POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION

(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION
JUNE 2012 SESSION

J5110: MECHANICS OF MACHINE 2

DATE : 20 NOVEMBER 2012 (TUESDAY)

DURATION : 2 HOURS (2.30PM – 4.30PM)

This paper consists of **SEVEN (7)** pages including the front page.
Essay (6 questions – answer 4 questions)

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ESSAY (100 marks)

INSTRUCTION:

This section consists of **SIX (6)** questions. Answer any **FOUR (4)** questions.

QUESTION 1

Figure 1 shows a mechanism consists of lever O_2A, link AB and link $BO_4.O_2A$ rotates clockwise with constant angular velocity of $\omega = 36$ rad/s. At the position shown:

a) Draw the space diagram

(7 marks)

b) Draw the velocity diagram

(9 marks)

c) Determine the velocity of point A

(3 marks)

d) Determine the velocity of point B

(3 marks)

e) Determine the angular velocity of link AB

(3 marks)

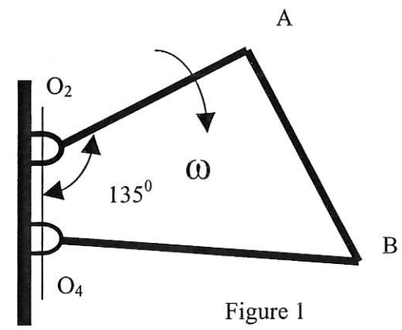


Figure 1

Given:

$O_2A = 350$ mm, $AB = 425$ mm, $BO_4 = 400$ mm and $O_4O_2 = 100$mm

QUESTION 2

The crank OA rotates clockwise with angular velocity ω = 10 rad/s and angular acceleration α = 30 rad/s^{2}as shown in Figure 2.

a) Draw the space diagram (scale 1 cm = 20 mm)

(3 marks)

b) Draw the velocity diagram (scale 1 cm = 0.1 m/s)

(5 marks)

c) Draw the acceleration diagram (scale 1 cm = 1 m/s^2)

(15 marks)

d) Find the acceleration of point B (2 marks)

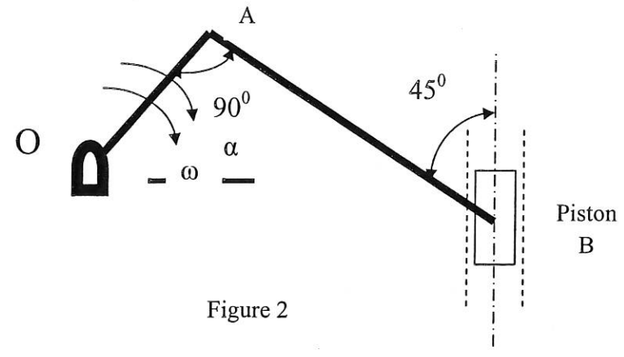


Figure 2

Given:

OA = 75 mm

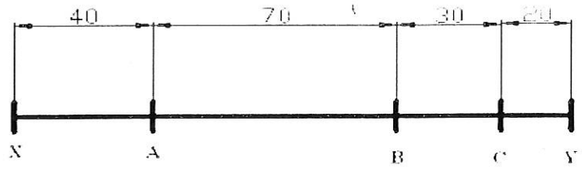
AB = 150 mm

ω = 10 rad/s

α = 30 rad/s^2

QUESTION 3

a) A rotating shaft carrying three masses A, B and C of 10 kg, 16 kg, 22 kg and each mass has a radius of rotation of 70mm, 120mm and 100mm respectively from the axis of rotation O. The arrangement of masses are shown in Figure 3. This system will be balanced by placing 2 masses on the X and Y axis. The radius of rotation of the two masses is 8cm. The angle between AOB and BOC is 130°. By choosing plane X as a reference:



unit in cm

Figure 3

i. Complete the Mr and Mrl table

(2 marks)

ii. Draw the Mr and Mrl polygon

(11marks)

iii. Find the mass of M_x and M_y

(4 marks)

iv. The angle of X and Y relative to crank A

(4 marks)

b) Define:

i. Gear ratio

(2 marks)

ii. Gear efficiency (2 marks)

QUESTION 4

a) A body of 6 kg suspended from a helix spring produces 47 mm static deflection. The body is pushed 35.6 mm from its static equilibrium position and oscillates. Calculate:

i. The frequency of the vibration

(4 marks)

ii. The velocity and acceleration when the body is 22 mm from static equilibrium position

(6 marks)

iii. The maximum force in the spring

(2 marks)

b) A body rotates with Simple Harmonic Motion with 25oscillations per minute. When the distance of the body is 100 mm from its static equilibrium position, the velocity is 2/5 from its maximum velocity. Determine:

i. The amplitude of the oscillation

(7 marks)

ii. The maximum acceleration of the body

(3 marks)

iii. The velocity when it is 55 mm from its static equilibrium position

(3 marks)

QUESTION 5

Uniform rod AE as shown in Figure 5 has mass of 1.5 kg. 2 kg massesare placed at point B and E respectively . The system employsa spring of stiffness of 1.5 KN/m and a damper of coefficient C = 10 Ns/m . The system is then allowed to vibrate. Determine :

a) The natural circular frequency of the system ω_n

(13 marks)

b) The damping ratio ς

(6 marks)

c) If the first amplitude is 12 mm , find the fifth amplitude of the system

(6 marks)

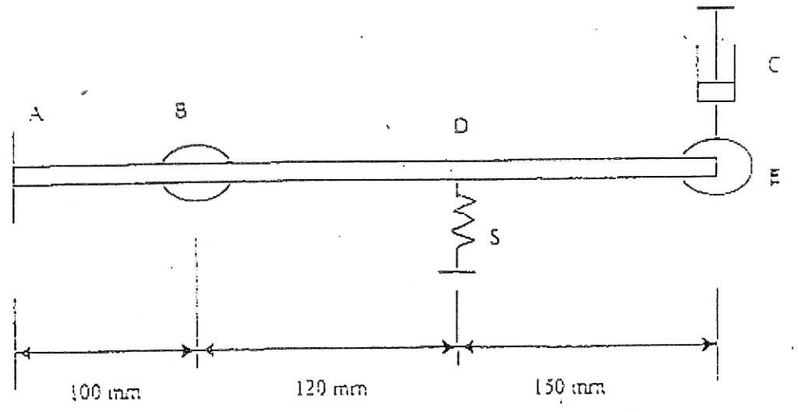


Figure 5

QUESTION 6

A vehicle of 2000 kg has 3 m wheel base. Its centre of gravity is 700 mm from the road surface and 1.5 m from front driven shaft. Friction coefficient is 0.7.

a) Sketch the diagram of forces acting on the vehicle when it moves up a gradient 1 in 15.

(4 Marks)

b) Calculate the maximum acceleration when:

i. Four wheel driven

(7 Marks)

ii. Front wheel driven

(7 Marks)

iii. Rear wheel driven

(7 Marks)