Indian Institute of Engineering Science and Technology, Shibpur

B.Tech (AE, CE, ME, MT, MN, CST, ETC, IT, EE) 1st Semester Mid Semester Examination, February, 2021

Mechanics (AM 1101)

Full marks: 30 Time: 45 Minutes

All notations have their usual meanings
Marks for each question are shown in the right
(i) Take g = 9.81 m/s^2.
(ii) Assume any other data not given in the question.
(iii) The numerical problems have to be solved with the data corresponding to the respective Enrollment No of individual student if mentioned
(iv) Answer any **Three (03)** questions

Answer any **Three (03)** questions

1. A uniform ring of mass m and radius r, shown in Fig. 1 carries an eccentric mass m_0 at a radius b and a vertical Force of P Newton is acting at the centroid of the eccentric mass and the ring is in an equilibrium position on the incline, which makes an angle α with the horizontal. If the contacting surfaces are rough enough to prevent slipping, calculate the angle θ which defines the equilibrium position. Take, $m = 40$ kG, $m_0 = 20$ kG, $r = 10$ meter, $b = 8$ meter, $\alpha = 15^0$.
   [*The value of P (in Newton) is the sum of last 3 digits of student's Enrollment No multiplied by g i.e. for the Student with Enrollment No. 2020EEB049:* $P = (0 + 4 + 9) * 9.81\ Newton = 127.53\ Newton$]. [10]

2. The uniform slender rod of mass m and length L is initially at rest in a centered horizontal position on the fixed circular surface of radius $R = 0.7L$ as shown in Fig. 2. If a force normal to the bar is gradually applied to its end until the bar begins to slip at the angle $\theta = (20 + 2 * \mathrm{I})^0$, determine the coefficient of static friction μ_s.
   [*Here, I is the last digit of student's Enrollment No i.e. for the Student with Enrollment No. 2020CEB106,* $I = 6$ *and* $\theta = 32^0$ *and for the Student with Enrollment No. 2020CEB090,* $I = 0$ *and* $\theta = 20^0$]. [10]

3. Solve for force in the member CG of the truss as shown in Fig. 3 by Method of Section.
   [*In the figure, the value of* $\boldsymbol{j}$ *is given by the last digit of the Student's Enrollment Number. For example, Enrollment No. 2020CEB123 will correspond to* $j = 3$]. [10]

4. In the spring clamp shown in Fig. 4, an internal spring is coiled around the pin A and the spring ends bear against the inner surfaces of the handle halves in order to provide the desired clamping force. In the position shown, a force of magnitude P = 50 N is required to release the clamp. Determine the compressive force at B if P = 0.
   [*In the figure, the value of* ***i*** *is given by the last 3 digits of the Student's Enrollment Number. For example, Enrollment No. 2020CEB123 will correspond to* $i = 123$]. [10]

5. The circular disk rotates about an axis through its center O and has three holes of diameter d positioned as shown in Fig. 5. A fourth hole is to be drilled in the disk at the same radius r so that the disk will be in balance (mass center at O). Determine the required diameter D of the new hole and its angular position (θ).
   [*"i" is last digit of Student's Enrollment No: Example for 2020AMB031,* $i = 1$] [10]

6. Determine the Moment of Inertia, I_x, I_y and I_{xy} for the composite of the two semicircular areas shown in Fig. 6 about the centroidal axes through C. [All dimensions are in mm].
   [*The value of "i" is last three digit of Student's Enrollment No: Example for 2020AMB031,* $i = 031$ *and* $radius = 50 + 031 = 81\ mm$]. [10]

