface. **08**

   b) A leather belt is required to transmit 15KW from a pulley of 1200 mm effective diameter running at 300 rpm. The angle of contact is spread over 5/12 of circumference and coefficient of friction between belt and pulley rim is 0.3. If the safe working stress for the belt materials is 1.5MPa and mass of leather is 1000 Kg/m^3. and thickness of belt is 10 mm, determine the width of the belt taking centrifugal tension into account. **12**

OR

4. In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and roller radius is 17.5 mm. The angle of ascent is 75° and the total lift is 17.5 mm. The speed of the cam shaft is 600 r.p.m. Calculate: i. The principal dimensions of the cam; ii. the accelerations **20**

of the follower at the beginning of the lift, where straight flank merges into the circular nose and at the apex of the circular nose. Assume that there is no dwell between ascent and descent

UNIT - III

5. a) Explain briefly static and dynamic balancing of rotating masses. **04**

b) A shaft carries four masses A, B, C and D, 200,300,240 and 360 Kg respectively, revolving at radii 90,70,100, and 120 mm respectively. The distance from the plane A are 270 mm ,420 mm and 720 mm respectively. Angle between the crank A and B is 45°, B and C is 75°,C and D is 130°.Balancing masses are placed 120 mm and 100 mm from D and A respectively. The distance between them being 500 mm. Find the balancing masses and their angular position if they are placed at a radius of 100 mm. **16**

UNIT - IV

6. a) Obtain an expression for primary forces for V engine having two identical cylinders lying in a plane. **06**

    b) A 5 cylinder inline engine running at 500 rpm has successive cranks at 144° apart. The distance between the cylinder Centre line is 300 mm. Piston stroke =240 mm. Length of connecting rod=480 mm. 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 values occur. The reciprocating mass for each cylinder is 150 N. **14**

UNIT - V

7. a) Derive an expression for the gyroscopic couple from the first principle. **05**

    b) Explain the effect of gyroscopic couple on an aeroplane. **06**

    c) A Ship is propelled by a turbine rotor which has a mass of 5000 kg and has a speed of 2100 rpm.The rotor has a radius of gyration of 0.5 m and rotates in clockwise direction when viewed from stern.Find the gyroscopic effect in the following conditions. **09**

    (i) The ship runs at a speed of 16 Knots(1 Knots=1860 m/hr).

    It steers to the left in a curve of 60 m radius.

    (ii) The ship pitches 6° above and 6° below the horizontal position.

    The bow descends with its maximum velicity.The motion due to pitching is SHM and periodic time is 20 secs.

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