

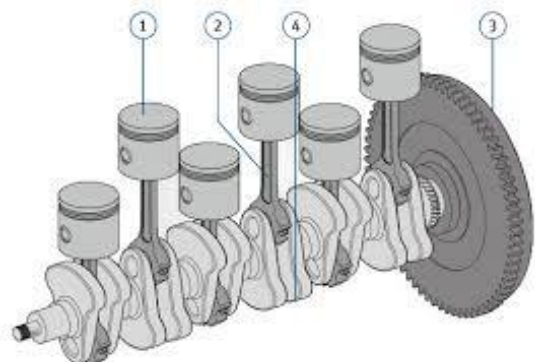
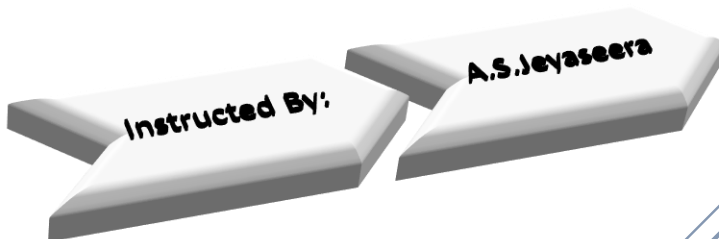
ME1032 MECHANICS:

Take Home Assignment

Semester: I

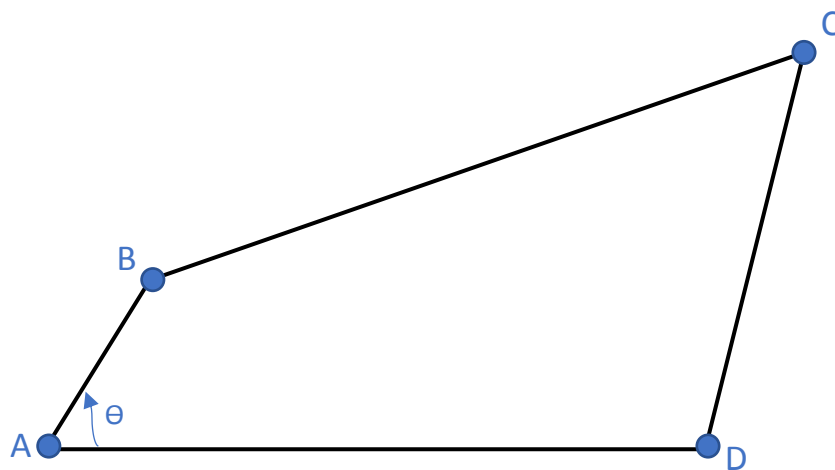
Index No.	Name	Practical Group
190562G	Sanjith.S	E7-G6

Date of Submission : 16/09/2020
Due Date of Submission : 16/09/2020



Department of Mechanical Engineering
University of Moratuwa

Contents... Answer for the following Questions...



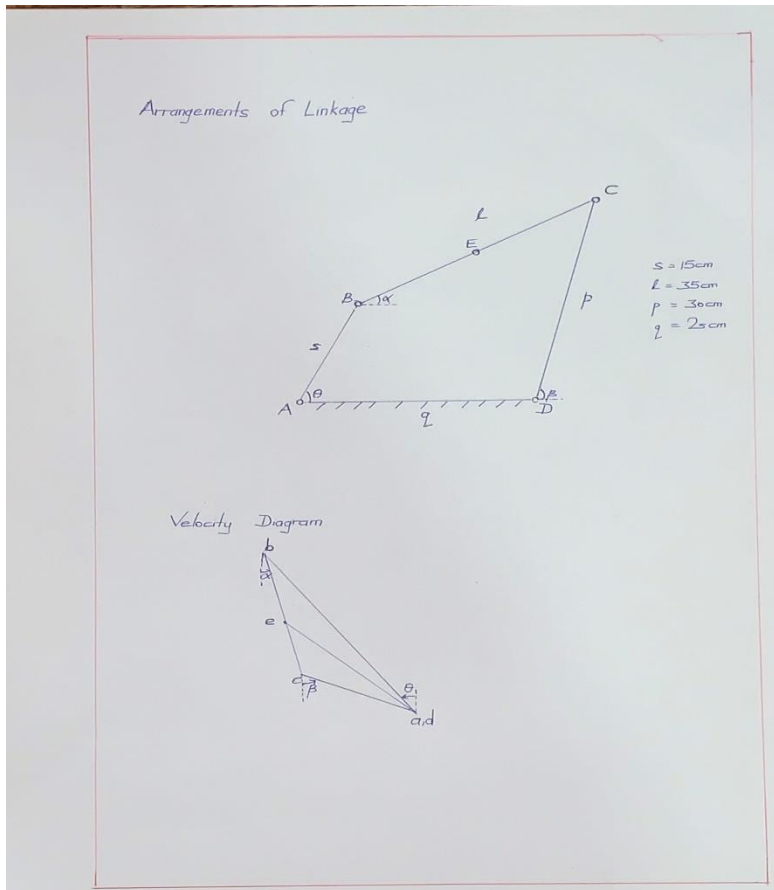
1. Write down a brief introduction about Mechanisms. **[10 Marks]**
2. For the configuration, input angle(θ) and angular velocity (ω) *specified by the instructor?*
 - a) Draw the velocity diagram of the coplanar link BC. **[25 Marks]**
 - b) Calculate the velocity of center point of BC. **[15 Marks]**
 - c) Plot the crank angle(θ) vs Velocity of point C (V_c). **[20 Marks]**
3. Mention two possible application of four bar linkage mechanism. **[10 Marks]**
4. Discuss two important mechanisms with applications (except four bar linkage). **[20 Marks]**