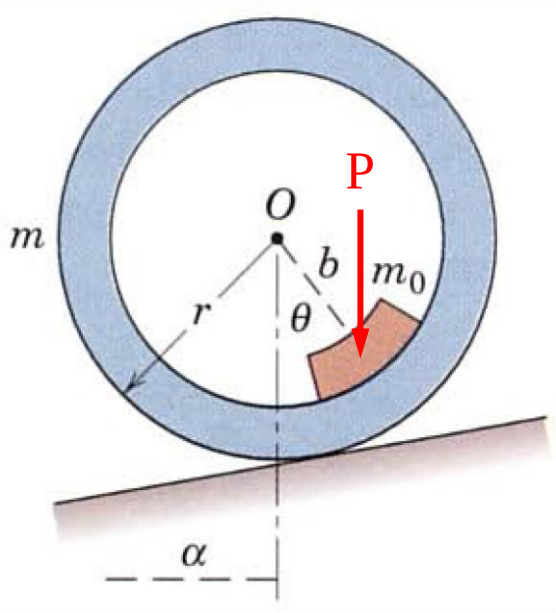

Fig. 1

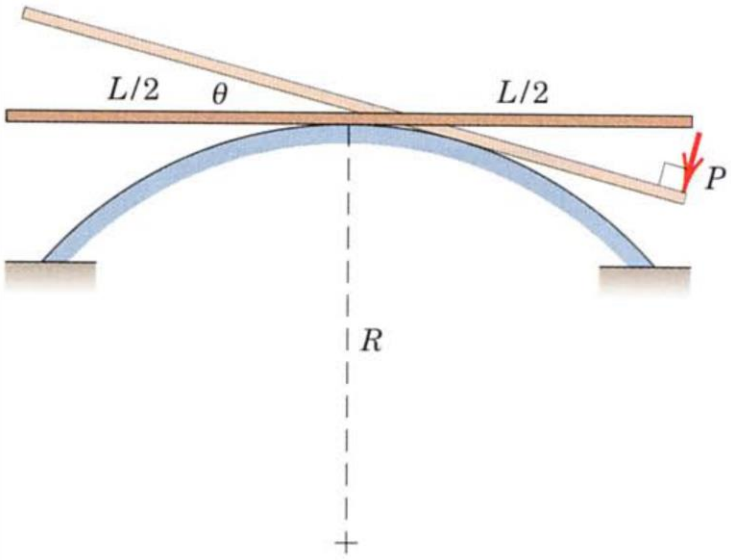

Fig. 2

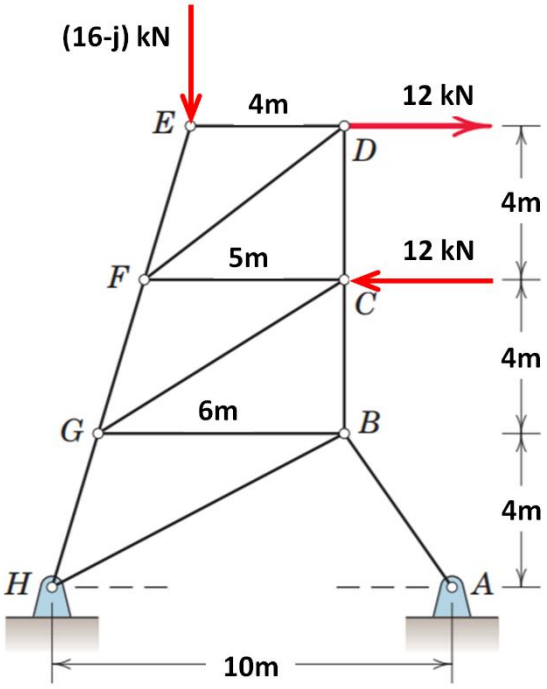

Fig. 3

