SCHEME OF EVALUATION

(Scoring Indicators)

Revision2015	Engineering Mathematics	Course CODE 2002		
Qst :No	Scoring Indicators	Split up score	sub Total	Total
I	Part A			
1	$2\times3+p\times-2+1\times4=0$ $p=5$	1 1	2	2
2.	$x^2-36=0$ $x=\pm6$	1 1	2	2
3.	$\begin{bmatrix}0+1 & 1-2\\ 0-1 & 2+2\end{bmatrix}$ $=\begin{bmatrix}1 & -1\\ -1 & 4\end{bmatrix}$	1 1	2	2
4.	$=[\tan^{-1}x]_0^1$ $=\tan^{-1}(1)-\tan^{-1}(0)$ $=\pi/4$	1 1	2	2
5.	$IF=e^{\int p\,dx}$ $=e^{\int x\,dx}$ $=e^{x^2/2}$	1 1	2	2

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II	Part B			
1.	$\bar{a}+\bar{b} = 3i-j+k$	1		
	$\bar{a}-\bar{b} = i+3j-3k$	1		
	$(\bar{a}+\bar{b})\times(\bar{a}-\bar{b}) = \begin{vmatrix} i & j & k \\ 3 & -1 & 1 \\ 1 & 3 & -3 \end{vmatrix}$	1		
	$= i(3-3)-j(-9-1)+k(9+1)$		6	6
	$= 10j+10k$	1		
	$\lvert(\bar{a}+\bar{b})\times(\bar{a}-\bar{b})\rvert = \sqrt{100+100} = 10\sqrt{2}$	1		
	unit vector $= \dfrac{(\bar{a}+\bar{b})\times(\bar{a}-\bar{b})}{\lvert(\bar{a}+\bar{b})\times(\bar{a}-\bar{b})\rvert}$	1		
	$= \dfrac{j+k}{\sqrt{2}}$			
2.	Number of terms = 8	1		
	middle terms = 4^{th} & 5^{th}	1		
	4^{th} term $= {}^7C_3 (2x)^{7-3}\left(\frac{-3}{2x^2}\right)^3$	1		
	$= \dfrac{-945}{2x^2}$	1		

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	$5^{th}\ term = {}^{7}C_4 (x)^{7-4} \left(\frac{-3}{x^2}\right)^4$	1	6	6
	$= \frac{2835}{x^5}$	1		
3.	$A = \begin{bmatrix} 3 & -1 & 1 \\ 2 & -7 & 3 \\ 1 & 1 & -1 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, $B = \begin{bmatrix} 4 \\ -6 \\ 4 \end{bmatrix}$	1		
	$\lvert A \rvert = 3(7-3)+1(-2-3)+1(2+7)$			
	$= 16$	1		
	$A_{11} = 4 \quad A_{21} = 0 \quad A_{31} = 4$			
	$A_{12} = 5 \quad A_{22} = -4 \quad A_{32} = -7$	2	6	6
	$A_{13} = 9 \quad A_{23} = -4 \quad A_{33} = -19$			
	$A^{-1} = \frac{adj A}{\lvert A \rvert} = \frac{1}{16}\begin{bmatrix} 4 & 0 & 4 \\ 5 & -4 & -7 \\ -9 & -4 & -19 \end{bmatrix}$	1		
	$X = A^{-1}B = \frac{1}{16}\begin{bmatrix} 32 \\ 16 \\ -16 \end{bmatrix}$	1		
	$= \begin{bmatrix} 2 \\ 1 \\ -1 \end{bmatrix}$ $x=2,\ y=1,\ z=-1$			

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4.	$\begin{vmatrix} 1 & -x & -1 \\ 2 & 3 & x \\ 0 & -1 & x \end{vmatrix} = 2$			
	$1(3x+x)+x(2x-0)-1(-2-0)=2$	2		
	$4x+2x^2+2=2$	(1)	6	6
	$x^2+2x=0$			
	$x(x+2)=0$	(2)		
	$x=0,-2$	1		
5.	$\int f(x)g(x)dx = f(x)\int g(x)dx$			
	$-\int \frac{d}{dx}f(x)\int g(x)dx$	1		
	$\int x^2\sin x\,dx = x^2(-\cos x)-\int 2x(-\cos x)dx$	2	6	6
	$= -x^2\cos x + 2\left[x\sin x - \int 1\sin x dx\right]$	2		
	$= -x^2\cos x + 2x\sin x + 2\cos x + C$	1		
6.	Area $= \int_a^b y\,dx$	1		

