School of Engineering and Applied Science (SEAS), Ahmedabad University

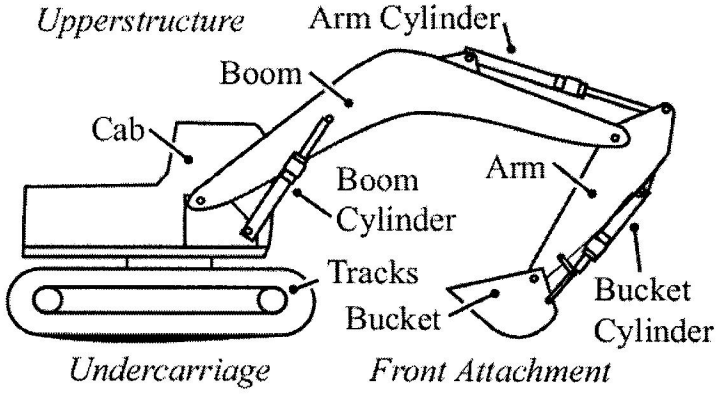
Name: _____ Roll no.: _____

B. Tech. (Mechanical): Semester III
Kinematics and Structures of Machines (MEC 200): Mid Term Exam (Monsoon Sem: 2023);
Marks: 40 M, Wt.: 25 %
September 18, 2023, Monday: 5.00 PM – 6.30 PM

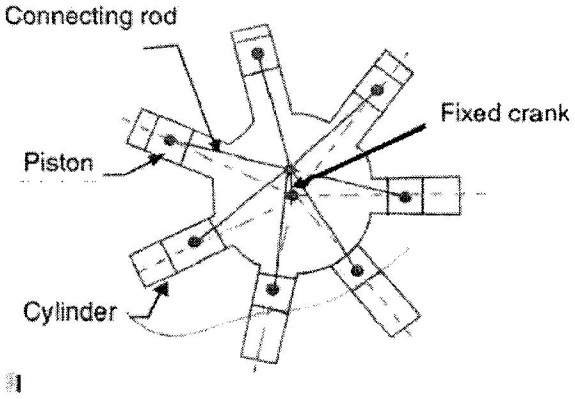
Instructions:

1. You are allowed to use only software and no other ppts/ study materials should be opened
2. Figures to right indicate full marks.
3. All acronyms carry their usual meaning.
4. Assume suitable data wherever necessary and specify it clearly in your answers.
5. Copying is strictly prohibited. Anyone found cheating will get zero marks.

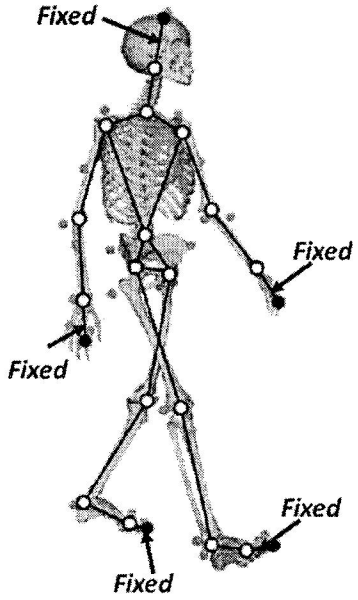
1(a). Calculate the degrees of freedom of the following machines. Draw kinematic diagrams wherever required and mark the number of links and joints in the kinematic diagrams suitably. **[12]**



