SCHEME OF VALUATION

(Scoring Indicators)

Revision 2015 | Course Code 1002

Course Title: ENGINEERING MATHEMATICS-I

Qn. No	Scoring Indicator	Split up score	Sub total	Total
	PART A			
1.	$\sin 30 = 1/2 \quad \cos 60 = \frac{1}{2}$	1	2	
	$\tan 45 = 1$			
	Ans: $\frac{1}{2} + \frac{1}{2} - 1 = 0$	1		
2.	$\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$	1	2	
	Ans: $4/3$	1		
3.	Area $= \frac{1}{2} ab \sin C$	1	2	10
	$= \frac{1}{2} \times 4 \times 2 \times \sin 30 = 2$	1		
4	$\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1$	1	2	
	$\lim_{\theta \to 0} \frac{\sin 5\theta}{5\theta} \times 5 = 5$	1		
5	Slope of the tangent $= \frac{dy}{dx}$	1	2	
	$= \sec^2 x$			
	Slope at $x = \frac{\pi}{4}$ is $\sec^2 \frac{\pi}{4} = 2$	1		

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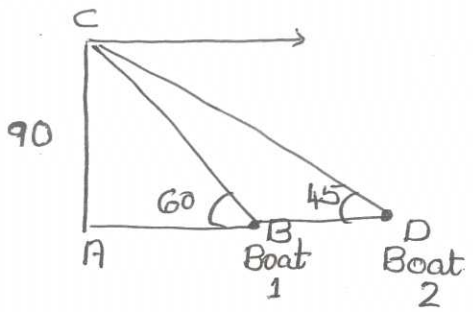
II	Part B			
1		1		
	$\tan 45 = \frac{90}{AD}$	1		
	$AD = 90$	1	6	6
	$\tan 60 = \frac{90}{AB}$	1		
	$AB = \frac{90}{\sqrt{3}}$	1		
	Distance blw boats $= 90 - \frac{90}{\sqrt{3}} = 38.1$	1		
2	$\sin x - \sqrt{3}\cos x = K\sin(x-\alpha)$	1		
	Equating $K\cos\alpha = 1$ — ① $K\sin\alpha = \sqrt{3}$ — ②	2		

Qn. No	Scoring Indicator	Split up score	Sub total	Total
	Squaring & adding $k = \pm 2$	1		
	Dividing, $\tan\alpha = \sqrt{3}$ $\alpha = \frac{\pi}{3}\ (=60^\circ)$	1	6	
	$\sin\alpha - \sqrt{3}\cos\alpha = \pm 2\sin(\alpha - \frac{\pi}{3})$	1		
3	$\cos 20\ \cos 40\ \cos 80$			
	$= \frac{1}{2}\cos 20\ \frac{1}{2}[\cos 120 + \cos 40]$	1		
	$= \frac{1}{4}\cos 20\ [-\frac{1}{2} + \cos 40]$	1		
	$= -\frac{1}{8}\cos 20 + \frac{1}{4}\cos 20\cos 40$	1	6	
	$= -\frac{1}{8}\cos 20 + \frac{1}{8}\cos 60 + \frac{1}{8}\cos 20$	2		
	$= \frac{1}{8} \times \frac{1}{2} = \frac{1}{16}$	1		

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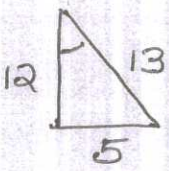
4.	$(a+b)\sin\frac{C}{2}$			
	$= (2R\sin A + 2R\sin B)\sin\frac{C}{2}$	1		
	$= 4R\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)\sin\frac{C}{2}$	2 1		
	$= \cos\left(\frac{A-B}{2}\right) 4R\sin\left(90-\frac{C}{2}\right)\sin\frac{C}{2}$	1	6	
	$= \cos\left(\frac{A-B}{2}\right) 2R\sin C$	2		
	$= c\cos\left(\frac{A-B}{2}\right)$	1		
5	$y = \sin x$			
	$y + \Delta y = \sin(x+\Delta x)$			
	$\Delta y = \sin(x+\Delta x) - \sin x$	1		
	$\frac{\Delta y}{\Delta x} = \frac{2\cos\left(x+\frac{\Delta x}{2}\right)\sin\left(\frac{\Delta x}{2}\right)}{\Delta x}$	3	6	
	$\lim_{\Delta x\to 0}\frac{\Delta y}{\Delta x} = \lim_{\Delta x\to 0}\cos\left(x+\frac{\Delta x}{2}\right)\frac{\sin\frac{\Delta x}{2}}{\frac{\Delta x}{2}}$ $= \sin x$	2		