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Qst :No	Scoring Indicators	Split up score	sub Total	Total
	$\left(\frac{x^2}{4}\right)^2 = 4x \quad x^4 = 64x$			
	$x = 0, 4$	1		
	$\text{Area} = \int_0^4 2\sqrt{x}\,dx - \int_0^4 \frac{x^2}{4}\,dx$	1		
	$= 2\left[\frac{x^{3/2}}{3/2}\right]_0^4 - \frac{1}{4}\left[\frac{x^3}{3}\right]_0^4$	1	6	6
	$= \frac{4}{3}(8-0) - \frac{1}{12}(64-0)$	1		
	$= \frac{32}{3} - \frac{16}{3} = \frac{16}{3}$	1		
7.	$\frac{dy}{dx} + \frac{y}{x} = \frac{x^2+1}{x}$	1		
	$P = \frac{1}{x}, \quad Q = \frac{x^2+1}{x}$	1		
	$IF = e^{\int P\,dx} = e^{\int \frac{1}{x}dx} = x$	1+1		
	$x\frac{dy}{dx} + x \times \frac{y}{x} = \frac{x^2+1}{x} \times x$	1		
	$\frac{d}{dx}(xy) = x^2+1$	1		
	$xy = \frac{x^3}{3} + x + C$			

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(Scoring Indicators)

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Qst :No	Scoring Indicators	Split up score	sub Total	Total
III	Part C			
(a)	$\vec{AB} = -i - 3j + 5k \quad \vec{AC} = i + j + k$	1		
	$\vec{AB} \times \vec{AC} = \begin{vmatrix} i & j & k \\ -1 & -3 & 5 \\ 1 & 1 & 6 \end{vmatrix}$	1		
	$= -8i + 6j + 2k$		5	5
	$\lvert\vec{AB} \times \vec{AC}\rvert = \sqrt{64+36+4} = \sqrt{104}$	1		
	Area of $\Delta^{le} = \frac{1}{2}\lvert\vec{AB} \times \vec{AC}\rvert$	1		
	$= \frac{1}{2}\sqrt{104}$	1		
(b)	$\bar{a} = 2i + j - k \quad \bar{b} = 3i - 4j$			
	$\bar{a} \cdot \bar{b} = 6 - 4 = 2$	2		
	$\lvert\bar{b}\rvert = \sqrt{9+16} = 5$	1		
	Projection of $\bar{a}$ on $\bar{b} = \frac{\bar{a} \cdot \bar{b}}{\lvert\bar{b}\rvert}$	1	5	5
	$= \frac{2}{5}$	1		

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(Scoring Indicators)

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Qst :No	Scoring Indicators	Split up score	sub Total	Total
III (c)	$(a+b)^n = a^n + {}^nC_1 a^{n-1}b + \cdots + b^n$	1		
	$(3x-2y)^5 = (3x)^5 - 5C_1(3x)^4(2y) + 5C_2(3x)^3(2y)^2$ $- 5C_3(3x)^2(2y)^3 + 5C_4(3x)(2y)^4$ $-(2y)^5$	2	5	5
	$= 243x^5 - 810x^4y + 1080x^3y^2 - 720x^2y^3$ $+ 240xy^4 - 32y^5$	2		
IV (a)	$\bar{a} = 2i+j-2k \quad \bar{b} = 3i-j+3k$	1		
	$\bar{a}\cdot\bar{b} = 6-1-6 = -1$ $\lvert\bar{a}\rvert = \sqrt{4+1+4} = 3 \quad \lvert\bar{b}\rvert = \sqrt{9+1+9} = \sqrt{19}$	1+1	5	5
	$\cos\theta = \frac{\bar{a}\cdot\bar{b}}{\lvert\bar{a}\rvert\lvert\bar{b}\rvert} = \frac{-1}{3\times\sqrt{19}}$	1+1		
(b)	$\bar{F} = 5i+j-3k$	1		
	$P = i+2j+k, \quad Q = 3i-j+k$	1		
	$\overrightarrow{PQ} = 2i-3j$	1		
	Moment $= \overrightarrow{PQ} \times \bar{F}$	1		

SCHEME OF EVALUATION

(Scoring Indicators)

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Qst :No	Scoring Indicators	Split up score	sub Total	Total
	moment $= \begin{vmatrix} i & j & k \\ 2 & -3 & 0 \\ 5 & 1 & -3 \end{vmatrix} = 9i + 6j + 17k$	1	5	5
IV c	$(r+1)^{th}$ term $= {}^nC_r\, a^{n-r} b^r$	1		
	$= {}^{12}C_r (5x^2)^{12-r} \left(\frac{2}{x}\right)^r$	1		
	$= {}^{12}C_r \times 5^{12-r} \times 2^r \times x^{24-3r}$	1	5	5
	$24 - 3r = 0$			
	$r = 8$	1		
	Term independent of x			
	$= {}^{12}C_8 \times 5^4 \times 2^8$	1		
V (a)	$A = \begin{bmatrix} 2 & -6 & 4 \\ -2 & 1 & 3 \\ 0 & 5 & 4 \end{bmatrix}$, $A^T = \begin{bmatrix} 2 & -2 & 0 \\ -6 & 1 & 5 \\ 4 & 3 & 4 \end{bmatrix}$	1		

