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SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JULY 2010 SESSION

SUBJECT CODE	:	FKB 13202
SUBJECT TITLE	:	ENGINEERING MATHEMATICS 2
LEVEL	:	BACHELOR
TIME / DURATION	:	8.00 pm – 10.00 pm (2 HOURS)
DATE	:	13 NOVEMBER 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of FIVE (5) questions. You are required to answer FOUR (4) questions only. Answer all questions in English.
6. Fomula is appended.

THERE ARE 2 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

(Total : 60 marks)

INSTRUCTION : Answer FOUR (4) questions only.
Please use the answer booklet provided.

Question 1

Use the substitution $y = vx$ to show that the particular solution to the differential equation

$$7x(x-y)dy = 2(x^2 + 6xy - 5y^2)dx$$

given that $x = 1$ when $y = 0$ is

$$\left(\frac{x+3y}{x}\right)^{\frac{4}{3}}\left(\frac{2x-y}{x}\right) = 2x$$

(15 marks)

Question 2

Determine the general solution to the differential equation

$$y'' - 4y' + 5y = -3e^{x}\cos x$$

(15 marks)

Question 3

Determine

(a) $L\{\sin(2t+3) + e^{-3t}\sin^2 t\}$

(b) $L\{(8+t^2)^3 - e^{-4t}t^4\}$

(15 marks)

Question 4

Solve the given differential equation using Laplace Transform

$$\frac{d^2x}{dt^2} - 4\frac{dx}{dt} + 8x = e^{2t}$$

given that when $t = 0$, $x = 2$ and $\frac{dx}{dt} = -2$

(15 marks)

Question 5

(a) Sketch the periodic function defined by

$$f(x) = \begin{cases} 0, & -\pi < x < -\frac{\pi}{2} \\ 4, & -\frac{\pi}{2} < x < \frac{\pi}{2} \\ 0, & \frac{\pi}{2} < x < \pi \end{cases}$$

from $-3\pi < x < 3\pi$. (4 marks)

(b) Determine whether $f(x)$ is even, odd or neither even nor odd. (1 mark)

(c) Hence, determine the Fourier series for $f(x)$. (10 marks)

END OF QUESTION

APPENDIX 1

TABLE OF DIFFERENTIATION

Trigonometric Functions - GENERAL FORM
$\frac{d}{dx}(\sin f(x)) = f'(x)\cos f(x)$
$\frac{d}{dx}(\cos f(x)) = -f'(x)\sin f(x)$
$\frac{d}{dx}(\tan f(x)) = f'(x)\sec^2 f(x)$
$\frac{d}{dx}(\csc f(x)) = -f'(x)\csc f(x)\cot f(x)$
$\frac{d}{dx}(\sec f(x)) = f'(x)\sec f(x)\tan f(x)$
$\frac{d}{dx}(\cot f(x)) = -f'(x)\csc^2 f(x)$

Exponential Function - GENERAL FORM
$\frac{d}{dx}\left(e^{f(x)}\right) = f'(x)\,e^{f(x)}$

Logarithmic Function - GENERAL FORM
$\frac{d}{dx}(\ln f(x)) = \frac{1}{f(x)}\,f'(x)$

APPENDIX 2

TRIGONOMETRIC IDENTITIES AND FORMULAS

FUNDAMENTAL IDENTITIES

$$\csc\theta = \frac{1}{\sin\theta}$$

$$\sec\theta = \frac{1}{\cos\theta}$$

$$\cot\theta = \frac{1}{\tan\theta} = \frac{\cos\theta}{\sin\theta}$$

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

$$\sin^2\theta + \cos^2\theta = 1$$

$$1 + \tan^2\theta = \sec^2\theta$$

$$1 + \cot^2\theta = \csc^2\theta$$

FORMULAS FOR NEGATIVES

$$\sin(-\theta) = -\sin\theta$$

$$\cos(-\theta) = \cos\theta$$

$$\tan(-\theta) = -\tan\theta$$

$$\csc(-\theta) = -\csc\theta$$

$$\sec(-\theta) = \sec\theta$$

$$\cot(-\theta) = -\cot\theta$$

ADDITION FORMULAS

$$\sin(A + B) = \sin A\cos B + \cos A\sin B$$

$$\cos(A + B) = \cos A\cos B - \sin A\sin B$$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A\tan B}$$

