



12 Pages

Complete, fold and seal
(see note 2 below)

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1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	DAV22868331
2	Title of Examination Paper	DND Electrical and Electronic Engineering
3	Module Code	EOEE4002
4	Date and Time of Examination	13/05/25
5	Examination Venue	Tycoch Main Hall
6	Seat Number	C6
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

~~53%~~ ~~EQ~~
✓
RE

Question 5

Data

$$R = 150 \Omega$$

$$L = 2 \text{ H}$$

$$C = 25 \text{ Mf}$$

$$\frac{d^2 i}{dt^2} + \frac{R}{L} \frac{di}{dt} + \frac{1}{LC} i = \frac{V}{CL}$$

Homogeneous differential equation

$$\frac{d^2 \theta_c}{dt^2} + 2\zeta \omega_n \frac{d\theta}{dt} + \omega_n^2 \theta_0 = 0, \omega_n^2 \theta_0$$

a) $\omega_n = ?$

$$\omega_n = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(2)(25 \times 10^{-6})}} = \frac{1}{\sqrt{(2)(0.000025)}}$$

$$\omega_n = \frac{1}{\sqrt{0.00005}} = \frac{1}{0.005} = 200 \text{ rad/s}$$

b) $\zeta = ?$

$$\zeta = \frac{R}{2L\omega_n} \quad \text{error carried over}$$

$$\zeta = \frac{R}{2L\omega_n} = \frac{150}{2(2)(200)} = 0.1875 \quad (1)$$

Is the system damped or underdamped?

c) $\omega_d = ?$

$$\omega_d = \omega_n \sqrt{1 - \zeta^2}$$

error carried over

$$\omega_d = (200) \sqrt{1 - (0.1875)^2}$$

$$\omega_d = 200 \sqrt{0.9648}$$

$$\omega_d = 196.448 \text{ rad/s}$$

d) $\tau = ?$

$$\tau = \frac{1}{\zeta \omega_n}$$

$$\tau = \frac{1}{(0.1575)(200)} = \frac{1}{31.5}$$

$$\tau = 0.0266 \text{ sec.}$$

(4)

e) $V(t) = V_0$

$$V_0 = 10 \text{ V}$$

$$i_{ss} = ?$$

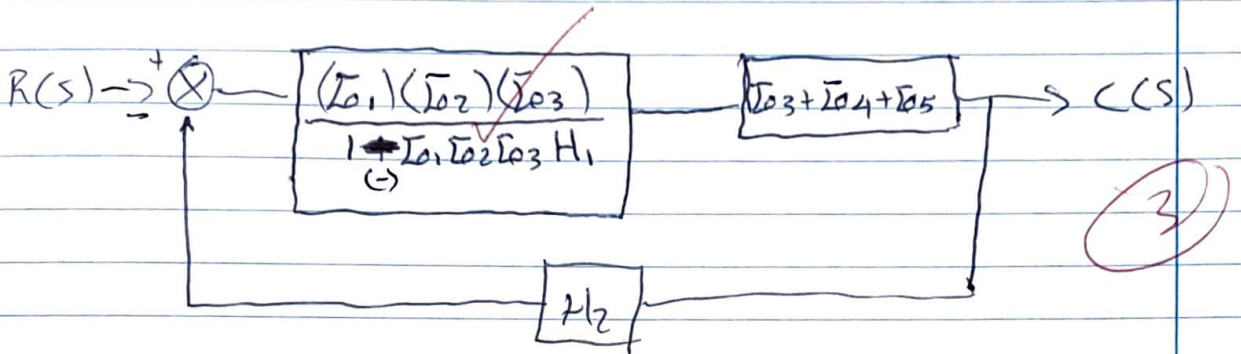
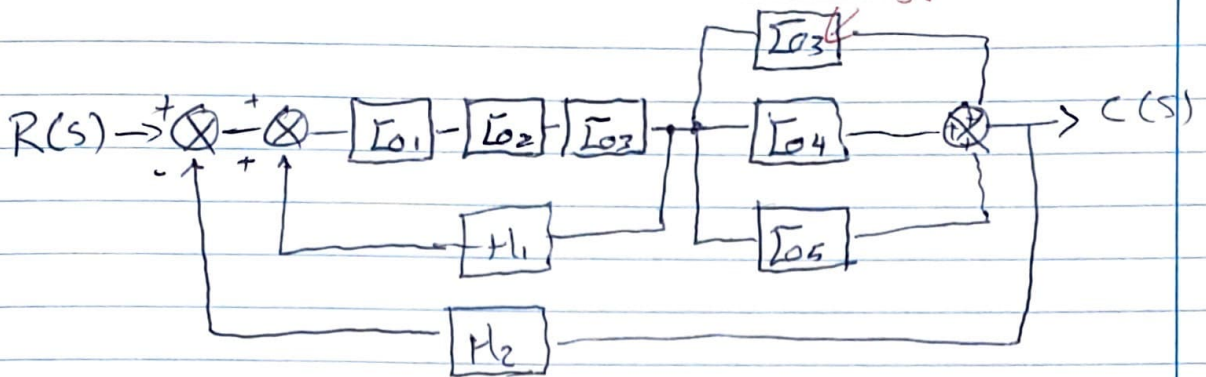
OHMS LOW

