



colegsirgâr

EXAMINATION INTERNAL VERIFICATION FORM (2017-2018)

MODULE :	PSDE4003 Engineering Mathematics			LEVEL:	4
PROGRAMME :	HNC Electrical and Electronic Engineering			TERM OF EXAM: (SPRING OR SUMMER)	n/a
LEARNING OUTCOME(S) BEING ASSESSED:	MILO1, MILO 2 (partially covered)	EXAM PAPER:	Main Class Test 2	EXAMINATION AUTHOR :	A. Thomas

VERSION:	DATE SUBMITTED FOR VERIFICATION:	INTERNAL VERIFIER COMMENTS (Approval or detail of amendments required):	DATE:
1.	7/2/2018	Clear instructions are given to the candidates. The set examination questions are at the appropriate level commensurate with that of HNC level as outlined by the University exam board.	8/2/2017
2.			

INTERNAL VERIFIER PLEASE TICK TO INDICATE THAT THE EXAMINATION:

☒	Conforms to the assessment pattern described in the module syllabus
☒	Tests the module learning outcome(s) appropriately

SIGNATURES OF FINAL APPROVAL:		SIGNATURE	DATE
INTERNAL VERIFIER: I confirm that this version of the exam paper is ready to be sent to the external examiner		<i>Nigel H. Dawkins</i>	8/2/2017
EXAM AUTHOR: I confirm that internal verifier and external examiner approval have been received and that this version of the exam paper is ready for printing.			

HNC Electrical and Electronic Engineering**PSDE4003 Engineering Mathematics**

Level 4, Year 1

Class Test 2 (2017-18)

This is a closed book test, worth **45%** of the module mark and addresses Module Intended Learning Outcomes 1 & 2.

Date of test =

Time allowed = 2 hours

Answer all questions**Marks**

1. Differentiate the following functions:

i. $v = 2s^4 - \frac{5}{s^2} + \sqrt{s}$

ii. $y = x^3 \sin 4x$

iii. $i = 3\sin(2t + 4)$

[6, 8, 8]2. If $i = 4(2 - e^{-10t})$, find the initial rate of growth of voltage**[8]**

3. Evaluate the following integrals:

a) $\int_2^4 (5 + 3t + 4t^2) dt$

b) $\int_0^{\pi/2} (2\sin 3x + 3\cos 2x) dx$

[8,8]

4. Express $\frac{6}{(s-2)(s+1)}$ in partial fractions. Hence evaluate the integral $\int_4^5 \frac{6}{(s-2)(s+1)} ds$ to 3 d.p.

[18]

5. Estimate the integral $\int_4^5 \frac{6}{(s-2)(s+1)} ds$ using the Trapezium rule with 4 strips, to 3 d.p.

By comparing your answer to question 4, what is the percentage error?

[14]

6. Shown in the following table are the times taken to produce 100 components:

Time (s)	0-5	5-10	10-15	15-20	20-25
Frequency	11	25	33	22	9

Calculate the mean and standard deviation for the data to 4 significant figures. (Full marks will be given with workings shown).

[14]

7. An electrical circuit has two switches A and B. The probability that switch A works is 0.35 and the probability that switch B works is 0.65. Find the probability that there is a connection across the two switches if the switches are arranged

- a) in series
- b) in parallel

[8]

Formulae

1. If: $ax^2 + bx + c$

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

2. Differentiation

(i) Standard derivatives

y	$\frac{dy}{dx}$
ax^n	nax^{n-1}
$a \sin(kx)$	$ka \cos(kx)$
$a \cos(kx)$	$-ka \sin(kx)$
ae^{kx}	kae^{kx}
$a \ln x$	$\frac{a}{x}$

(ii) product rule $\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$

(iii) quotient rule $\frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$

(iv) function of a function rule $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

3. $y = f(x)$ has a stationary point where $\frac{dy}{dx} = 0$.

If, at this point, $\frac{d^2y}{dx^2} < 0$ the point is a maximum.

If, at this point, $\frac{d^2y}{dx^2} > 0$ the point is a minimum.

4. Integration

(i) Standard integrals

$\int ax^n dx$	$\frac{ax^{n+1}}{n+1} + c$ (except when $n = -1$)
$\int \cos ax dx$	$\frac{1}{a} \sin ax + c$
$\int \sin ax dx$	$-\frac{1}{a} \cos ax + c$
$\int e^{ax} dx$	$\frac{1}{a} e^{ax} + c$
$\int \frac{1}{x} dx$ or $\int x^{-1} dx$	$\ln x + c$
$\int \frac{1}{ax+b} dx$	$\frac{1}{a} \ln(ax+b) + c$

(ii) Numerical integration:

Trapezium Rule: $h \left\{ \frac{1}{2} (y_0 + y_n) + y_1 + y_2 + y_3 + \dots \right\}$

Simpson's Rule: $\frac{1}{3} h \{ (y_0 + y_n) + 4(y_1 + y_3 + \dots) + 2(y_2 + y_4 + \dots) \}$

