Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Mechanisms and Machine Theory

Time: 3 hrs.   Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Assume missing data suitably if necessary.*

Module-1

1   a.   Define the following : (i) Degrees of freedom   (ii) Successfully constrained motion
         (iii) Kinematic chain   (iv) Mechanism   (v) Machine.   **(10 Marks)**
    b.   Explain Bull engine and Elliptical trammel with suitable sketch.   **(10 Marks)**

OR

2   a.   Determine the Degrees of freedom for the following mechanisms shown in Fig. Q2 (a).
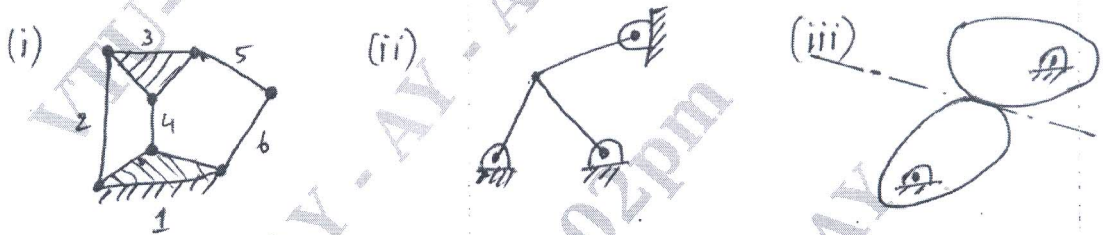   **(09 Marks)**

Fig. Q2 (a)

    b.   Define Inversion. Explain Peaucellier's mechanism and Geneva wheel mechanism.
                                                                           (11 Marks)

Module-2

3   The Fig. Q3 shows a four bar mechanism. Crank O_2A rotates at 200 rpm and an angular
         acceleration of 150 rad/s^2 at an instant when the crank makes an angle of 45° to the
         horizontal. Find the acceleration of points B and C and angular velocities and angular
         acceleration of link 3 and 4.
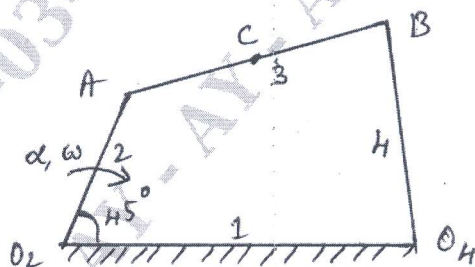
$O_2O_4 = 120$ mm
$O_2A = 45$ mm
$AB = 90$ mm
$O_4B = 60$ mm
$AC = 40$ mm

Fig. Q3

                                                                           (20 Marks)

OR

4   In a four bar mechanism shown in Fig. Q4 torque $T_3 = 3000$ Nm and $T_4 = 2000$ Nm. Take AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm for static equilibrium of mechanism, find the required input torque on the crank.
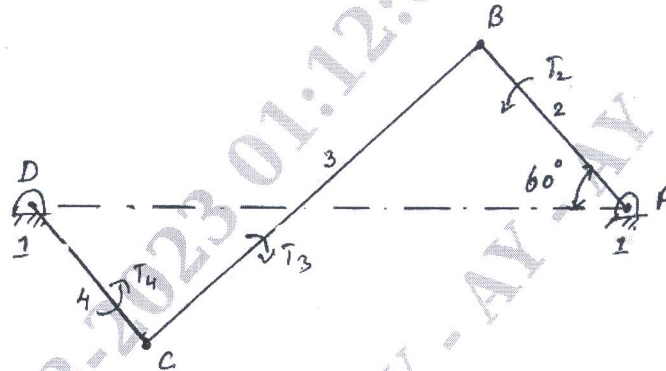

Fig. Q4   **(20 Marks)**

Module-3

5   a.   Explain the various spur Gear terminology with the help of a neat sketch.   **(10 Marks)**
    b.   Derive an expression for length of path of contact for a pair of involute gear in contact.
                                                                  (10 Marks)

OR

6   a.   A pair of gears 40 and 30 teeth respectively are of 25° involute form. Addendum = 5 mm. Module is 2.5 mm. If the smaller wheel is the driver and rotate at 1500 rpm, find the velocity of sliding at the point of contact, at pitch point and at disengagement also find length of path of contact and length of arc of contact.   **(10 Marks)**
    b.   An internal wheel B with 80 teeth is keyed to a shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel D-E gears with the two internal wheels ; D has 28 teeth and gears with C while E gears with B. The compound wheels revolve freely on a pin which projects from a disc keyed to a shaft A co-axial with F. If all the wheels have same pitch and shaft A makes 800 rpm, what is the speed of shaft F. Sketch the arrangement.
                                                                  (10 Marks)

Module-4

7   A shaft carries 4 masses A, B, C and D, 12 kg, 10 kg, 18 kg and 15 kg respectively, revolving at radii 40 mm, 50 mm, 60 mm and 30 mm respectively. The planes B, C and D are at a distance of 65 mm, 160 mm and 240 mm apart respectively from A. Angle between the masses B, C, D with respect to A is 60°, 135° and 270° respectively. Find the magnitude and angular position of two balancing masses revolving at 50 mm radius in planes L and M. The first between A and B, 30 mm from A, the second between C and D 70 mm from C. (Use Graphical method).   **(20 Marks)**

OR

8   The piston of a 4 cylinder vertical inline engine reach their uppermost position at 90° interval in order of their axial position. Pitch of cylinder is 0.35 m. Crank radius is 0.12 m, length of C.R = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg, find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. (Use Graphical method).   **(20 Marks)**

Module-5

9 a. Define with respect to Governor :
  (i)   Sensitiveness
  (ii)   Governor effort
  (iii) Governor power
  (iv)   Hunting
  (v)   Isochronous Governor.   (10 Marks)

  b. The upper arms of a porter governor are pivoted to the axis of rotation having length 40 cm. The lower arm pivoted on the sleeve at a distance of 2 cm from the axis, their length is 30 cm. Mass of each ball is 5 kg the sleeve mass is 50 kg. Determine the equilibrium speed for the radius of rotation of 20 cm and also the effort and power for 1% speed change.
                                                                   (10 Marks)

OR

10 a. In a Hartnell Governor the length of ball and sleeve arms are 12 and 10 cm respectively. The distance of fulerum of the bel crank lever from the governor axis is 14 cm. Mass of each governor ball is 4 kg. When the governor runs at the mean speed of 300 rpm, the ball arm is vertical and sleeve arm is horizontal for an increase of speed of 4% the sleeve moves 10 mm upword. Neglecting the friction find (i) minimum equilibrium speed if the total sleeve movement is 20 mm (ii) Spring stiffness (iii) Sensitiveness of Governor (iv) Spring stiffness if Governor is to be isochronous at 300 rpm.   (12 Marks)

  b. Explain the Gyroscopic effect on Aeroplane for following cases with the help of neat sketches:
  (i)   Propeller turns clockwise (viewed from tail) and aeroplane take right turn.
  (ii)   For the same case if the aeroplane take left turn.   (08 Marks)

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