$$i_{ss} = \frac{V}{R} = \frac{10}{150} = 0.066 \text{ Amp.}$$

(4)

Question 4

Type in script



Show all steps.

~~R(s)~~

$$* \frac{(G_1 G_2 G_3)(G_3 + G_4 + G_5)}{(1 - G_1 G_2 G_3)(G_3 + G_4 + G_5)} \cdot \frac{1 + G_1 G_2 G_3 H_1}{(1 - G_1 G_2 G_3)(G_3 + G_4 + G_5)} \cdot H_2$$

$$* \frac{(G_1 G_2 G_3)(G_3 + G_4 + G_5)}{1 - (G_1 G_2 G_3)(G_3 + G_4 + G_5) + (G_1 G_2 G_3)(G_3 + G_4 + G_5) H_2}$$

$$\frac{C(s)}{R(s)} = \frac{(G_1 G_2 G_3)(G_3 + G_4 + G_5)}{1 - (G_1 G_2 G_3)(G_3 + G_4 + G_5) + (G_1 G_2 G_3)(G_3 + G_4 + G_5) H_2}$$

Question 3

$$F(s) = \frac{(s+3)}{(s+4)(s^2+3s+6)}$$

$$z_1 = -3$$

$$p_1 = -4$$

$$P_{2,3} \Rightarrow s^2 + 3s + 6$$

$$s = -3$$

$$s = \frac{-3 \pm \sqrt{3^2 - 4(1)(6)}}{2(1)}$$

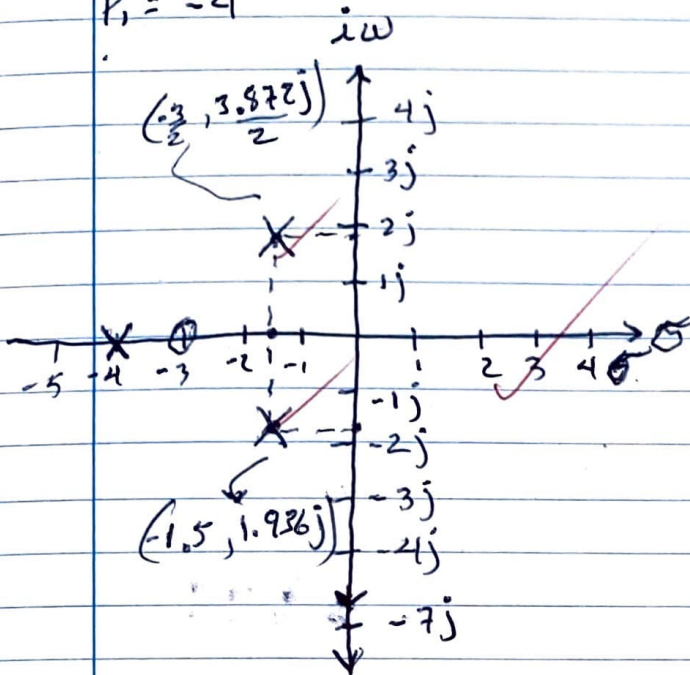
$$s = \frac{-3 \pm \sqrt{9 - 24}}{2}$$

$$s = \frac{-3 \pm \sqrt{-15}}{2}$$

$$s = \frac{-3 \pm 3.872j}{2}$$

$$P_2 = -1.5 + 1.936j$$

$$P_3 = -1.5 - 1.936j$$



$$b) s = -2 + j$$

$$F(-2+j) = \frac{(-2+j+3)}{(-2+j+4)((-2+j)^2 + 3(-2+j) + 6)}$$

$$= \frac{(1+j)}{(2+j)(3-j)}$$

$$= \frac{1+j}{7+j} \Rightarrow \frac{1+j}{7+j} \cdot \frac{7-j}{7-j}$$

$$= \frac{8}{50} + \frac{6}{50}j$$

$$r = \sqrt{\left(\frac{8}{50}\right)^2 + \left(\frac{6}{50}\right)^2}$$

$$r =$$

$$r = \sqrt{0.04} \approx 0.2$$

$$\theta = \tan^{-1}\left(\frac{6/50}{8/50}\right)$$

$$\theta = \tan^{-1}\left(\frac{6}{8}\right)$$

$$\theta = 40.96^\circ$$

$$\text{answer} = 0.2 \angle 40.96^\circ$$

$$\begin{aligned} & * (1-j)^2 + 10 \\ & \rightarrow j^2 - 4j + 4 \\ & \rightarrow -6 + 3j + 6 \\ & \rightarrow 3-j \end{aligned}$$

$$\begin{aligned} & (2+j)(3-j) \\ & = 6 - 2j + 3j - j^2 \\ & = 6 + j + 1 \\ & = 7+j \end{aligned}$$

$$\begin{aligned} & \frac{7-j+7j-j^2}{49-7j+7j-j^2} \\ & \frac{8+6j}{50} \end{aligned}$$