5. Statistics:

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

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

Test 2 Solutions/Mark Scheme

				Qu total
1a)	$v = 2s^4 - 5s^{-2} + s^{1/2}$ $\frac{dv}{ds} = 8s^3 + 10s^{-1} + \frac{1}{2}s^{-1/2}$	2 4	6	
(i)	$y = x^3 \sin 4x$ Let $u = x^3$ and $v = \sin 4x$ $\frac{du}{dx} = 3x^2 \quad \frac{dv}{dx} = 4 \cos 4x$ $\frac{dy}{dx} = (x^3)(4 \cos 4x) + (\sin 4x)(3x^2)$ $= 4x^3 \cos 4x + 3x^2 \sin 4x$	4 3 1	8	
(ii)	$i = 3 \sin (2t + 4)$ $u = 2t + 4 \quad i = 3 \sin u$ $\frac{du}{dt} = 2 \quad \frac{di}{dt} = 3 \cos u$ $\frac{di}{dt} = 2 \times 3 \cos u$ $= 6 \cos (2t + 4)$	4 2 2	8	22
2.	$i = 4(2 - e^{-10t})$ $i = 8 - 4e^{-10t}$ $\frac{di}{dt} = 40e^{-10t}$ where $t = 0$ $\frac{di}{dt} = 40e^0 = 40$	2 3 1 2	8	8

Test 2 Solutions/Mark Scheme

				Qu total
3a)	$\int_2^4 (5 + 3t + 4t^2) dt$ $= \left[5t + \frac{3t^2}{2} + \frac{4t^3}{3} \right]_2^4$ $= \left[5(4) + \frac{3(4)^2}{2} + \frac{4(4)^3}{3} \right] - \left[5(2) + \frac{3(2)^2}{2} + \frac{4(2)^3}{3} \right]$ $= \left[20 + 24 + 85\frac{1}{3} \right] - \left[10 + 6 + 10\frac{2}{3} \right]$ $= 129\frac{1}{3} - 26\frac{2}{3} = 102\frac{2}{3}$	3 3 2	8	
(b)	$\int_0^{\pi/2} (2\sin 3x + 3\cos 2x) dx$ $= \left[-\frac{2}{3} \cos 3x + \frac{3}{2} \sin 2x \right]_0^{\pi/2}$ $= \left[-\frac{2}{3} \cos (3\pi/2) + \frac{3}{2} \sin \pi \right] -$ $\left[-\frac{2}{3} \cos 0 + \frac{3}{2} \sin 0 \right]$ $= \left[0 + 0 \right] - \left[-\frac{2}{3} + 0 \right]$ $= \frac{2}{3}$	3 3 2	8	16

Test 2 Solutions/Mark Scheme

				Qu total												
4.	$\frac{6}{(s-2)(s+1)} = \frac{A}{s-2} + \frac{B}{s+1}$ $6 = A(s+1) + B(s-2)$ put $s = -1$ $6 = A(0) + B(-3)$ $B = \frac{6}{-3} = -2$ put $s = 2$ $6 = A(2+1) + B(0)$ $A = \frac{6}{3} = 2$ $\therefore \frac{6}{(s-2)(s+1)} = \frac{2}{s-2} - \frac{2}{s+1}$ $\int_4^5 \left(\frac{2}{s-2} - \frac{2}{s+1} \right) = \left[2 \ln(s-2) - 2 \ln(s+1) \right]_4^5$ $= [2 \ln(3) - 2 \ln(6)] - [2 \ln(2) - 2 \ln(5)]$ $= -1.386 - (-1.833)$ $= 0.447$	2 2 2 2 4 2 2														
5.	$h = \frac{5-4}{4} = 0.25$ <table border="1"> <tr> <td>x</td> <td>4</td> <td>4.25</td> <td>4.5</td> <td>4.75</td> <td>5</td> </tr> <tr> <td>y</td> <td>0.6</td> <td>0.5079</td> <td>0.4364</td> <td>0.3794</td> <td>0.3333</td> </tr> </table> $\therefore \int \approx (0.25) \left[\frac{1}{2}(0.6 + 0.3333) + 0.5079 + 0.4364 + 0.3794 \right]$ $\approx 0.25 \times 1.79035 = 0.448$	x	4	4.25	4.5	4.75	5	y	0.6	0.5079	0.4364	0.3794	0.3333	2 2 5 3 2		18
x	4	4.25	4.5	4.75	5											
y	0.6	0.5079	0.4364	0.3794	0.3333											

$$\% \text{ age error} = \frac{0.448 - 0.447}{0.447}$$

$$= 0.22\%$$

2

14

Test 2 Solutions/Mark Scheme

						Qu total																											
6.	<table border="1"> <thead> <tr> <th>x</th> <th>f</th> <th>xf</th> <th>$f(x-\bar{x})^2$</th> </tr> </thead> <tbody> <tr> <td>2.5</td> <td>11</td> <td>27.5</td> <td>1024.3475</td> </tr> <tr> <td>7.5</td> <td>25</td> <td>187.5</td> <td>540.5625</td> </tr> <tr> <td>12.5</td> <td>33</td> <td>412.5</td> <td>4.0425</td> </tr> <tr> <td>17.5</td> <td>22</td> <td>385</td> <td>629.695</td> </tr> <tr> <td>22.5</td> <td>9</td> <td>202.5</td> <td>964.1025</td> </tr> <tr> <td></td> <td>100</td> <td>1215</td> <td>3162.75</td> </tr> </tbody> </table>	x	f	xf	$f(x-\bar{x})^2$	2.5	11	27.5	1024.3475	7.5	25	187.5	540.5625	12.5	33	412.5	4.0425	17.5	22	385	629.695	22.5	9	202.5	964.1025		100	1215	3162.75				
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	$\sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}} = \sqrt{\frac{3162.75}{100}}$ $= 5.624$																																
7.	$P(\text{Both}) = P(A) \times P(B)$ $= 0.35 \times 0.65$ $= 0.2275$ $P(\text{Neither}) = 0.65 \times 0.35$ $= 0.2275$ $\therefore P(\text{connection}) =$ $1 - 0.2275$ $= 0.7725$																																