



Instructions to Candidates

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 the 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	2217176
2	Title of Examination Paper	Advanced Rapid Fire Systems
3	Module Code	ACD ~~6019~~ 6019
4	Date and Time of Examination	1/05/2025 9:00
5	Examination Venue	IQ 310
6	Seat Number	22
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Q1

$$a) \quad L = 12 \mu\text{H/m}$$

$$C = 18 \text{ pF/m}$$

$$Z_0 = \sqrt{\frac{L}{C}} = \frac{12}{18} = 0.667$$

$$R_L = 1200 \Omega$$

$$\text{Reflection} = \Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$$

$$\frac{1200 - 0.667}{1200 + 0.667} = 0.99889$$

$$\text{Reflection coefficient} = 0.99889$$

$$\text{SWR} = \frac{1 + |\Gamma|}{1 - |\Gamma|} = 3997.999$$

$$\text{SWR} = 3998.999$$

a) ~~for~~ the smaller the frequency the larger the dipole antenna shown by the dipole ~~2~~ having a length of 0.165 m whereas as dipole 1 has a length of 0.1 m. if you were to decrease the frequency further it would increase the dipole size.

b) ~~180 MHz~~ $\Rightarrow$ 180 MHz

$$\frac{3 \times 10^8}{180 \times 10^6} = 1.667 \text{ m}$$

$$\frac{1.667}{2} = 0.8335 \text{ m}$$

driven element $\text{length} = 0.8335 \text{ m}$
 difference in direct and reflect = 5%

$$0.8335 \div 100 = 0.008335 = 0.8\%$$
~~$$0.041675 \times 5 =$$~~

$$0.008335 \times 5 = 0.041675$$
~~$$0.8335 \times 0.05 = 0.041675$$~~

$$\text{director length} = 0.8335 - 0.041675 = 0.791825 \text{ m}$$

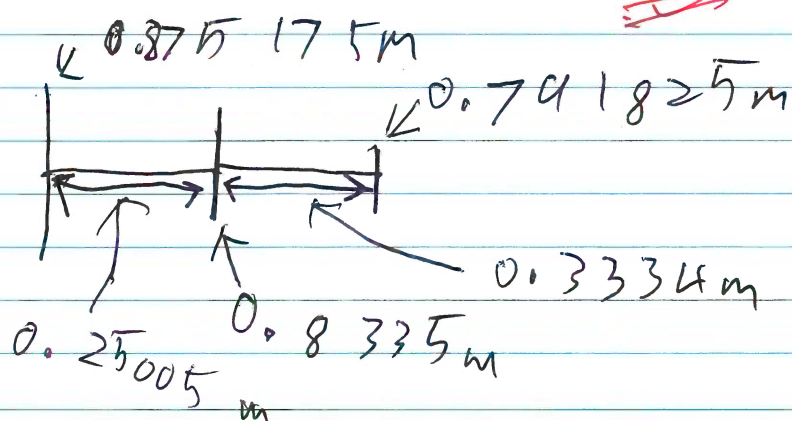
$$\text{Reflector Length} = 0.8335 + 0.041675 = 0.875175 \text{ m}$$

$$\text{Reflector distance} = 0.15 \lambda$$

$$0.15 \times 1.667 = 0.25005 \text{ m}$$

$$\text{director distance} = 0.2 \lambda$$

$$0.2 \times 1.667 = 0.3334 \text{ m}$$



$$\text{director length} = 0.791825 \text{ m}$$

$$\text{Reflector length} = 0.875175 \text{ m}$$

$$\text{driven length} = 0.8335 \text{ m}$$

$$\text{Reflector distance} = 0.25005 \text{ m}$$

$$\text{director distance} = 0.3334 \text{ m}$$

$$c) \begin{bmatrix} s_{11} & s_{12} \\ s_{21} & s_{22} \end{bmatrix}$$

$$\begin{bmatrix} 0 & s_{12} \\ s_{21} & s_{22} \end{bmatrix}$$

$$Q_2 = 25$$

Q3

a) Total power 100 W

$$\text{max Rad} = 80 \text{ W/sr}$$

$$P = \frac{4\pi U}{\text{prad}}$$

$$n = 80$$

$$\text{prad} = 100$$

$$D_{ad} = 10 \log_{10} (D)$$

$$D = \frac{4 \times \pi \times 80}{100} = 10.053$$

$$D_{db} = 10 \log_{10} (10.053) = 10.0229 \text{ dB}$$

B)