Answers

1. Mechanism

- Mechanism is a set of systems (commonly referred to as machines) and components which are assembled and utilized in a way that can convert available forces and motions in to desired forces and motions.
- Mechanisms generally consist of moving components that can include:
 - ✚ Gear systems and Trains
 - ✚ Belt and chain drives
 - ✚ Linkages
 - ✚ Friction based components such as brakes...
 - ✚ Structural components which include frame, bearings, springs, lubricants
- Mechanism may convert
 - ❖ Change directions of force. (pulley)
 - ❖ Decrease or Increase the value of force necessary to do particular task. (Hydraulic Jack)
 - ❖ Transmit Motions in between wheels and bars. (Sewing Machine)
 - ❖ Decrease and Increase velocities of motions as to obtain desired motions. (Bicycle wheel)
 - ❖ Change type of Motions. (Piston Crank Mechanism)

2.



By Equating vertical and horizontal distance of C from A

$$[X]: AB * \cos \theta + BC * \cos \alpha = AD + CD * \cos \beta$$

$$l * \cos \alpha - p * \cos \beta = q - s * \cos 30^\circ$$

$$0.35 * \cos \alpha - 0.30 * \cos \beta = 0.25 - 0.15 * (\sqrt{3}/2) \text{ ————— (01)}$$

$$[Y]: AB * \sin \theta + BC * \sin \alpha = CD * \sin \beta$$

$$l * \sin \alpha - p * \sin \beta = s * \sin 30^\circ$$

$$0.35 * \sin \alpha - 0.30 * \sin \beta = 0.15 * (1/2) \text{ ————— (02)}$$

By solving (1) and (2)

$$\alpha = 24.7793^\circ \text{ \& } \beta = 48.7793^\circ$$

$$ab = AB * \omega \gg ab = 0.15 * 1.2566 \gg ab = 0.1885 \text{ ms}^{-1}$$

In Δabc Sine rule

$$\frac{\sin(\theta - \alpha)}{ac} = \frac{\sin(\beta - \theta)}{bc} = \frac{\sin(180 - \beta + \alpha)}{ab}$$

$$\frac{\sin(5.2207^\circ)}{ac} = \frac{\sin(18.7793^\circ)}{bc} = \frac{\sin(156^\circ)}{0.1885}$$

$$bc = 0.1492 \text{ ms}^{-1}$$


$$ac = 0.04202 \text{ ms}^{-1}$$

In Δace Cos rule

$$ae^2 = ac^2 + ce^2 - 2 * ac * ce * \cos(180 - \beta + \alpha)$$

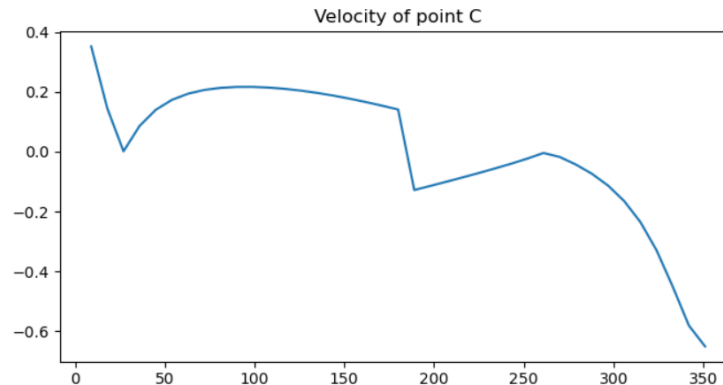
$$ae = \sqrt{(0.0583^2 + 0.0746^2 - 2 * 0.0583 * 0.0746 * \cos 156^\circ)} \\ = 0.1300 \text{ ms}^{-1}$$

$$\text{Angle with vertical} = \beta - \theta \quad \text{where } \theta = \cos^{-1}\left(\frac{ae^2 + ac^2 - ce^2}{2 * ac * ae}\right)$$