Question 2

Data

$$m = 5 \text{ kg}$$

$$\mu = 0.3$$

$$F = 20 \text{ N}$$

$$a = ?$$

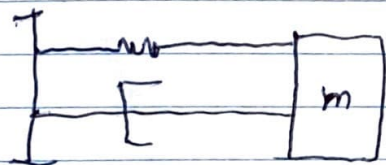
$$\textcircled{1} F_f = (5)(9.8)(0.3)$$

$$F_f = 14.7 \text{ N}$$

$$F_{app} = 20 \text{ N}$$

$$a) a = 1.06 \text{ m/s}^2$$

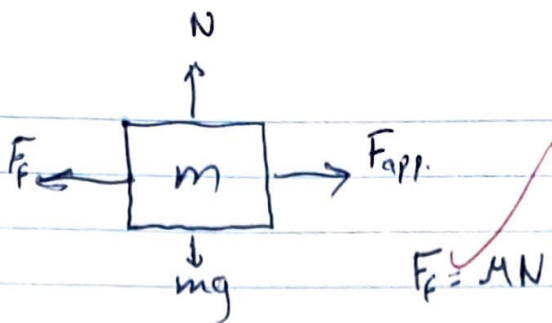
$$b) \tau_0(s) = \frac{1}{ms + b}$$



$$\textcircled{c) \text{ Data}} \\ b = 0.5 \text{ Ns/m} \\ v = 2 \text{ m/s}$$

$$\tau(0) = \frac{1}{0 + 0.5} = 2 \text{ m/s}$$

Explanation of importance of $G(0)$
in determining of F_{ss}



$$F_f = 14.7 \text{ N}$$

$$F_{net} = F$$

$$F_{app} =$$

$$F_f = ma$$

$$20 \text{ N} - 14.7 = (5)a$$

$$a = \frac{20 - 14.7}{5}$$

$$a = \frac{20 - 14.7}{5} = 1.06 \text{ m/s}^2$$

$$a = \frac{20 - 14.7}{5} = 1.06 \text{ m/s}^2$$

$$F_d = bV \Rightarrow (-0.5)(2) = 1$$

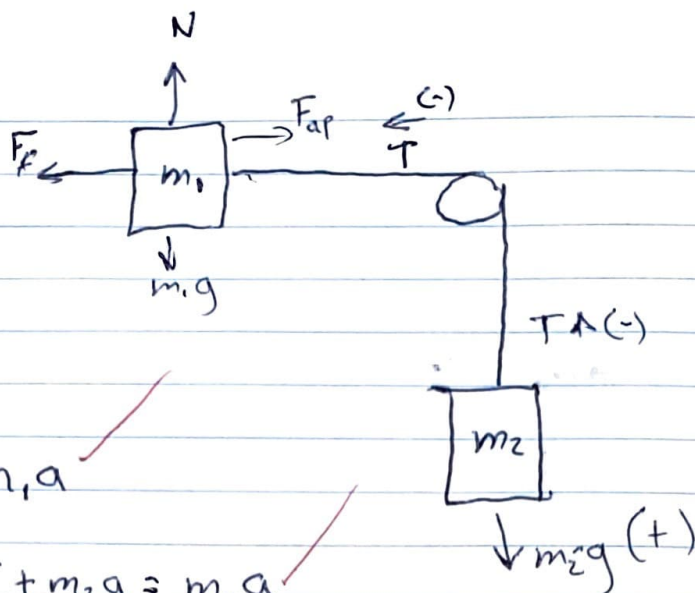
$$F_{ss} = F_f + |F_d|$$

$$F_{ss} = 14.7 + 1$$

$$F_{ss} = 15.7 \text{ N}$$

3
5

c) $m_2 = 8 \text{ kg}$
 $m_1 = 5 \text{ kg}$
