



Complete, fold and seal
(see note 2 below)

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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 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	
2	Title of Examination Paper	Further Eng Maths
3	Module Code	SGEE5001
4	Date and Time of Examination	Tues 5/4/22
5	Examination Venue	G43
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A	25.
84	19
1	3
3	5.
Total	52

Section B

4)

$$R = 65 \Omega \quad L = 3.5 \text{ H} \quad C = \frac{1}{50} \text{ F} \quad E(t) = 70 \text{ V}$$

$$C = 0.02 \text{ F}$$

$$E = RI + L \frac{dI}{dt} + \frac{1}{C} \int I dt$$

$$70 = 65I + 3.5 \frac{dI}{dt} + \frac{1}{0.02} I$$

$$E = \frac{dE}{dt} \quad \frac{dE}{dt} = 0$$

$$3.5 \frac{d^2 I}{dt^2} + 65 \frac{dI}{dt} + 50 I = 0$$

$$3.5m^2 + 65m + 50 = 0 \quad \checkmark$$

$$m = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$m = \frac{-65 \pm \sqrt{65^2 - 4(3.5)(50)}}{2(3.5)}$$

$$= \frac{-65 \pm \sqrt{4225 - 700}}{7}$$

$$= \frac{-65 \pm \sqrt{3525}}{7}$$

$$m = -0.804 \quad \checkmark \quad \text{or} \quad m = -17.767 \quad \checkmark$$

$$(\text{Real} + \text{Different}) \quad y = Ae^{m_1 x} + Be^{m_2 x}$$

$$I = Ae^{-0.804t} + Be^{-17.767t}$$

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$$I(0) = 0 \quad t = 0$$

$$0 = Ae^0 + Be^0$$

$$0 = A + B \quad \checkmark \textcircled{1}$$

$$I'(0) = 25 \quad t = 0$$

$$\frac{dI}{dt} = 25$$

$$\frac{dI}{dt} = -0.804 Ae^{-0.804t} + 17.767 Be^{-17.767t}$$

$$\frac{dI}{dt} = -0.804 Ae^0 + 17.767 Be^0$$

$$25 = -0.804 A - 17.767 B \quad \textcircled{2}$$

$$0 = A + B$$

$$25 = -0.804 A - 17.767 B \quad \checkmark$$

$$25 = -17.767 B \quad \times$$

$$\div \text{ by } -0.804$$

$$-31.1 = 22.1 B$$

$$\frac{-31.1}{22.1} = B$$

$$B = -1.407$$

$$B = -1.407$$

Sub into $\textcircled{1}$

$$0 = A + 1.407$$

$$A = -1.407$$

$$\therefore I = -1.407e^{-0.804t} - 1.407e^{-17.767t} \quad \times$$

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25

Section B

1) $R = 30 \Omega$, $C = \frac{1}{30} \text{ f}$, $E = 30e^{-3t}$, $I(0) = 0$
 $C = 0.03 \text{ f}$

$$E(t) = RI + \frac{1}{C} \int I dt$$

$$E = \frac{dE}{dt} - 90e^{-3t} = 30 \frac{dI}{dt} + 0.03 I$$

$$\frac{dE}{dt} = 0$$

$$P = 30$$

$$Q = -90e^{-3t}$$

3.

$$\int P dt = \int 30 dt = 30t$$

$$e^{\int 30t} = \int e^{\int 30t} \times (-90e^{-3t}) dt$$

$$I e^{30t} = e - 90e^{27t}$$

X

$$\frac{3}{25}$$

Section B

3) $y'' + 4y' + 3y = e^{-2t}$ $y=0, y'=3, t=0$

$$(S^2 \bar{y} - Sy_0 - y_1) + 4(S\bar{y} - y_0) + 3(\bar{y}) = \frac{1}{S+2}$$

$$(S^2 \bar{y} - 0 - 3) + 4(S\bar{y} - 0) + 3(\bar{y}) = \frac{1}{S+2}$$

$$(S^2 \bar{y} - 3) + (4S\bar{y}) + 3\bar{y} = \frac{1}{(S+2)}$$

$$\bar{y} (S^2 - 3) + (4S)(3) = \frac{1}{S+2}$$

$$\bar{y} (S^2 - 3) + (4S)(3) = \frac{1+3}{S+2}$$

$$\bar{y} = \frac{4+4S}{(S-3)(S+2)(S-3)} = \frac{A}{(S-3)} + \frac{B}{S+2} + \frac{C}{S-3}$$

$$\bar{y} = A(S-6) + B(S+9) + C(S-6)$$

put $S=6$

$$A(0) + B(15) + C(0)$$

$$S = -9$$

$$A(-15) + B(0) + C(-15)$$

$$\mathcal{L}^{-1} \left\{ \frac{-15}{(S-3)} + \frac{15}{S+2} + \frac{-15}{S-3} \right\}$$

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Section A

a)

x	f	xf	$f(x-\bar{x})^2$
6	23	138	176.48
7	56	392	175.44
8	65	520	38.54
9	53	477	2.80
10	47	470	71.11
11	37	407	184
12	19	228	198.23
Total	$\Sigma = 300$	$\Sigma = 2632$	$\Sigma = 846.6$

$$\bar{x} = \frac{\sum fx}{\sum f}$$

$$\sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$$

$$\bar{x} = \frac{2632}{300}$$

$$\sigma = \sqrt{\frac{846.6}{300}}$$

$$\bar{x} = 8.77$$

$$\sigma = 1.68$$

b) $\lambda = 2.25$

(i) $P(x=r) = \frac{e^{-\lambda} \lambda^r}{r!}$

$$P(x=3) = \frac{e^{-2.25} \times 2.25^3}{3!}$$

$$P(3 \text{ goals are Scored}) = 0.2001$$

(ii) $P(0) = \frac{e^{-2.25} \times 2.25^0}{0!}$ $P(0) = 0.1054$

$$P(1) = \frac{e^{-2.25} \times 2.25^1}{1!}$$

$$P(1) = 0.2371$$

$$P(\text{More than 1 goals are Scored}) = 1 - P(0) - P(1) = 1 - 0.1054 - 0.2371 = 0.6575$$

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