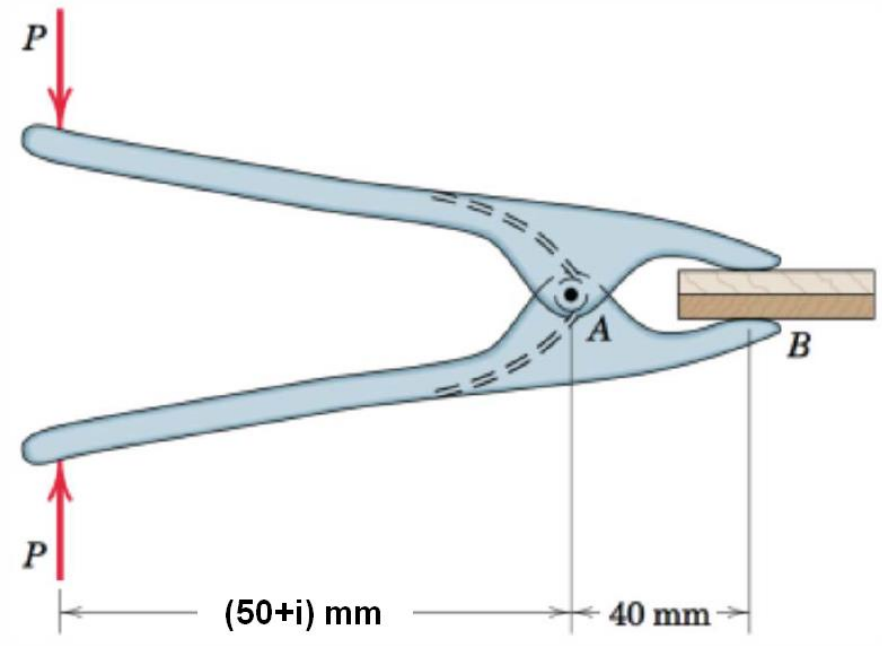

Fig. 4

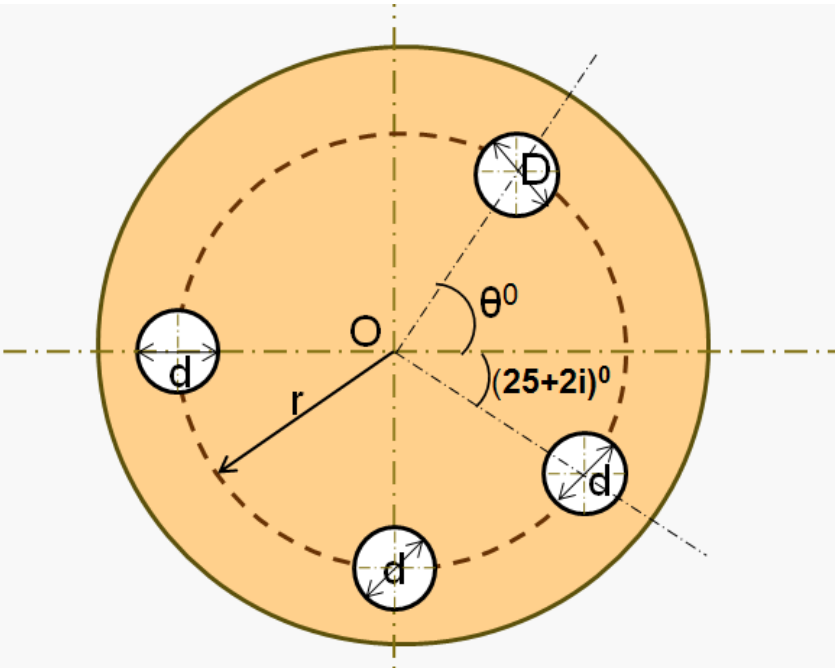

Fig. 5

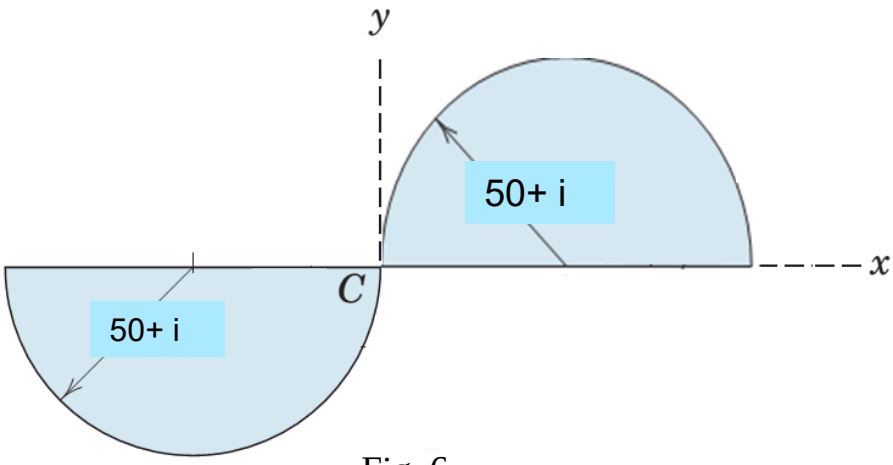

Fig. 6