Qn. No	Scoring Indicator	Split up score	Sub total	Total
6.	$2x^3+6xy+2y^3=16$	1		
	Diff. w.r.t. x.	1		
	$6x^2+6\left[x\frac{dy}{dx}+y\right]+6y^2\frac{dy}{dx}=0$	3	6	
	$\frac{dy}{dx}=-\frac{x^2-y}{x+y^2}$	2		
7	$y=4x^3+9x^2-12x+5$			
	y is maximum when			
	$\frac{dy}{dx}=0$ & $\frac{d^2y}{dx^2}<0$	1		
	$\frac{dy}{dx}=12x^2+18x-12$	1		
	$\frac{d^2y}{dx^2}=24x+18$	1	6	
	$\frac{dy}{dx}=0 \Rightarrow x=-2,\frac{1}{2}$	1		
	$\frac{d^2y}{dx^2}<0$ for $x=-2$	1		
	Max. value = 33	1		

Qn. No	Scoring Indicator Part C	Split up score	Sub total	Total
III				
a)	$\frac{\sin^2\theta + (1+\cos\theta)^2}{(1+\cos\theta)\sin\theta}$	1		
	$= \frac{\sin^2\theta + 1 + \cos^2\theta + 2\cos\theta}{(1+\cos\theta)\sin\theta}$	1		
	$= \frac{2(1+\cos\theta)}{(1+\cos\theta)\sin\theta}$	2	5	
	$= 2\operatorname{Cosec}\theta$	1		
b)	$\cos 120 = \frac{-1}{2}$	1		
	$\sin 210 = \frac{-1}{2}$	1		
	$\sin 240 = -\frac{\sqrt{3}}{2}$	1		
	$\cos 330 = \frac{\sqrt{3}}{2}$	1	5	
	$\cos 120 \sin 210 - \sin 240 \cos 330 = 1$	1		

Qn. No.	Scoring Indicator	Split up score	Sub total	Total
c)	$\tan 75 = \tan(45+30)$			
	$= \dfrac{1+1/\sqrt{3}}{1-1/\sqrt{3}}$	2		
	$= \dfrac{\sqrt{3}+1}{\sqrt{3}-1} = 2+\sqrt{3}$	1	5	
	$\cot 75 = 2-\sqrt{3}$	1		
	$\tan 75 + \cot 75 = 4$	1		
IV a)	$\dfrac{\sqrt{1-\sin\theta}}{\sqrt{1+\sin\theta}} \times \dfrac{\sqrt{1-\sin\theta}}{\sqrt{1-\sin\theta}}$	1		
	$= \dfrac{1-\sin\theta}{\cos\theta}$	2		
	$= \dfrac{1}{\cos\theta} - \dfrac{\sin\theta}{\cos\theta}$	1	5	
	$= \sec\theta - \tan\theta$	1		

Qn. No	Scoring Indicator	Split up score	Sub total	Total
b)	$\tan\theta = \frac{5}{12}$ 	1		
	Since θ lies in the 3rd quadrant, $\tan\theta$ & $\cot\theta$ are +ve	1	5	
	$\sin\theta = \frac{-5}{13}$ $\cos\theta = \frac{-12}{13}$			
	$\cot\theta = \frac{12}{5}$ $\operatorname{cosec}\theta = \frac{-13}{5}$	3		
	$\sec\theta = \frac{-13}{12}$			
c)	$\sin(A+B)$ ~~$\sin(A-B)$~~			
	$= \sin A \cos B + \cos A \sin B$	1		
	$\sin(A-B)$			
	$= \sin A \cos B - \cos A \sin B$	1		
	$\sin(A+B)\sin(A-B)$			
	$= \sin^2 A \cos^2 B - \cos^2 A \sin^2 B$	1		

