SECTION A

STRUCTURED (25 marks)

INSTRUCTION:

This section consists of **ONE (1)** question. Answer **ALL** questions.

QUESTION 1

a) Find the values of the following functions: **CLO 1 : C1**

i. cosh 4.5 (2 marks)

ii tanh (- 0.5) (2 marks)

iii. sinh (- 0.375) + cosh (1.35) (3 marks)

b) The curve assumed by a cable is $y^2 = c\cosh\frac{x}{c}$. If c =50 and x=109 find the value of y. **CLO 1 : C3** (4 marks)

c) Find the principle values for the following functions. Then, with the help of a graph, find all solution for θ from 0^o to 360^o. **CLO 1 : C1**

i. $\theta = \cos^{-1} 0.45$ (3 marks)

ii. $\theta = \sin^{-1}(-0.8660)$ (3 marks)

iii. $\theta = \tan^{-1}(\sqrt{3})$ (3 marks)

d) Prove that $\frac{1+\tanh x}{1-\tanh x} = e^{2x}$ **CLO1: C2** (5 marks)

POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

DEPARTMENT OF MATHEMATICS, SCIENCE AND COMPUTER

FINAL EXAMINATION

JUNE 2012 SESSION

BA601: ENGINEERING MATHEMATICS 5

DATE: 17 NOVEMBER 2012(SATURDAY)
DURATION: 2 HOURS (2.30PM - 4.30PM)

This paper consists of **SEVEN (7)** pages including the front page and appendix.

Section A: **ONE (1)** question – Answer all.
Section B: **THREE (3)** questions – Answer **TWO (2)**
Section C: **TWO (2)** questions – Answer **ONE (1)**

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QUESTION 3

a) Use implicit differentiation to find $\frac{dy}{dx}$ for the equation below. **CLO 2: C3**

$5x + 3\sin y - x^2 y^3 = 0$ (5 marks)

b) Given that $z = 3y^4 + 5x^2 y^3 - 4x^4$, find: **CLO 2: C1**

i. $\frac{\delta z}{\delta x}$ (2 marks)

ii. $\frac{\delta z}{\delta y}$ (2 marks)

iii. $\frac{\delta^2 z}{\delta x^2}$ (2 marks)

iv. $\frac{\delta^2 z}{\delta y^2}$ (2 marks)

v. $\frac{\delta^2 z}{\delta x \delta y}$ (1 mark)

c) Given that $z = 2\sin(3x^2 - 2y)$, find: $\frac{\delta z}{\delta x}$ *and* $\frac{\delta z}{\delta y}$ **CLO 2: C1**

(4 marks)

b) Given that $z = x^5 y + 3xy^5$. Find the total differential of z, dz, when a point changes from (1,2) to (1.02,1.98). **CLO 2: C3**

(7 marks)

SECTION B

STRUCTURED (50 marks)

INSTRUCTION:

This section consists of **THREE (3)** questions. Answer **TWO (2)** questions only.

QUESTION 2

a) Differentiate the following equations with respect to x :

i. $y = \sec^{-1}(e^{2x})$ **CLO2 : C1**

(4 marks)

ii. $y = \sqrt{2}\ln(\cosh 4x)$ **CLO2 : C3**

(4 marks)

iii. $y = 3\sinh^2(5x)$ **CLO2 : C2**

(5 marks)

iv. $y = \frac{\sin^{-1} x^3}{x}$ **CLO2 : C3**

(6 marks)

v. $y = 4\tanh^{-1}(e^{2x}\cos x)$ **CLO2 : C3**

(6 marks)

QUESTION 4

a) Integrate the following functions with respect to x. **CLO 2 : C2**

i. $\int \cos ech^2(3x)dx$ (3 marks)

ii. $\int \frac{4dx}{\sqrt{121-25x^2}}$ (5 marks)

iii. $\int \frac{dx}{x^2-2x+2}$ (6 marks)

b) Solve the following integrals: **CLO 2 : C3**

i. $\int_1^2 \frac{2dx}{\sqrt{64-16x^2}}$ (6 marks)

ii. $\int_2^3 \frac{\sinh x}{\cosh x}dx$ (5 marks)

SECTION C

STRUCTURED (25 marks)

INSTRUCTION:

This section consists of **TWO (2)** questions. Answer **ONE (1)** question only.

QUESTION 5

Determine the first order differential equation by using appropriate methods for each function below: **CLO3 : C4**

a) $x^2 - 2x + 4\frac{dy}{dx} = 9x^2 + 2x - 8$ (5 marks)

b) $\frac{1}{y}\frac{dy}{dx} = \frac{(2x^2+1)}{(y-3)^2}$ (7 marks)

c) $\frac{dv}{ds} = (5s^2+4)^2$ (5 marks)

d) $x\frac{dy}{dx} = \frac{-2y^2}{1+y}$ (8 marks)