 $a = 2 \text{ m/s}^2$
 $T = ?$



Block 1

$$F_{ap} - F_f - T = m_1 a$$

$$\text{Block 2} = -T + m_2 g = m_2 a$$

Develop

$$F_{net} \Rightarrow -14.7 - T = (5)(2)$$

$$F_{ap} = 10 + 14.7 + 68.4 \text{ (N)}$$

$$\begin{aligned} -T &= m_1 a - m_2 g \\ T &= m_2 g - m_1 a \\ T &= 78.4 - 10 \\ T &= 68.4 \end{aligned}$$

d) $\text{Vol factor} = 0.01 \text{ V/m}$

$$V = \frac{0.01 \text{ V}}{0.4} = 0.025 \text{ V}$$

error carried over

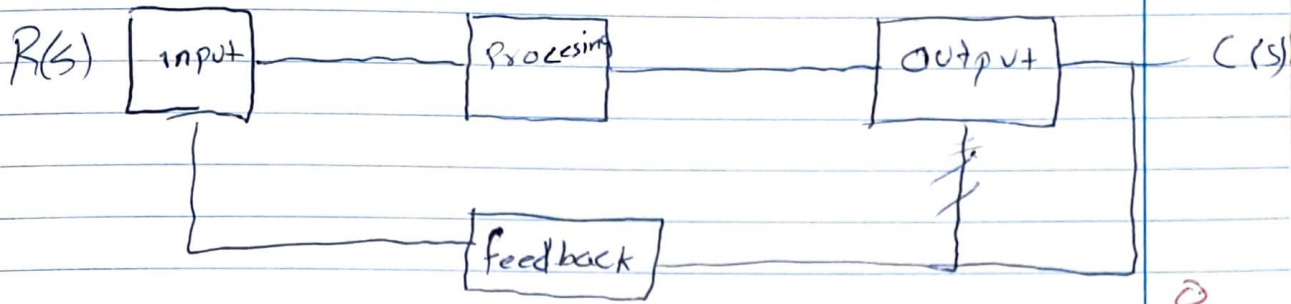
$$d = vt$$

$$v = \frac{d}{t} \quad v = \frac{d}{t}$$

$$d = \frac{v}{t}$$

$$d = \frac{2}{5} = 0.4 \text{ m}$$

Question 1





3. Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

- Llenwch, plygwrch a seilwch
(gweler nodyn 2 isod)

ENW(AU) CYNTAF:

ENW(AU) CYNTAF:

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Archoliad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

Rhestrwch ffai'r cwestiynau a ymgeistwyd genych	
At Dibenion y Swyddfa	Cyfanswm

(See the other side for English version)