



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

LOCATION SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 4

LEFEL 4

EXAMINATION PERIOD
MAY 2018

CYFNOD ARHOLIADAU
MAI 2018

HND ELECTRICAL AND ELECTRONIC ENGINEERING

MODULE CODE: M4X01405

Dynamics Control and Instrumentation

TIME: 2 HOURS

ANSWER ALL SIX QUESTIONS

Equipment or materials required – Calculators are allowed

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ANSWER ALL 6 QUESTIONS

Question One (10 marks)

A particle is projected up a plane which is set at 24° (degrees) elevation to the horizontal (Figure 1 below). The particle leaves point A with a velocity of 80m/s at an angle of 40° (degrees) to the plane. If the effects of drag are ignored, determine:-

- a) The time to impact at point B (6 marks)
- b) The total distance along the plane to B, the point of impact on the plane. (4 marks)

(Assume gravity is 9.81m/s^2)

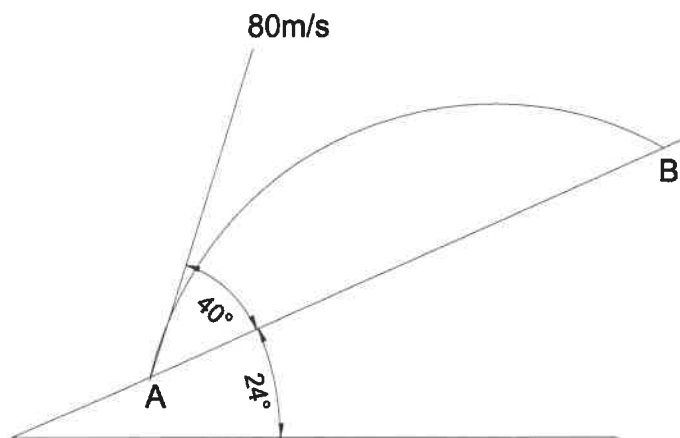


Figure 1

Question Two (10 marks)

The motion of two particles A and B have a motion which can be described by the following expressions:-

For particle A $S = 17t^2 + 10t$

For particle B $S = 9t^2 + 30$

Where S = displacement in m, t = time in seconds.

Determine:-

- a) The time when the velocity of particle A is twice that of particle B (5 marks)
- b) The distance travelled by each particle in the period from $t = 0$ to $t = 4$ seconds (4 marks)
- c) The acceleration of particle A after 3 seconds (1 mark)

Question Three (15 marks)

A mass spring damper system as shown in figure 2 below comprises of a mass of mass (m), with 3 identical springs with stiffness coefficient (k), and 2 viscous dampers with damping coefficient (c).

- a) Determine an expression for the transfer function for this system (assume Zero for all initial conditions).

(6 marks)

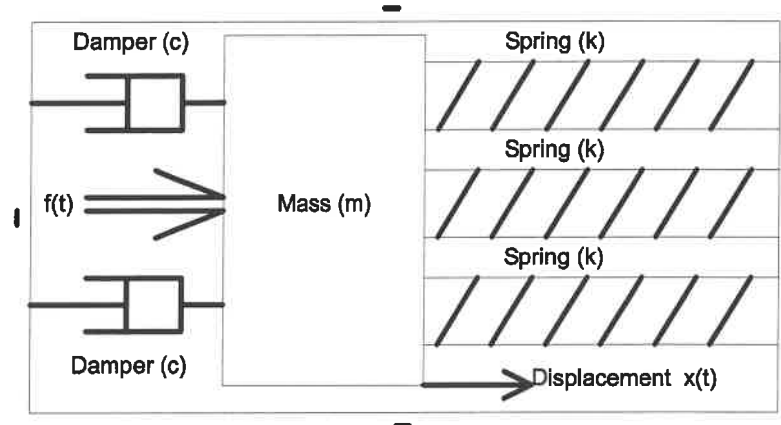


Figure 2

- b) If $m = 5$, $c = 3$ and $k = 10$, determine the natural frequency (*in Hz*) for the system.