SUBTRACTION FORMULAS

$$\sin(A - B) = \sin A\cos B - \cos A\sin B$$

$$\cos(A - B) = \cos A\cos B + \sin A\sin B$$

$$\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A\tan B}$$

HALF-ANGLE FORMULAS

$$\sin\frac{\theta}{2} = \pm\sqrt{\frac{1-\cos\theta}{2}}$$

$$\cos\frac{\theta}{2} = \pm\sqrt{\frac{1+\cos\theta}{2}}$$

$$\tan\frac{\theta}{2} = \frac{1-\cos\theta}{\sin\theta} = \frac{\sin\theta}{1+\cos\theta}$$

DOUBLE-ANGLE FORMULAS

$$\sin 2\theta = 2\sin\theta\sin\theta$$

$$\cos 2\theta = \cos^2\theta - \sin^2\theta$$

$$\text{..........} = 1 - 2\sin^2\theta$$

$$\text{..........} = 2\cos^2\theta - 1$$

$$\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$$

PRODUCT-TO-SUM FORMULAS

$$\sin\alpha\mathrm{in}\alpha\mathrm{c} = \frac{1}{2}[\sin(\alpha+\beta) + \sin(\alpha-\beta)]$$

$$\cos\alpha\mathrm{os}\alpha\mathrm{s} = \frac{1}{2}[\sin(\alpha+\beta) - \sin(\alpha-\beta)]$$

$$\cos\alpha\mathrm{os}\alpha\mathrm{c} = \frac{1}{2}[\cos(\alpha+\beta) + \cos(\alpha-\beta)]$$

$$\sin\alpha\mathrm{in}\alpha\mathrm{s} = \frac{1}{2}[\cos(\alpha-\beta) - \cos(\alpha+\beta)]$$

SUM-TO-PRODUCT FORMULAS

$$\sin\alpha + \sin\beta = 2\sin\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$$

$$\sin\alpha - \sin\beta = 2\cos\frac{\alpha+\beta}{2}\sin\frac{\alpha-\beta}{2}$$

$$\cos\alpha + \cos\beta = 2\cos\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$$

$$\cos\alpha - \cos\beta = -2\sin\frac{\alpha+\beta}{2}\sin\frac{\alpha-\beta}{2}$$

APPENDIX 3

TABLE OF INTEGRATION

Where $f(x) = ax + b$ and $f'(x) = a$

Trigonometric Functions - GENERAL FORM
$\int \cos f(x)\,dx = \dfrac{\sin f(x)}{f'(x)} + C$
$\int \sin f(x)\,dx = -\dfrac{\cos f(x)}{f'(x)} + C$
$\int \sec^2 f(x)\,dx = \dfrac{\tan f(x)}{f'(x)} + C$
$\int \csc^2 f(x)\,dx = -\dfrac{\cot f(x)}{f'(x)} + C$
$\int \sec f(x) \tan f(x)\,dx = \dfrac{\sec f(x)}{f'(x)} + C$
$\int \csc f(x) \cot f(x)\,dx = -\dfrac{\csc f(x)}{f'(x)} + C$

Exponential Function - GENERAL FORM
$\int e^{f(x)}\,dx = \dfrac{e^{f(x)}}{f'(x)} + C$

Logarithmic Function - GENERAL FORM
$\int \dfrac{1}{f(x)}\,dx = \dfrac{\ln\lvert f(x)\rvert}{f'(x)} + C$

APPENDIX 4

TABLE OF LAPLACE TRANSORM

$f(t)$	$F(s)$
1	$\frac{1}{s}$
k	$\frac{k}{s}$
e^{at}	$\frac{1}{s-a}$
$\sin at$	$\frac{a}{s^2+a^2}$
$\cos at$	$\frac{s}{s^2+a^2}$
t	$\frac{1}{s^2}$
t^2	$\frac{2!}{s^3}$
t^k	$\frac{k!}{s^{k+1}}$
$\sinh at$	$\frac{a}{s^2-a^2}$
$\cosh at$	$\frac{s}{s^2-a^2}$
$e^{at}t^k$	$\frac{k!}{(s-a)^{k+1}}$
$e^{at}\sin bt$	$\frac{b}{(s-a)^2+b^2}$
$e^{at}\cos bt$	$\frac{s-a}{(s-a)^2+b^2}$
$e^{at}\sinh bt$	$\frac{b}{(s-a)^2-b^2}$

$e^{at}\cosh bt$	$\dfrac{s-a}{(s-a)^2-b^2}$
$t\sin at$	$\dfrac{2as}{(s^2+a^2)^2}$
$t\cos at$	$\dfrac{s^2-a^2}{(s^2+a^2)^2}$