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(Scoring Indicators)

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Qst :No	Scoring Indicators	Split up score	sub Total	Total
	$A+A^T = \begin{bmatrix} 4 & -8 & 4 \\ -8 & 2 & 8 \\ 4 & 8 & 8 \end{bmatrix}$	1		
	$P = \begin{bmatrix} 2 & -4 & 2 \\ -4 & 1 & 4 \\ 2 & 4 & 4 \end{bmatrix}$	1		
	$P^T = \begin{bmatrix} 2 & -4 & 2 \\ -4 & 1 & 4 \\ 2 & 4 & 4 \end{bmatrix} = P$	1		
	$\therefore$ P is Symmetric		5	5
	$A-A^T = \begin{bmatrix} 0 & -4 & 4 \\ 4 & 0 & -2 \\ -4 & 2 & 0 \end{bmatrix}$ $Q = \begin{bmatrix} 0 & -2 & 2 \\ 2 & 0 & -1 \\ -2 & 1 & 0 \end{bmatrix}$	1		
	$Q^T = -Q$			
	$P+Q = A$	1		
7(b)	$2A = \begin{bmatrix} 0 & 4 \\ -2 & 2 \end{bmatrix}$, $A = \begin{bmatrix} 0 & 2 \\ -1 & 1 \end{bmatrix}$	2+1		

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	$\begin{bmatrix} 0 & 2 \\ -1 & 1 \end{bmatrix} + B = \begin{bmatrix} 2 & 1 \\ -3 & 0 \end{bmatrix}$	1		
	$B = \begin{bmatrix} 2 & -1 \\ -2 & -1 \end{bmatrix}$	1	5	5
V (c)	$\Delta = \begin{vmatrix} 3 & 1 & -1 \\ 2 & 1 & 4 \\ 1 & -1 & 3 \end{vmatrix} = 22$	1		
	$\Delta_1 = \begin{vmatrix} 8 & 1 & -1 \\ 1 & 1 & 4 \\ -2 & -1 & 3 \end{vmatrix} = 44$	1		
	$\Delta_2 = \begin{vmatrix} 3 & 8 & -1 \\ 2 & 1 & 4 \\ 1 & -2 & 3 \end{vmatrix} = 22$	1	5	5
	$\Delta_3 = \begin{vmatrix} 3 & 1 & 8 \\ 2 & 1 & 1 \\ 1 & -1 & -2 \end{vmatrix} = -22$	1		
	$x = \frac{\Delta_1}{\Delta} = \frac{44}{22} = 2$			
	$y = \frac{\Delta_2}{\Delta} = \frac{22}{22} = 1$	1		
	$z = \frac{\Delta_3}{\Delta} = \frac{-22}{22} = -1$			

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Qst :No	Scoring Indicators	Split up score	sub Total	Total
VI (a)	$A = \begin{bmatrix} 2 & 1 \\ 3 & 5 \end{bmatrix}$ $\quad |A| = 7$			
	$\text{adj}A = \begin{bmatrix} 5 & -1 \\ -3 & 2 \end{bmatrix}$			
	$A^{-1} = \frac{\text{adj}A}{|A|}$	1		
	$= \frac{1}{7}\begin{bmatrix} 5 & -1 \\ -3 & 2 \end{bmatrix}$	1		
	$B^{-1} = \frac{1}{7}\begin{bmatrix} 3 & 2 \\ -2 & 1 \end{bmatrix}$	1		
	$B^{-1}A^{-1} = \frac{1}{49}\begin{bmatrix} 9 & 1 \\ -13 & 4 \end{bmatrix}$		5	5
	$AB = \begin{bmatrix} 4 & -1 \\ 13 & 9 \end{bmatrix}$	1		
	$\|AB\| = 49$			
	$\text{adj}(AB) = \begin{bmatrix} 9 & 1 \\ -13 & 4 \end{bmatrix}$	1		
	$(AB)^{-1} = \frac{1}{49}\begin{bmatrix} 9 & 1 \\ -13 & 4 \end{bmatrix}$			