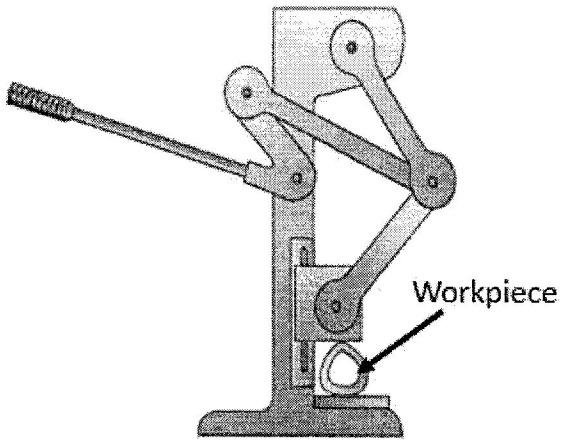
(a) *Excavator*



(b) **Aircraft Gnome rotary engine**



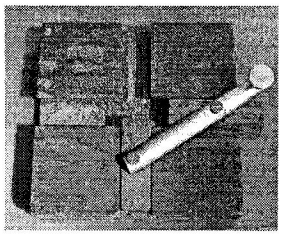
(c) *Kinematic model of a human body*

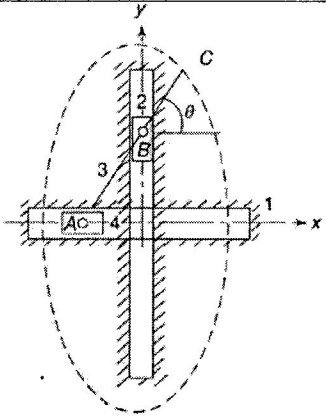


(d) *Mechanical press*

P.T.O

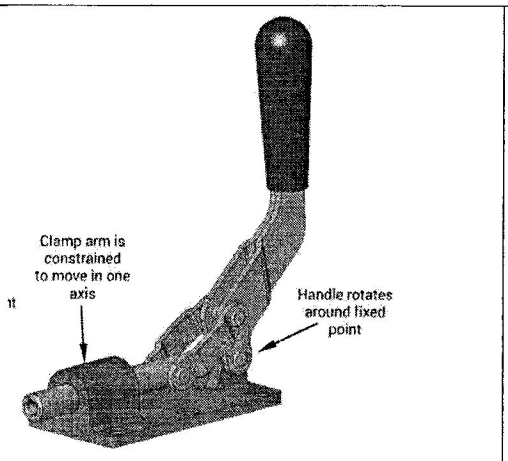
(b). An elliptical trammel is a mechanism used to trace an ellipse as shown in Figure. At any instant of time, the coordinates of point **C** with respect to the origin are given as (15 mm, 30 mm) and the length AC is three times the length BC. Find the length of link AB in the mechanism. **[3]**



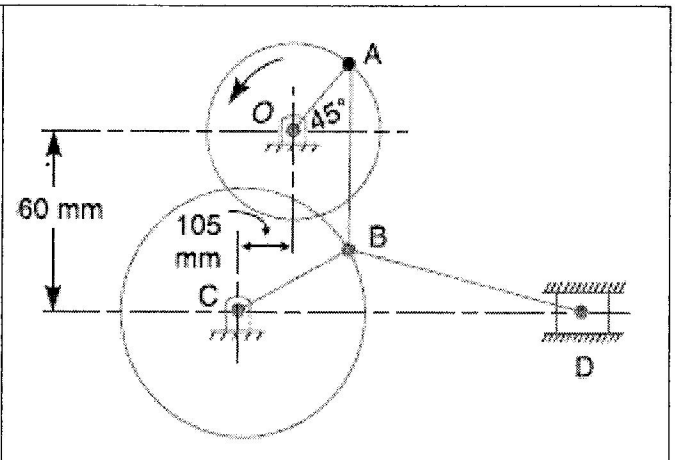


2. Figure below shows a toggle mechanism used in clamping applications, clutches, rock crushers, etc. In the toggle mechanism, the dimensions of the various links are: OA = 180 mm; AB = 360 mm; CB = 240 mm; and BD = 540 mm. The crank OA rotates at an angular speed of 180 R.P.M with an acceleration rate of 50 rad/s^2. For the given configuration, determine the following: **(a)** Velocity of slider D and angular velocity of BD, and **(b)** Acceleration of slider D and angular acceleration of BD. Use graphical approach to solve the problem. **[15]**

Note: You are allowed to use **FreeCAD** software for solving the problem. However, please note down the following **(i)** sketch the final vector diagrams in the answer sheet **(ii)** mark the scales chosen, vector lengths and directions, etc. suitably in the vector diagrams.



Toggle mechanism for clamping

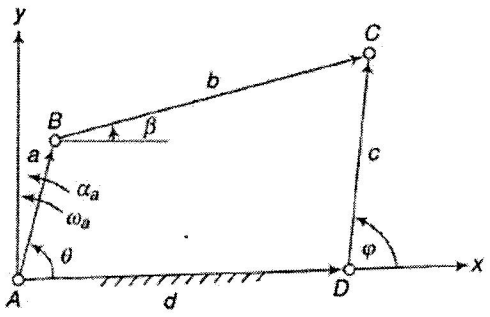


3. For a four-bar mechanism ABCD shown in Figure below, the crank AB rotates at a uniform angular velocity of 15 rad/s in the counter-clockwise direction. At a particular instant, the crank AB makes an angle of 30° with the link AD in the positive x-direction. The length of the link AD is 100 mm. The angles **β** and **φ** for the given configuration are 10° and 95°. The angular velocity of the link CD is 8 rad/s.

Calculate the following **(a)** length of the remaining links, **a**, **b** and **c** (b) linear velocity and acceleration of point **C.**

[10]

Note: You are allowed to use **Python** software for solving the problem. However, please note down that you need to write down the numerical data and necessary equations appropriately in your answer sheets.



All the best