$$S = \begin{bmatrix} 0.4 \angle 0 & 0.5 \angle -30 & 0.7 \angle 60 \\ 0.5 \angle 30 & 0.2 \angle 0 & 0.9 \angle -40 \\ 0.7 \angle -60 & 0.9 \angle 40 & 0.1 \angle 20 \end{bmatrix}$$

$$S = \begin{bmatrix} 11 & 21 & 31 \\ 12 & 22 & 32 \\ 13 & 23 & 33 \end{bmatrix}$$

- i) the network is NOT Reciprocal
 as the ~~Reflections~~ $S_{12}, S_{21}, S_{31}, S_{32}, S_{23}$
 all are different from each other
 $0.5 \angle 30$ is not the same as
 $0.5 \angle -30$ and $S_{21} \neq S_{12}$.

- ii) The network is lossy as the magnitude in the Reflections

$$0.4 + 0.2 \neq 0.1$$

$$0.4 + 0.5 = 0.9 \neq 1$$

iii)

$$\text{Return Loss} = 20 \log_{10} |S_{11}|$$

$$20 \log_{10} (\sqrt{0.4}) = -3.079 \text{ dB}$$

c) $R = 0.006 \Omega/\text{m}$
 $L = 2.5 \mu\text{H}/\text{m}$
 $C = 4.45 \text{ pF}/\text{m}$
 $F = 10 \text{ MHz}$

~~for~~
 $\frac{3 \times 10^8}{10 \times 10^6} = 30 \text{ m}$

$$Z_0 = \sqrt{\frac{L}{C}} \quad \checkmark$$

i) $= \sqrt{\frac{2.5}{4.45}} = 0.749 \Omega = Z_0 \quad \checkmark$

ii) $2.5 + 4.45 + 0.006 = 7.01 \quad \checkmark$

iii) $\beta = \omega \sqrt{LC} \quad \checkmark$
 $\omega = 2\pi f$
 $\omega = 2 \times \pi \times 10^7 = 62.83185307$
 $62.83185307 \sqrt{2.5 \times 4.45}$
 $= 209.5703691 = \beta \quad \checkmark$

iv

$$= 3 \times 10^8 \text{ or speed of light}$$

~~or~~

$$\frac{1}{\sqrt{\epsilon \mu}}$$

Q3 = (17)



c) $R = 0.006 \Omega/m$
 $L = 2.5 \mu H/m$
 $C = 4.45 pF/m$
 $F = 10 MHz$

~~for~~
 $\frac{3 \times 10^8}{10 \times 10^6} = 30 m$

$$Z_0 = \sqrt{\frac{L}{C}}$$

i) $= \sqrt{\frac{2.5}{4.45}} = 0.749 \Omega = Z_0$

ii) $2.5 + 4.45 + 0.006 = 7.01$

iii) $B = W \sqrt{LC}$
 $W = 2\pi f$
 $W = 2 \times \pi \times 10^7 = 62.83185307$
 $62.83185307 \sqrt{2.5 \times 4.45}$
 $= 209.5703691 = B$

14

$= 3 \times 10^8$ or speed of light
~~or~~
 $\frac{1}{\sqrt{\epsilon \mu}}$

$Q_3 = (17)$

Q4
a)