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VI (b)	$3a+3b+1=1$	1		
	$3b-2=4 \quad b=2$	1		
	$a=-2$	2	5	5
	$6+c=8, \quad c=2$	1		
(c)	$A^2=\begin{bmatrix}7 & 1\\ 3 & 4\end{bmatrix}$	2		
	$A^2-A-5I=\begin{bmatrix}7 & 1\\ 3 & 4\end{bmatrix}-\begin{bmatrix}2 & 1\\ 3 & -1\end{bmatrix}-\begin{bmatrix}5 & 0\\ 0 & 5\end{bmatrix}$	2	5	5
	$=\begin{bmatrix}0 & 0\\ 0 & 0\end{bmatrix}=0$	1		
VII (a)	$\int \frac{1-\sin x}{1-\sin^2 x}\,dx$	1		
	$=\int \frac{1-\sin x}{\cos^2 x}\,dx=\int(\sec^2 x-\sec x\tan x)$	1+1	5	5
	$=\tan x-\sec x+C$	1+1		

SCHEME OF EVALUATION

(Scoring Indicators)

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VII (b)	$\int_0^{\pi/2} \sqrt{1+\sin 2x}$			
	$= \int_0^{\pi/2} \sqrt{\cos^2 x + \sin^2 x + 2\sin x \cos x}$	1		
	$= \int_0^{\pi/2} (\cos x + \sin x)\, dx$	1		
	$= (\sin x - \cos x)_0^{\pi/2}$	1	5	5
	$= \sin \pi/2 - \cos \pi/2 - (\sin 0 - \cos 0)$	1		
	$= 1 - 0 - (0-1)$			
	$= 2$	1		
VII C	$1 + 4x^3 = u$	1		
	$12x^2\, dx = du$			
	$x^2\, dx = \frac{du}{12}$	1		
	$2 \int \frac{1}{u} \frac{du}{12}$	1	5	5
	$= \frac{1}{6} \log \lvert u \rvert + C$	1		
	$= \frac{1}{6} \log \lvert 1 + 4x^3 \rvert + C$	1		

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VIII (a)	$1+\cos x = u$			
	$-\sin x\,dx = du$, $u=2$ to $u=1$	1+1		
	$\int_2^1 \sqrt{u}\,du$	1	5	5
	$= -\left[\frac{u^{3/2}}{3/2}\right]_2^1$	1		
	$= -\frac{2}{3}\left[1-2^{3/2}\right]$	1		
(b)	$\frac{1}{4}\int(\cos 3x + 3\cos x)\,dx$	2		
	$= \frac{1}{4}\left[\frac{\sin 3x}{3} + 3\sin x\right] + C$	3	5	5
(c)	$\int f(x)g(x)\,dx = f(x)\int g(x)\,dx$			
	$-\int\left[\frac{d}{dx}f(x)\int g(x)\,dx\right]dx$	1		
	$= \log x \cdot \frac{x^3}{3} - \int \frac{1}{x}\frac{x^3}{3}\,dx$	3	5	5
	$= \frac{x^3}{3}\log x - \frac{x^3}{9} + C$	1		

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IX				
(a)	$V = \pi \int_a^b y^2 dx$	1		
	$= \pi \int_0^{\pi/3} \sin^2 3x \, dx$	1		
	$= \pi \int_0^{\pi/3} \frac{1-\cos 6x}{2} dx$	1		
	$= \frac{\pi}{2} \left[x - \frac{\sin 6x}{6} \right]_0^{\pi/3}$	1	5	5
	$= \frac{\pi}{2} [\pi/3 - 0 - 0 - 0]$			
	$= \frac{\pi^2}{6}$	1		
(b)	$\frac{y}{y^2+1} dy = \frac{x}{x^2+1} dx$	2		
	$\frac{1}{u} du = \frac{1}{t} dt$	1	5	5
	$\log\lvert u\rvert = \log\lvert t\rvert + \log C$	1		
	$u = ct$			
	$y^2+1 = C(x^2+1)$	1		
(c)	$\frac{dy}{dx} = \tan x + C_1$			
	$y = \log\lvert \sec x\rvert + C_1 x + C_2$	2 3	5	5

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8(a)	$A = \int_a^b y\,dx = \int_0^4 \sqrt{x}\,dx$	1+1		
	$= \left[\frac{x^{3/2}}{3/2}\right]_0^4 = \frac{2}{3}\left[4^{3/2} - 0\right]$	1+1	5	5
	$= \frac{16}{3}$	1		
(b)	$P = \cot x \quad Q = 1$			
	$If = e^{\int P\,dx} = e^{\int \cot x\,dx} = \sin x$	1+1+1		
	$\frac{d}{dx}(\sin x \times y) = \sin x$	1	5	5
	$\sin x \times y = -\cos x + C$	1		
(c)	$dy = e^{-2y} \times e^{3x}\,dx$	1		
	$e^{2y}\,dy = e^{3x}\,dx$	1+1	5	5
	$\frac{e^{2y}}{2} = \frac{e^{3x}}{3} + C$	1+1		