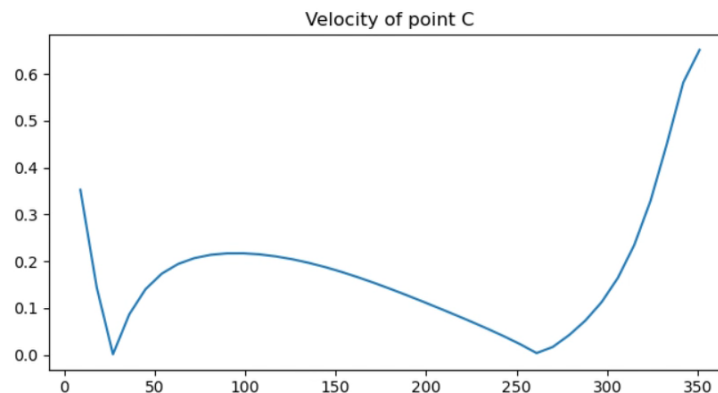
$$= 35.193^\circ$$


3. To analyze change of velocity of point C with time... I created an algorithm with the use python

- If we consider the velocity of point C with respect to Y axis (i.e. taking velocity to be positive if y component of V_c positive...)



- If we only consider the magnitude of velocity of point C.... we are likely to obtain a graph like

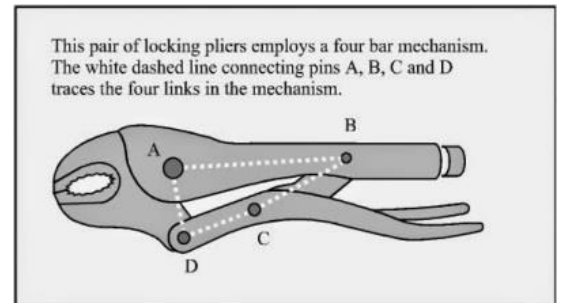


I used plot and matplotlib library of python to visualize the changes happen while crank motion of short arm.... Also attached the code (as text document), I use to go through ideas with this document....

4. Applications of Four-bar linkage system...

I. The Pairs of Locking Pliers....

- ✚ Here linkages are arranged as to perform double rocker mechanism.
- ✚ When C is above 180 then force at D act towards cause front part to expand and after locked the angle C become less than 180 and keep in locked position by providing extra force.
- ✚ Here direction of applying force and value of it were utilized in a useful manner

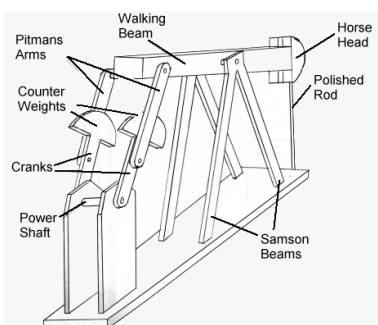


- ##### II. In nature parrotfish also get mechanical advantage of muscle force by four-bar like mechanism inside its jaws in order to acquire its powerful bite requirement.



III. Oil Well Pumps ...

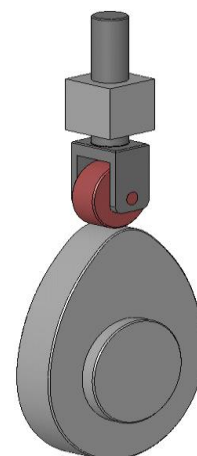
- ✚ Here we use crank rocker mechanism to transform rotary motion of crank in to vertical reciprocating motion that drives polished rod.



5. Mechanisms with Application

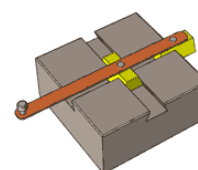
I. Cam and Follower Mechanism

- ☞ Cam and Follower mechanism commonly used to transfer rotary motion into linear motion specially in cases where we require asymmetrical and sudden changes in linear velocity....
- ☞ Here cam is designed in a way as to increase acceleration of follower in a gentle manner and keep increasing until it reaches top of cam and then decreasing it in a smooth way...
- ☞ Since the whole process of changing linear velocities are happening in a very smooth manner the mechanism is very useful in many applications.
- ☞ Application:
 - i. Used in IC engine to determine the opening and closing time of fuel valves during stroke cycle (Since opening and closing of valve required to be happen in sudden manner and held open for comparatively long time, this mechanism is best)
 - ii. Also used in regulating machineries used in filling bottles and tins...



II. ELLIPTICAL TRAMMEL MECHANISM.

- ✚ Movement of one slider along its linear path transfer a linear movement in perpendicular to that to another slider through the link....
- ✚ During the movements of sliders, the end of link moves in an elliptical path...
- ✚ Application:



Used to draw ellipse with different proportions by determining motion of sliders in appropriate way.



The End