

1809799 HNC 2 Maths Exam

Thomas Grennan

by Thomas Grennan

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HNC Year 2

SGEE5001: Further Engineering Mathematics

Exam 1

07/05/2020



Section A

Q)

x	F	$x F$	$F(x - \bar{x})^2$
3	3	9	26.46
4	12	48	46.57
5	21	105	19.76
6	28	168	0.025
7	23	161	24.40
8	11	88	45.33
9	2	18	18.36

$$\sum F = 100$$

$$\sum x F = 597$$

$$\sum F(x - \bar{x})^2 = 180.905$$

$$\bar{x} = \frac{\sum x F}{\sum F} = \frac{597}{100} = 5.97$$

$$\sigma = \sqrt{\frac{\sum F(x - \bar{x})^2}{\sum F}} = \sqrt{\frac{180.905}{100}} = 1.35$$

Therefore :

$$\text{Mean } (\bar{x}) = 5.97$$

$$\text{Standard deviation } (\sigma) = 1.35$$

Section A

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

$$\text{When } \lambda = 1.9$$

$$\therefore P(x=r) = \frac{e^{-1.9} 1.9^r}{r!}$$

$$(i) \quad P(x=3) = \frac{e^{-1.9} 1.9^3}{3!} = 0.171$$

$$(ii) \quad \text{more than 1} = P(2) + P(3) + \dots$$
$$\therefore 1 - \{P(0) + P(1)\}$$

$$P(x=0) = \frac{e^{-1.9} 1.9^0}{0!} = 0.1495$$

$$P(x=1) = \frac{e^{-1.9} 1.9^1}{1!} = 0.2842$$

$$\therefore P(x > 1) = 1 - (0.1495 + 0.2842) = 0.5663$$

Section B

1. $\frac{dy}{dT} + 2y = 10e^{-t}$

$$(s\bar{y} - y_0) + 2\bar{y} = \frac{10}{s+1}$$

Since $y(0) = 0$, $y_0 = 0$

$$\therefore s\bar{y} + 2\bar{y} = \frac{10}{(s+1)}$$

$$\bar{y}(s+2) = \frac{10}{(s+1)}$$

$$\bar{y} = \frac{10}{(s+1)(s+2)}$$

$$\frac{10}{(s+1)(s+2)} = \frac{A}{(s+1)} + \frac{B}{(s+2)}$$

$$10 = A(s+2) + B(s+1)$$

Put $s = -2$

$$10 = A(-2+2) + B(-2+1)$$

$$10 = A(0) + B(-1)$$

$$10 = -B$$

$$B = -10$$

Put $s = -1$

$$10 = A(-1+2) + B(-1+1)$$

$$10 = A(1) + B(0)$$

$$10 = A$$

$$A = 10$$

$$f^{-1} \left[\frac{10}{s+1} - \frac{10}{s+2} \right] = 10e^{-t} - 10e^{-2t}$$

$$L \left[\begin{array}{cc} s+1 & s+2 \end{array} \right]$$

25/25

2. $R = 40$, $L = 0.5$, $E = 30$ and $I(0) = 0$.

Since $E = RI + L \frac{dI}{dt}$

$\therefore 30 = 40I + 0.5 \frac{dI}{dt}$

Divide through by 0.5

$60 = 80I + \frac{dI}{dt}$

Therefore, $P = 80$ and $Q = 60$

$\int P dt \int 80 dt = 80t$

$\therefore \text{I.F.} = e^{80t}$

$I \cdot e^{80t} = \int e^{80t} \times 60 dt$

$I e^{80t} = \int \frac{60}{80} \times e^{80t}$

$I e^{80t} = 0.75 e^{80t} + c$

When $t = 0$, $I = 0$

$\therefore 0 = 0.75 e^{80(0)} + c$

$$D = 0.13 \text{ T } C$$

$$C = -0.75$$

Particular Solution

$$I e^{80t} = 0.75 e^{80t} - 0.75$$

Therefore, I equals :