Qn. No	Scoring Indicator	Split up score	Sub total	Total
	$= (1-\cos^2 A)\cos^2 B - \cos^2 A(1-\cos^2 B)$	1	5	
	$= \cos^2 B - \cos^2 A$	1		
V a)	$\sin 3x = 3\sin x - 4\sin^3 x$	1		
	$\cos 3x = 4\cos^3 x - 3\cos x$	1		
	$\frac{\sin 3x}{\sin x} = 3 - 4\sin^2 x$	1		
	$\frac{\cos 3x}{\cos x} = 4\cos^2 x - 3$	1	5	
	$\frac{\sin 3x}{\sin x} - \frac{\cos 3x}{\cos x} = 6 - 4[\sin^2 x + \cos^2 x]$	1		
	$= 6 - 4 = 2$	1		
b)	$\cos 3A - \cos A = -2\sin 2A \sin A$ $= 2\cos 2A \cos A$	2		
	$\sin A - \sin 3A = -2\cos 2A \sin A$	2		

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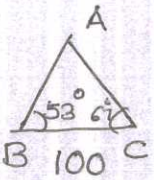
	$\frac{\cos 3A - \cos A}{\sin A - \sin 3A} = \tan 2A$	1	5	
c)	$A = \cos^{-1}\left[\frac{b^2+c^2-a^2}{2bc}\right]$	1		
	$= 28^\circ 58'$	1		
	$B = \cos^{-1}\left[\frac{a^2+c^2-b^2}{2ac}\right]$	1	5	
	$= 46^\circ 34'$	1		
	$C = 180 - (A+B)$ $= 104^\circ 28'$	1		
VI a)	$\frac{1}{\sin 2A} + \frac{\cos 2A}{\sin 2A}$	1		
	$= \frac{1+\cos 2A}{\sin 2A}$	1		
	$= \frac{2\cos^2 A}{2\cos A \sin A}$	2		

Qn. No	Scoring Indicator	Split up score	Sub total	Total
	$= \cot A$	1		
b)	$\cos 55 + \cos 65$			
	$= 2\cos 60 \cos 5$	2		
	$= 2 \times \frac{1}{2} \times \cos 5 = \cos 5$	1		
	$\cos 175 = -\cos 5$	1		
	ans:- 0	1		
c)	$A = 180 - 120 = 60^\circ$ 	1		
	$\frac{a}{\sin A} = \frac{b}{\sin B}$			
	$b = \frac{100 \sin 53}{\sin 60} = 92.21$	2		
	$\frac{a}{\sin A} = \frac{c}{\sin C}$ $c = 106.29$	1		
	The length of fencing			
	$= 100 + 92.21 + 106.29 = 298.5$	1		

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VII a) (i)	$\lim_{x\to 3} \frac{x^3-3^3}{x^2-3^2}$	1	3	6
	$\lim_{x\to 3} \frac{\frac{x^3-3^3}{x-3}}{\frac{x^2-3^2}{x-3}} = \frac{3\times 3^2}{2\times 3} = \frac{9}{2}$	2		
(ii) (b)	$\lim_{x\to\infty} \frac{x^2\left(1+\frac{1}{x}-\frac{1}{x^2}\right)}{x^2\left(2+\frac{3}{x}+\frac{1}{x^2}\right)}$ & $\lim_{x\to\infty} \frac{1}{x}=0$	2	3	
	$= \frac{1}{2}$	1		
b)	$\frac{d}{dx}\left(\frac{\sin x}{\cos x}\right)$	1	4	
	$= \frac{\cos x \frac{d}{dx}(\sin x) - \sin x \frac{d(\cos x)}{dx}}{\cos^2 x}$	1		
	$= \frac{\cos x \cos x - \sin x - \sin x}{\cos^2 x}$	1		
	$= \frac{1}{\cos^2 x}$	1		
	$= \sec^2 x$	1		

