17AE/AS44

USN

Fourth Semester B.E. Degree Examination, July/August 2021
Mechanisms and Machine Theory

Time: 3 hrs.   Max. Marks: 100

Note: *Answer any FIVE full questions.*

1   a.   Define the following terms :
        (i)   Kinematic pair
        (ii)   Mechanism
        (iii)   Inversion
        (iv)   Machine.   **(08 Marks)**
    b.   With a neat sketch, explain any three inversions of single slider crank chain.   **(12 Marks)**

2   a.   Explain the inversions of a double slider crank chain with the aid of neat sketches. **(10 Marks)**
    b.   Obtain the condition for 'correct sheering' for a four wheeled vehicle. Sketch and explain
        the working of Ackermann steering gear.   **(10 Marks)**

3   For a four bar mechanism shown in Fig. Q3, determine the acceleration of C and angular
        acceleration of link 3 when Crank 2 rotates at 20 radians per second.   **(20 Marks)**

$O_2O_4 = 200mm$,
$O_2A = 150mm$,
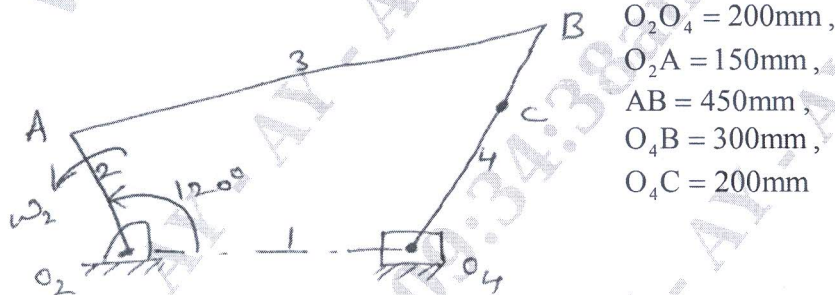$AB = 450mm$,
$O_4B = 300mm$,
$O_4C = 200mm$

Fig. Q3

4   A slider crank mechanism is shown in Fig. Q4. The force applied to the piston is 1000 N
        when the crank is at 60° from IDC. Calculate the driving torque T_2.   **(20 Marks)**
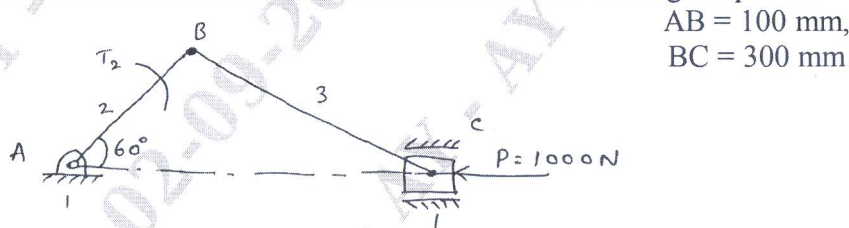

$AB = 100$ mm,
$BC = 300$ mm

Fig. Q4

5   a.   Obtain an expression for the length of path of contact for two involute profile gears in mesh.
                                                                                            (10 Marks)
    b.   Calculate (i) Length of path of contact (ii) Arc of contact and (iii) Contact ratio when a
        pinion having 17 teeth drives a gear having 49 teeth. The profile of the gear is involute with
        pressure angle 20°. Module 6mm and addendum on pinion and gear wheel equal to one
        module.   **(10 Marks)**

6 An Epicyclic gear train of sun and planet type, the pitch circle diameter of the annular wheel A is 425 mm and the module is 5 mm. When the annular wheel is stationary, the spider which carries 3 planet gears P of equal size has to make one revolution for every 6 revolutions of the driving spindle carrying sum wheel S. Determine the number of teeth on all the wheels. **(20 Marks)**

7 a. Why balancing is necessary? Define static and dynamic balancing. **(06 Marks)**
   b. A, B, C and D are 4 mass carried by a rotating shaft at radius 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses B, C and D are 10, 5, 4 kg respectively. Find the required mass A and the relative angular positions of the 4 masses to keep the shaft in balance. **(14 Marks)**

8 A six cylinder two stroke single acting diesel engine with cylinder centre lines are spaced at 650 mm. In the end view the cranks are $60°$ apart and in order $1 - 4 - 5 - 2 - 3 - 6$. The stroke of each piston is 400 mm and the crank to C.R ratio is $1 : 5$. The mass of reciprocating part is 250 kg per cylinder and that of rotating part is 100 kg per crank. The engine rotates at 240 rpm. Investigate the engine for out of balance primary and secondary forces and couples. **(20 Marks)**

9 a. Define the following terms : (i) Sensitiveness   (ii) Governor effort
                                      (iii) Hunting   (iv) Stability **(08 Marks)**
   b. A porter governor has all four arms 300 mm long. The upper arms are attached on the axis of rotation and the lower arms are fixed to the sleeve at a distance of 30 mm from the axis of rotation. The mass of each ball is 4 kg and the sleeve has a mass of 60 kg. The Extreme radii of rotation are 160 mm and 200 mm. Determine the range of speed of governor. **(12 Marks)**

10 a. Derive an expression for the gyroscopic couple. **(06 Marks)**
    b. An aeroplane make a complete half circle of 40 m radius towards left when flying at 175 km/hr. The mass of the rotary engine and propeller is 400 kg with radius of gyration 300 mm. The engine runs at 2500 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane turn towards right instead of left. **(08 Marks)**
    c. An aeroplane makes a complete half circle of 50 m radius towards left when flying at 200 km/hr. The mass of the rotary engine and propeller is 400 kg with radius of gyration 300 mm. The engine runs at 3000 rpm counter clockwise when viewed from the rear. Determine the gyroscopic couple and its effect on the air craft. **(06 Marks)**

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