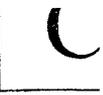# B.Tech. Degree IV Semester Examination in Marine Engineering May 2016

MRE 1401 MECHANICS OF MACHINERY

Time : 3 Hours   Maximum Marks : 100

$(5 \times 20 = 100)$

I.   (a)   Sketch and explain the three inversions of double slider crank chain.   (9)

       (b)   The mechanism shown in the figure has the following dimensions. AB = DE =   (11)
              150mm, BC = CD = 450 mm, EF = 375 mm. The crank AB makes an angle of
              $45°$ with the horizontal and rotates about A in the clockwise direction at a
              uniform speed of 120 rpm. The lever DC oscillates about a fixed point D,
              which is connected to AB by a coupler BC. The block F moves in the
              horizontal guides, being driven by the link EF. Determine the (i) velocity of
              the block F (ii) angular velocity of DC.
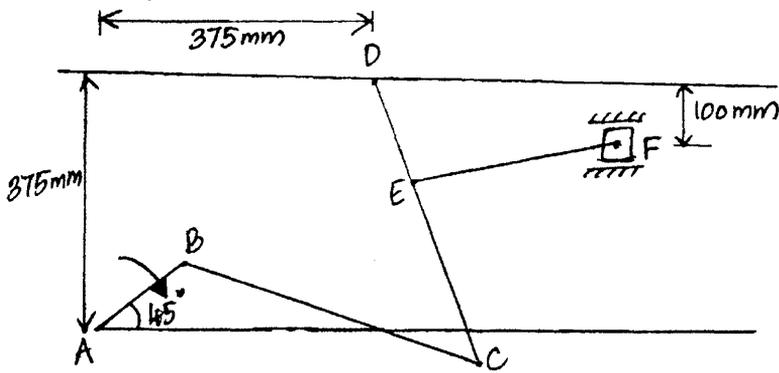
OR

II.   (a)   State and prove Arnold Kennedy'a theorem of three centers.   (8)

       (b)   In the mechanism shown in figure, the crank O_2A makes 300 rpm in the   (12)
              counter clockwise direction.   Find the (i) angular velocity of link O_1A
              (ii) velocity of slider at B. Given O_2A= 6 cm, O_1B = 30 cm.
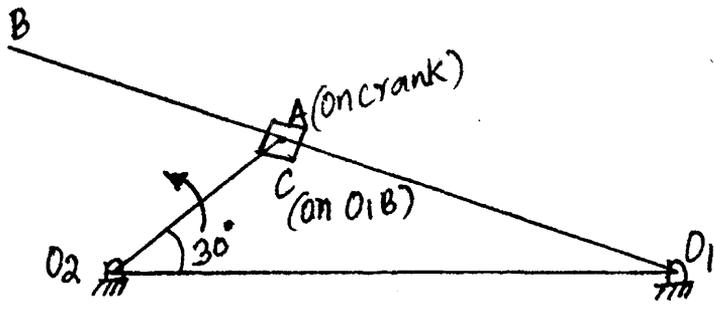
III.   (a)   Sketch and explain Peaucellier mechanism and Thompson indicator diagram.   (10)

       (b)   A cam drives a flat face follower. During the first $90°$ of rotation the cam, the   (10)
              follower moves outwards through a distance of 3 cm with S.H.M. The
              follower dwells during the next $90°$ cam rotation, the follower moves upwards
              with S.H.M. Draw the cam profile.

OR

IV.   A tangent cam with a base circle diameter of 50 mm operates a roller follower   (20)
        20 mm in diameter. The line of stroke of roller follower passes through the
        axis of the cam. The angle between the tangential faces of the cam is 60°,
        speed of the cam shaft is 200 rpm and the lift of the follower is 15 mm. Find
        (i) the main dimensions of the cam (ii) the acceleration of the follower at the
        beginning of the lift, where the roller just touches the nose and at the apex of
        the circular nose.

V.   (a)   Explain the terms (i) sensitiveness (ii) isochronous and (iii) hunting of a   (10)
            governor.
      (b)   A porter governor has all the four arms of 30 cm each. All the upper arms as   (10)
            well as the sleeve arms are pivoted to the axis of rotation. The mass of each
            ball is 1 kg. The mass on the sleeve is 20 kg. Find the speed of rotation when
            the balls rotate at a radius of 15 cm.

OR

VI.   (a)   Sketch and explain the working of a Hartnell governor.   (10)
      (b)   Compare a governor and flywheel.   (5)
      (c)   Explain the term governor effort and power of a governor.   (5)

VII. (a)   Differentiate between an involute and cycloidal profile of a toothed wheel.   (8)
      (b)   The following data refers to two mating involute gears of 20° pressure angle.   (12)

      Number of teeth on pinion   20
      Gear ratio   2
      Speed of pinion   250 rpm
      Module   12 mm

      If the addendum in each wheel is such that the path of approach and path of
      recess on each side are half the maximum possible length each, find (i) the
      addendum for both gears (ii) the length of arc of contact (iii) maximum
      sliding velocity during approach and recess.

OR

VIII.   A compound epicyclic gear train is shown in the figure. The gear A, D and E   (20)
        are free to rotate on the axis P, the compound gear B and C rotate together on
        the axis Q at the end of the arm F. All the gears have equal pitch. The number
        of external teeth on the gears A, B and C are 18, 45 and 21 respectively. The
        gears D and E are annular gears. The gear A rotates at 90 rpm in the
        anticlockwise sense and the gear D rotates at 450 rpm clockwise. Find the
        speed and direction of arm and gear E.
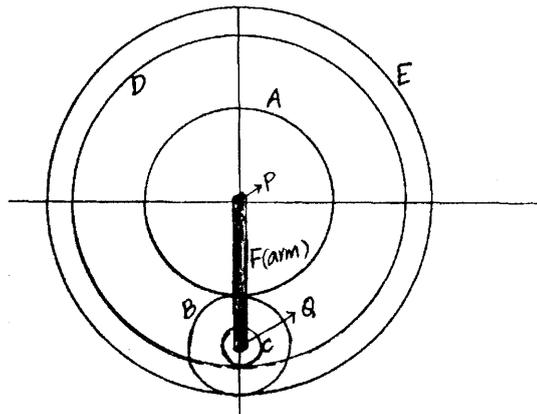
IX.   Derive the ratio of belt tensions for a V belt drive.   (8)
        Derive the expression for power transmitted in terms of torque by using   (12)
        uniform wear theory for a single plate clutch.

OR

X.   Sketch and explain the working of the following.   (20)
            (i)   Internal expanding shoe brake.
            (ii) Belt transmission dynamometer.

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