



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
B Tech. Mechanical Engineering
TMC 4212 : MECHANICS OF MACHINES I
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2 HOURS
DATE: Pick Date Sep 2018

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE

- a) Give the classification of kinematic pairs according to the following considerations:
- According to the type of relative motion between the elements
(5 marks)
 - According to the type of contact between the elements.
(2 marks)
 - According to the type of closure
(2 marks)
- b) With the aid of suitable diagrams and using the expressions $l = 2p - 4$ and $j = 1.5l - 2$, describe the following types of kinematic chains:
- Locked chain
 - Constrained kinematic chain
 - Unconstrained chain
(6 marks)

- c) In the slider crank mechanism shown in figure 1, the crank OA rotates at 30 rpm and transmits motion to the sliders B and D. if the dimensions for the various links are given as $AB = 1000$ mm, $OA = 200$ mm and $BC = CD = 400$ mm, find:
- Velocities of sliding at B and D,
 - Angular velocity of CD,
 - Linear acceleration of D, and
 - Angular acceleration of CD.

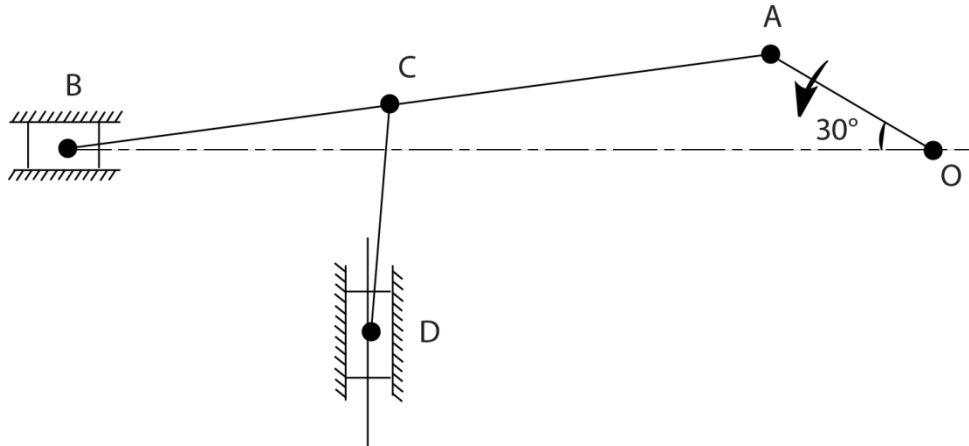


Fig. 1

(15 marks)

Question TWO

- a) Locate all the instantaneous centres for the crossed four bar mechanism as shown in Figure 2. The dimensions of various links are: $CD = 65$ mm; $CA = 60$ mm; $DB = 80$ mm; and $AB = 55$ mm. Find the angular velocities of the links AB and DB, if the crank CA rotates at 100 rpm in the anticlockwise direction.

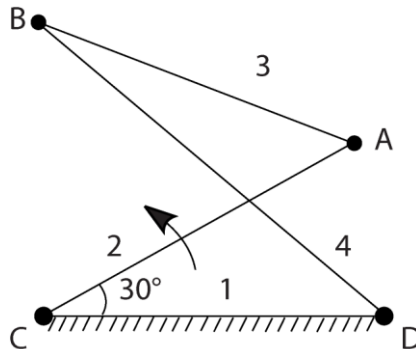
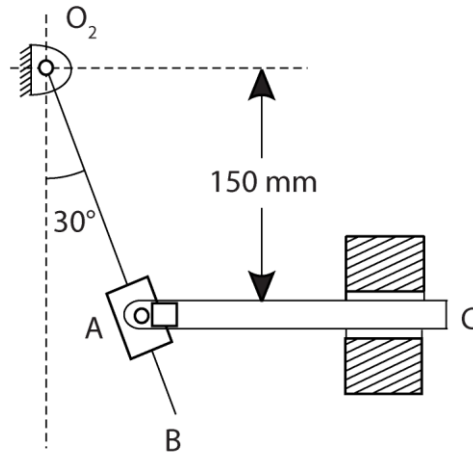


Figure 2

(10 marks)

- b) The mechanism as shown in Figure 3 is a marine steering gear, called Rapson's slide. O_2B is the tiller and AC is the actuating rod. The velocity of AC is 25 mm/min to the left. Find, using the relative velocity method, the angular velocity of the tiller.



(10 marks)

Question THREE

A mechanism of a crank and slotted lever quick return motion is shown in Figure 3. If the crank rotates counter clockwise at 250 rpm, determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever. Crank, $AB = 200$ mm; Slotted arm, $OC = 900$ mm and link $CD = 300$ mm.

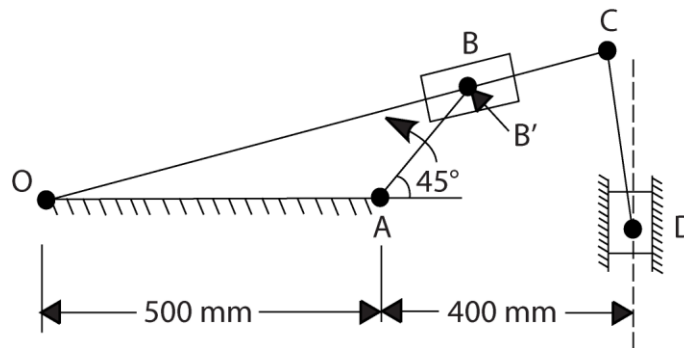


Figure 3

(20 marks)

Question FOUR

- a) State the following laws of friction:
 i) Laws of static friction

(5 marks)

ii) Laws of kinetic friction

(3 marks)

iii) Laws of fluid friction

(4 marks)

- b) The lead screw of a lathe has acme threads of 50 mm outside diameter and 10 mm pitch. The included angle of the thread is 29° . It drives a tool carriage and exerts an axial pressure of 2500 N. A collar bearing with outside diameter 100 mm and inside diameter 50 mm is provided to take up the thrust. If the lead screw rotates at 30 rpm, find the efficiency and the power required to drive the screw. The coefficient of friction for screw threads is 0.15 and for the collar is 0.12..

(8 marks)

Question FIVE

- a) A pulley is driven by a flat belt running at a speed of 600 m/min. The coefficient of friction between the pulley and the belt is 0.3 and the angle of lap is 160° . If the maximum tension in the belt is 700 N; find the power transmitted by a belt.

(8 marks)

- b) In a reverted gear train, two shafts A and B are in the same straight line and are geared together through an intermediate parallel shaft C. The gears connecting the shafts A and C have a module of 2 mm and those connecting the shafts C and B have a module of 4.5 mm. The speed of shaft A is to be about 12 times greater than the speed of shaft B, and the ratio at each reduction is same. Find suitable number of teeth for gears. The number of teeth of each gear is to be a minimum but not less than 16. Also find the exact velocity ratio and the distance of shaft C from A and B.

(12 marks)