50Ω

$F 14 \mu H$

Load

short circuited

$Z_L = 25 + j50 \Omega$

$$\frac{25 \times 50}{25^2 + 50^2}$$

$$= 0.5$$

$i = 0.5 + j1$

$$\frac{3 \times 10^8}{140 \times 10^6}$$

$= 2.142857 \mu A$

$ii = 2.143 \mu A$

$iii = \cancel{0.435} \quad 0.5 + j50$

iv

$$0.435 \times 2.143 \mu A$$

$$= 0.9322 \mu A = 0.9$$

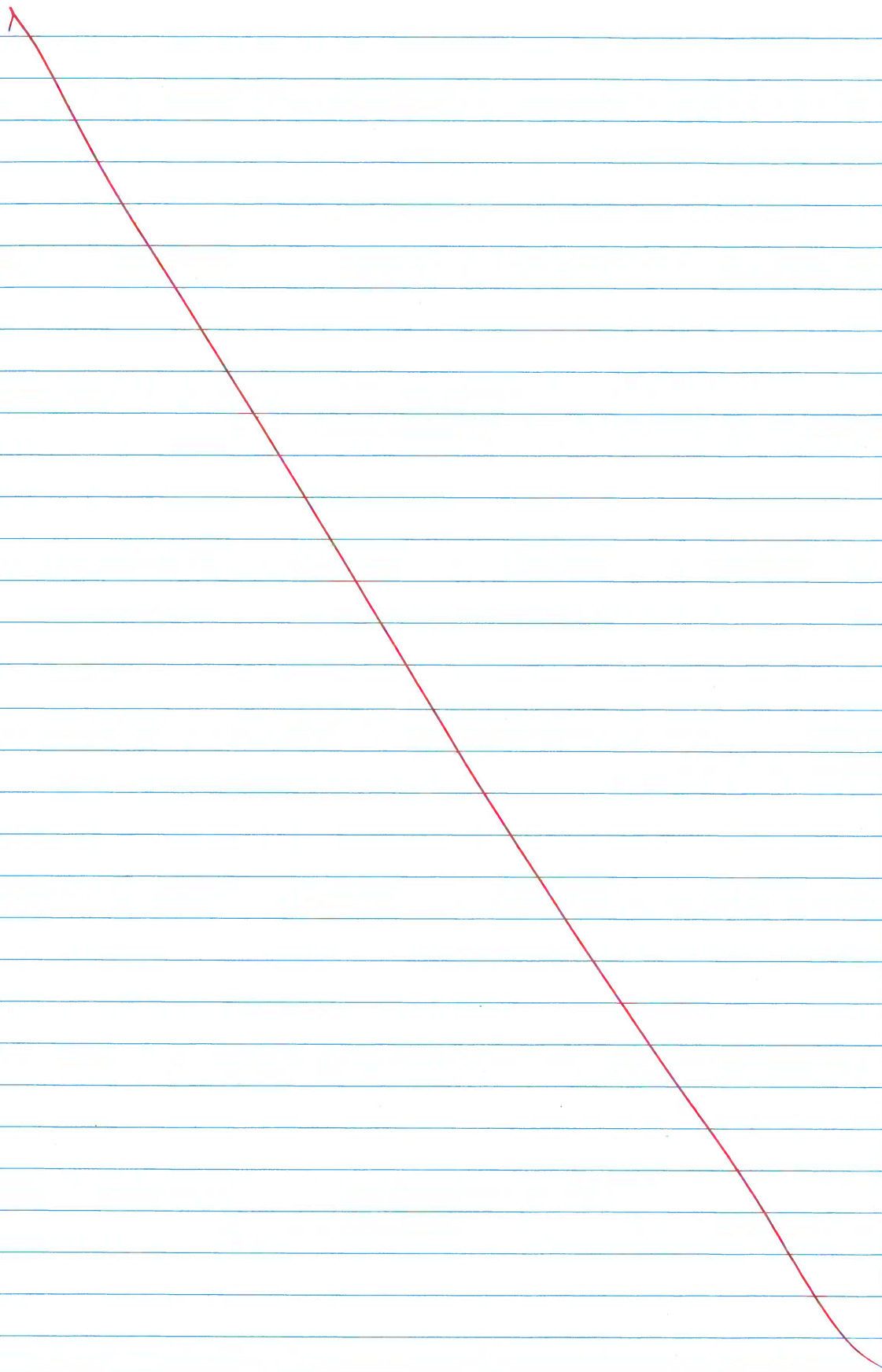
Ans = 3

Q4 = ⑦



Question No.

Examiner Only



Q4

0.107

2

