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Module Title: - Mathematics

Module Code: - M4X00391

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Starting Time of the Exam: - 13:00

Q2 Intergration

a) (i) $\int (x^2 - 6x)(3x^2 - x) dx$

$$\int 3x^4 - 19x^3 + 6x^2 dx$$
$$= \frac{3x^5}{5} - \frac{19x^4}{4} + \frac{6x^3}{3} + c$$

(ii) $\int (x^2 + 3x)^2 + e^{0.5x} - \sin 2x dx$

$$\int x^4 + 6x^3 + 9x^2 + e^{0.5x} - \sin 2x dx$$

$$\int = \frac{x^5}{5} + \frac{6x^4}{4} + \frac{9x^3}{3} + \frac{1}{0.5e} e^{0.5x} + 0.5 \cos 2x$$

(iii) $\int_0^3 (2x^2 + 3)^3 dx$

$$\int_0^3 8x^6 + 36x^4 + 54x^2 + 2 dx$$

$$\int_0^3 \left[\frac{8x^7}{7} + \frac{36x^5}{5} + \frac{54x^3}{3} + 2x \right] - 0$$

$$= [2499.43 + 1749.6 + 486 + 6]$$

$$= 4741.03$$

Q2

a) (iv) $\int_2^5 x^3 + 2x^2 - x + 5$

$$\int_2^5 \left[\frac{x^4}{4} + \frac{2x^3}{3} - \frac{x^2}{2} + 5x \right]$$

$$\int_2^5 \left[\frac{(s)^4}{4} + \frac{2(s)}{3} - \frac{(s)^2}{2} + 5(s) \right] -$$

$$- \int_2^5 \left[\frac{(2)^4}{4} + \frac{2(2)^3}{3} - \frac{(2)^2}{2} + 5(2) \right]$$

$$\int_2^5 [156.25 + 83.33 - 12.5 + 25] = [252.08]$$

$$\int_2^5 [4 + 5.33 - 2 + 10] = [17.33]$$

$$= 234.75$$

Q2

(b)

$$(i) \int 3x \sin 5x \, dx$$

$\uparrow$ $\uparrow$
 u $\frac{dv}{dx}$

$$\frac{du}{dx} = 3$$

$$v = -\frac{1}{5} \cos 5x$$

$$uv - \int v \frac{du}{dx}$$

$$-\frac{3x}{5} \cos 5x + \frac{3}{25} \cos 5x$$

$$(ii) \int x \cos \frac{x}{2} \, dx$$

$\downarrow$ $\downarrow$
 u $\frac{dv}{dx}$

$$\frac{du}{dx} = 1 \quad v = 2 \sin \frac{1}{2} x$$

$$vu - \int v \frac{du}{dx}$$

$$2x \sin \frac{1}{2} x + \cos \frac{1}{2} x$$

Q3

Q2

c)

$$(i) \int \frac{15x^2 - 4}{5x^3 - 2x^2 + 5} dx$$

$$\ln(5x^3 - 2x^2 + 5) + C$$

$$(ii) \int \frac{7}{4x-15} dx$$

$$7 \int \frac{1}{4x-15} dx$$

$$= \frac{7}{4} \ln(4x-15) + C$$

$$iii) \int 6 \tan^2 x dx$$

$$= 6 \tan x - x + C$$

$$d) \int \frac{x^3}{3\sqrt{2+x^4}} dx$$

$$u = 2 + x^4$$

$$\frac{du}{dx} = 4x^3$$

Q 3 (Matrices)

a) (i) $AB = \begin{pmatrix} 46 & 15 & 30 \\ -8 & -21 & -2 \\ 6 & 0 & 5 \end{pmatrix}$

(ii) $BA = \begin{pmatrix} 18 & 14 & 10 \\ 16 & 13 & 10 \\ 38 & 50 & -1 \end{pmatrix}$

(iii) $AC = \begin{pmatrix} 58 & 40 \\ 27 & 24 \\ 13 & 10 \end{pmatrix}$

(iv) CA is not mathematically possible

(v) $|A| = -105$

(vi) $|B| = 6$

Q3

(vii)

$$A + B = \begin{pmatrix} 9 & 6 & 7 \\ 4 & 8 & -6 \\ 6 & 4 & 2 \end{pmatrix}$$

(viii)

A + D is not mathematically possible.

Q3

$$b) \quad 14x^2 + 2x = 11$$

$$14x^2 + 2x - 11 = 0$$

$$\frac{-2 \pm \sqrt{2^2 - 4(14)(-11)}}{2(14)}$$

$$2(14)$$

$$x = 0.818 \quad \text{or} \quad x = -0.96$$

c)

$$d) \quad A = \begin{bmatrix} 2 & 3 & 2 \\ 1 & 2 & 5 \\ 3 & 1 & -2 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 14 \\ 6 \\ 19 \end{bmatrix}$$

$$|A| = 23$$

$$|A_1| = 115$$

$$|A_2| = 46$$

$$|A_3| = -23$$

$$x = \frac{115}{23}$$

$$y = \frac{46}{23}$$

$$z = \frac{-23}{23}$$

$$x = 5$$

$$y = 2$$

$$z = 1$$

Q3

C) $w = 2$

$$2 = 2x(15 - (x+1)) - 2(16x+2) - 25$$

$$2 = 30x - 2x^2 + 2x - 8x + 8 - 25$$

$$2 = -2x^2 + 24x - 17$$

$$2x^2 - 24x + 19 = 0$$