RUMUS BA601: ENGINEERING MATHEMATICS 5

TRIGONOMETRIC IDENTITIES

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

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

$\operatorname{cosec}^2 x = 1 + \cot^2 x$

$\sin 2x = 2 \sin x \cos x$

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

$= 1 - 2\sin^2 x$

$= 2\cos^2 x - 1$

$\tan 2x = \dfrac{2\tan x}{1-\tan^2 x}$

INVERSE HYPERBOLIC FUNCTIONS

$\sinh^{-1} x = \ln\left(x + \sqrt{x^2+1}\right); -\infty < x < \infty$

$\cosh^{-1} x = \pm \ln\left(x + \sqrt{x^2-1}\right); x \geq 1$

$\tanh^{-1} x = \dfrac{1}{2}\ln\dfrac{1+x}{1-x}; |x| < 1$

$\operatorname{sech}^{-1} x = \ln\left(\dfrac{1+\sqrt{1-x^2}}{x}\right); 0 < x \leq 1$

$\operatorname{cosech}^{-1} x = \ln\left(\dfrac{1}{x} + \dfrac{\sqrt{1+x^2}}{|x|}\right); x \neq 0$

$\coth^{-1} x = \dfrac{1}{2}\ln\dfrac{x+1}{x-1}; |x| > 1$

DIFFERENTIATION OF INVERSE HYPERBOLIC FUNCTIONS

$\dfrac{d}{dx}(\sinh^{-1} u) = \dfrac{1}{\sqrt{1+u^2}}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\cosh^{-1} u) = \dfrac{1}{\sqrt{u^2-1}}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\tanh^{-1} u) = \dfrac{1}{1-u^2}\dfrac{du}{dx}, |u| < 1$

$\dfrac{d}{dx}(\coth^{-1} u) = \dfrac{1}{1-u^2}\dfrac{du}{dx}, |u| > 1$

$\dfrac{d}{dx}(\operatorname{sech}^{-1} u) = \dfrac{-1}{u\sqrt{1-u^2}}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\operatorname{cosech}^{-1} u) = \dfrac{-1}{|u|\sqrt{1+u^2}}\dfrac{du}{dx}$

HYPERBOLIC IDENTITIES

$\cosh^2 x - \sinh^2 x = 1$

$\operatorname{sech}^2 x = 1 - \tanh^2 x$

$\operatorname{cosech}^2 x = \coth^2 x - 1$

$\sinh 2x = 2\sinh x \cosh x$

$\cosh 2x = \cosh^2 x + \sinh^2 x$

$= 1 + 2\sinh^2 x$

$= 2\cosh^2 x - 1$

$\tanh 2x = \dfrac{2\tanh x}{1-\tanh^2 x}$

DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS

$\dfrac{d}{dx}(\sin u) = \cos u \dfrac{du}{dx}$

$\dfrac{d}{dx}(\cos u) = -\sin u \dfrac{du}{dx}$

$\dfrac{d}{dx}(\tan u) = \sec^2 u \dfrac{du}{dx}$

$\dfrac{d}{dx}(\cot u) = -\operatorname{cosec}^2 u \dfrac{du}{dx}$

$\dfrac{d}{dx}(\sec u) = \sec u \tan u \dfrac{du}{dx}$

$\dfrac{d}{dx}(\operatorname{cosec} u) = -\operatorname{cosec} u \cot u \dfrac{du}{dx}$

DIFFERENTIATION OF INVERSE TRIGONOMETRIC FUNCTIONS

$\dfrac{d}{dx}(\sin^{-1} u) = \dfrac{1}{\sqrt{1-u^2}}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\cos^{-1} u) = \dfrac{-1}{\sqrt{1-u^2}}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\tan^{-1} u) = \dfrac{1}{1+u^2}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\cot^{-1} u) = \dfrac{-1}{1+u^2}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\sec^{-1} u) = \dfrac{1}{u\sqrt{u^2-1}}\dfrac{du}{dx}$

$\dfrac{d}{dx}(\operatorname{cosec}^{-1} u) = \dfrac{-1}{u\sqrt{u^2-1}}\dfrac{du}{dx}$

HYPERBOLIC FUNCTIONS

$\sinh x = \dfrac{e^x - e^{-x}}{2}$

$\cosh x = \dfrac{e^x + e^{-x}}{2}$

DIFFERENTIATION OF HYPERBOLIC FUNCTIONS

$\dfrac{d}{dx}(\sinh u) = \cosh u \dfrac{du}{dx}$

$\dfrac{d}{dx}(\cosh u) = \sinh u \dfrac{du}{dx}$

INTEGRATION OF HYPERBOLIC FUNCTIONS

$\int \sinh u\, du = \cosh u + c$

$\int \cosh u\, du = \sinh u + c$

QUESTION 6

a) Solve the following equations: **CLO3:C3**

i. $\dfrac{dy}{dx} + 3y = e^{4x}$ (5 marks)

ii. $\dfrac{dy}{dx} = \dfrac{3x+4y}{3x}$ (9 marks)

b) Solve the following second order differential equations: **CLO3 : C3**

i. $\dfrac{d^2y}{dx^2} - 2\dfrac{dy}{dx} + 5y = 0$ (8 marks)

ii. $\dfrac{d^2y}{dx^2} + 6\dfrac{dy}{dx} + 9y = 0$ (3 marks)