(5 marks)

- c) Determine the damping coefficient for the system

(3 marks)

- d) Show if the system is Under, Over or Critically damped

(1 mark)

Question four (15 marks)

Given the Laplace transforms

$$\text{unit step} = \frac{1}{s}$$

$$e^{-at} = \frac{1}{(s + a)}$$

For a system having the transfer function

$$G_s = \frac{(s + 5)}{s^2 + 8s + 7}$$

Determine :-

- a) The Poles and Zeros and hence determine its stability .(4 marks)
- b) The D.C. response.(3 marks)
- c) The system output after 2 seconds if a step signal of magnitude 3 is applied to its input?(8 marks)

Question five (10 marks)

- a) Determine if a system having a characteristic equation:-

$$2s^5 + 3s^4 + 2s^3 + s^2 - s + 4$$

Is stable, and if not, determine how many poles are in the RH plane of its pole zero diagram.(you are not expected to draw the pole zero diagram)

(10 marks)

Question six (10 marks)

- a) Derive a simplified expression for the transfer function of the system shown in figure 3 below.

(5 marks)

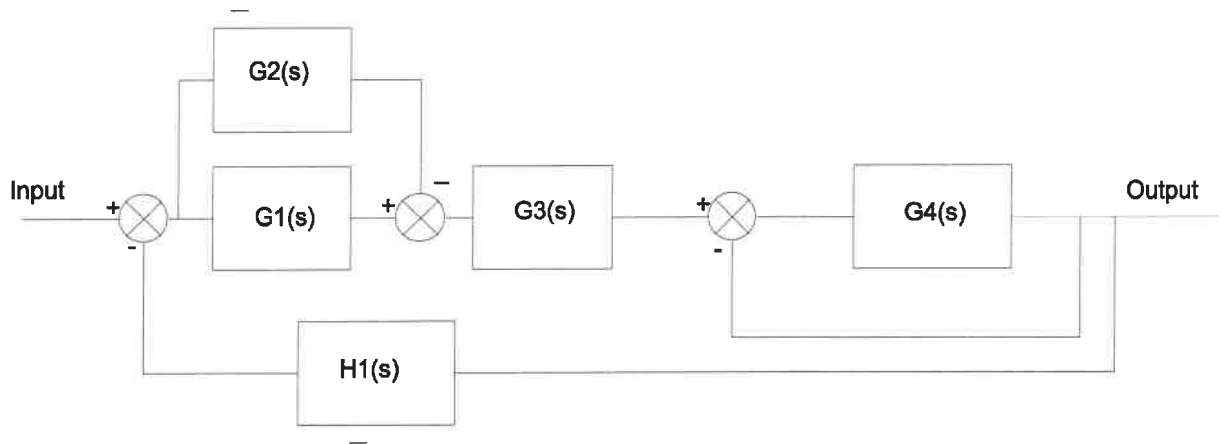


Figure 3

- b) Figure 4 below represents a servo control system. The output of the servomotor is controlled by a measured pressure. If the pressure is 1000 Pa what will be the servo rotation in degrees?

(5 marks)

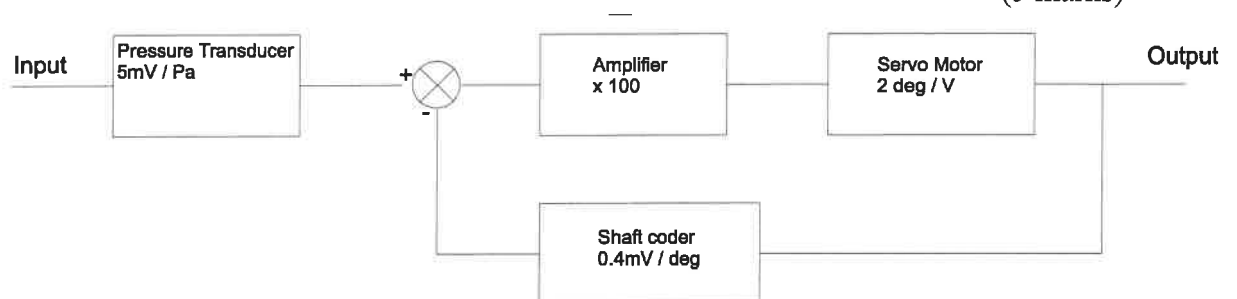


Figure 4

Diwedd/End

Total (70 Marks)