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c)	$y' = 1 - \frac{1}{x^2}$	1		
	$y'' = \frac{2}{x^3}$	1	5	
	$x^2 y'' = \frac{2}{x}$	1		
	$x y' = x - \frac{1}{x}$	1		
	$x^2 y'' + x y' = 2x + \frac{1}{x} = y$	1		
VIII				
a) i)	$\frac{dy}{dx} = e^{2x} \frac{d}{dx} \log 2x + \log 2x \frac{d e^{2x}}{dx}$	1		
	$\frac{d}{dx} \log 2x = \frac{1}{2x} \times 2 = \frac{1}{x}$	1	3	
	$\frac{d}{dx} e^{2x} = 2e^{2x}$	1		
	$\frac{dy}{dx} = \frac{e^{2x}}{x} + \log 2x \cdot 2e^{2x}$			6
ii)	$\frac{dy}{dx} = 5 \sin^4(x^2) \frac{d}{dx} \sin(x^2)$	1		
	$= 5 \sin^4(x^2) \cos(x^2) \frac{d(x^2)}{dx}$	1	3	
	$= 10x \sin^4(x^2) \cos(x^2)$	1		

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b)	$\frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}}$	1		
	$\frac{dy}{d\theta} = b\sec^2\theta$	1	4	
	$\frac{dx}{d\theta} = a\sec\theta\tan\theta$	1		
	$\frac{dy}{dx} = \frac{b}{a}\frac{\sec\theta}{\tan\theta} = \frac{b}{a\sin\theta}$	1		
c)	$y' = -am\sin mx + bm\cos mx$	2		
	$y'' = -am^2\cos mx - bm^2\sin mx$	2	5	
	$= -m^2y$	1		
IX a)	velocity $= \frac{ds}{dt} = 6t^2 - 18t + 12$	2		
	acceleration $= \frac{d^2s}{dt^2} = 12t - 18$	2	5	
	acceleration $= 0$ when $t = 3/2$	1		
b)	Slope of the tangent $= \frac{dy}{dx} = 2x + 1$ $= 5$	1 2	5	
	Slope of normal $= -1/5$	1		
	Eqn of tangent is $y - 5 = 5(x - 2)$	2		

Qn. No	Scoring Indicator	Split up score	Sub total	Total
	Eqn. of normal is $y-5=\frac{-1}{5}(x-2)$	1		
c)	length $= x$ breadth $= y$ perimeter $= k$. $2(x+y)=k$. $y=\frac{k-2x}{2}$	1		
	Area, $A=x\left(\frac{k-2x}{2}\right)=\frac{kx-2x^2}{2}$	1		
	A is max. if $\frac{dA}{dx}=0$ & $\frac{d^2A}{dx^2}<0$	1	5	
	$\frac{dA}{dx}=0 \Rightarrow x=\frac{k}{4}$ $y=\frac{k}{4}$ $\frac{d^2A}{dx^2}<0$	1+1		
X a)	Slope of the tangent $=\frac{dy}{dx}$	1		
	$=\frac{1-x^2}{(x^2+1)^2}$	2	5	
	$\perp^{nl}$ to x-axis is $\frac{dy}{dx}=0$	1		
	$x=\pm 1$	1		

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(Scoring Indicators)

Revision Course Title:				Course Code
Qn. No	Scoring Indicator	Split up score	Sub total	Total
b)	$V = \frac{4}{3}\pi r^3$	1		
	$\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$	1		
	$\frac{dr}{dt} = 1$	1	5	
	$r = 3 + 3\frac{dr}{dt} = 6$	1		
	$\frac{dV}{dt} = 144\pi$	1		
c)	At Maximum $\frac{dM}{dx} = 0$ & $\frac{d^2M}{dx^2} < 0$	1		
	$\frac{dM}{dx} = 2(10 - 2x)$	1		
	$\frac{d^2M}{dx^2} = -4$	1		
	$\frac{dM}{dx} = 0 \Rightarrow x = 5$	1	5	
	Max. bending Moment $= 50$	1		