$$I = \frac{0.75 e^{80t}}{e^{80t}} - \frac{0.75}{e^{80t}}$$

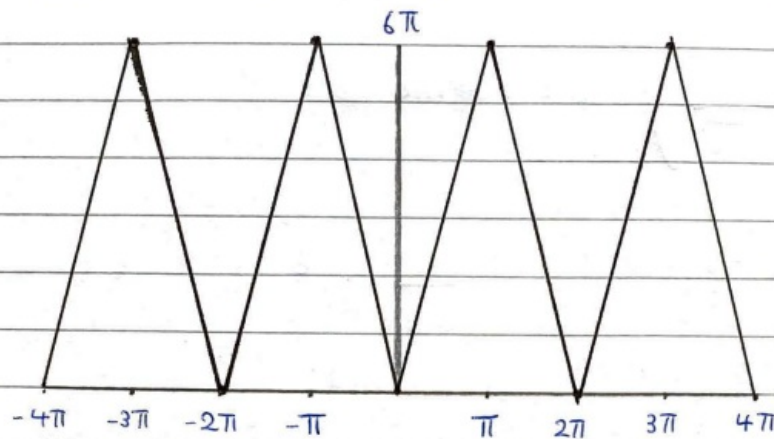
$$\begin{aligned} I &= 0.75 - 0.75 e^{-80t} \\ &= 0.75 (1 - e^{-80t}) \end{aligned}$$

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3. $F(x) = -6x \quad (-\pi < x < 0)$

$F(x) = 6x \quad (0 < x < \pi)$

and $F(x) = F(x + 2\pi)$



If $x = -\pi$, $-6(-\pi) = 6\pi$

If $x = 0$, $-6(0) = 0$

If $x = \pi$, $6(\pi) = 6\pi$

This is an even function as it is symmetrical along the y-axis.

In an even function: $b_n = 0$

$$a_0 = \frac{2}{\pi} \int_0^{\pi} 6x \, dx$$

$$= \frac{2}{\pi} \left[\frac{6x^2}{2} \right]_0^{\pi}$$

$$= \frac{2}{\pi} \left[3x^2 \right]_0^{\pi}$$

$$= \frac{2}{\pi} \left[3(\pi)^2 - 3(0)^2 \right]$$

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$$\frac{2}{\pi} \left[\frac{3(\pi)^2}{2} \right], = \frac{6\pi^2}{\pi}$$

$$\therefore a_0 = 6\pi$$

$$a_n = \frac{2}{\pi} \int_0^\pi 6x \cos nx \, dx$$

$$\text{let } u = 6x \quad \frac{du}{dx} = 6$$

$$\frac{du}{dx} = \cos nx \quad v = \frac{1}{n} \sin nx$$

Integration by Parts

$$6x \cos nx \, dx = (6x) \left(\frac{1}{n} \sin nx \right) - \int \frac{1}{n} \sin nx (6) \, dx$$

$$6x \cos nx \, dx = \frac{6x \sin nx}{n} - \int \frac{6}{n} \sin nx$$

$$= \frac{6x \sin nx}{n} + \frac{6}{n^2} \cos nx$$

$$a_n = \frac{2}{\pi} \left[\frac{6x \sin nx}{n} + \frac{6}{n^2} \cos nx \right]_0^\pi$$

$$\frac{2}{\pi} \left[\frac{6(\pi) \sin(n\pi)}{n} + \frac{6}{n^2} \cos(n\pi) \right] - \left[\frac{6(0) \sin(0)}{n} + \frac{6}{n^2} \cos(0) \right]$$

Since $\sin(0)$ and $\sin(n\pi) = 0$

$$\frac{2}{\pi} \left[\frac{6 \cos(n\pi)}{n^2} - \frac{6}{n^2} \right]$$

$$a_n = \frac{12}{\pi n^2} [\cos(n\pi) - 1]$$

$$n=1, a_1 = \frac{12}{\pi(1)^2} [\cos \pi - 1] = \frac{-24}{\pi(1)^2}$$

$$n=2, a_2 = \frac{12}{\pi(2)^2} [\cos(2\pi) - 1] = 0$$

$$n=3, a_3 = \frac{12}{\pi(3)^2} [\cos(3\pi) - 1] = \frac{-24}{\pi(3)^2}$$

$$n=4, a_4 = \frac{12}{\pi(4)^2} [\cos(4\pi) - 1] = 0$$

$$\therefore F(x) = \frac{1}{2} (6\pi) - \frac{24}{\pi(1)^2} \cos x - \frac{24}{\pi(3)^2} \cos 3x - \frac{24}{\pi(5)^2} \cos 5x$$

$$\text{or } \frac{6\pi}{2} - \frac{24}{\pi} \cos x - \frac{24}{9\pi} \cos 3x - \frac{24}{25\pi} \cos 5x \dots$$

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FINAL GRADE

GENERAL COMMENTS

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100/100

PAGE 1

PAGE 2

PAGE 3

Text Comment. 25/25

PAGE 4

Text Comment. 25/25

PAGE 5

PAGE 6

Text Comment. 25/25

PAGE 7

PAGE 8

PAGE 9

Text Comment. 25/25