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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Study Programme : Bachelor of Software Engineering Honours
Name of the Examination : Final Examination
Course Code and Title : EEZ3361/ECZ3161 Mathematics for computing
Academic Year : 2017/18
Date : 5th February 2019
Time : 0930hrs -1230hrs
Duration : **3 hours**

General Instructions

1. Read all the instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Five (5)** pages.
3. Answer any **Five (5)** questions only. All the questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Show the **intermediate steps** clearly.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

Q1

(a)

(i) By using the differentiation of the first principles, find the gradient of $f(x) = 5x^2 - 3x + 7$ at the point $x = -2$. **[4 Marks]**

(ii) Evaluate the limit $\lim_{x \to 0} \dfrac{\sin(\frac{\pi}{4} + x) - \sin(\frac{\pi}{4})}{x}$. **[4 Marks]**

(b) Find the first derivative of each of the following functions. **[6 Marks]**

(i) $f(x) = \dfrac{x \operatorname{cosec}(x)}{3 - \operatorname{cosec}(x)}$

(ii) $f(x) = (2e^{x^2} + x^2)^3$

(c) Find the equation of the line perpendicular to the graph of $y = \dfrac{\tan x}{1 + \tan x}$ at the point $x = \dfrac{\pi}{4}$. **[6 Marks]**

Q2

(a) Prove that the matrix $\begin{bmatrix} -i & 2+i \\ -2+i & 0 \end{bmatrix}$ is a skew-Hermitian matrix. **[4 Marks]**

(b)

(i) If A= $\begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$ and B = $\begin{bmatrix} 1 & 3 \\ 1 & 0 \end{bmatrix}$ show that $AB \neq BA$. **[3 Marks]**

(ii) If A= $\begin{bmatrix} 1 & 4 & 5 \\ 0 & 3 & 2 \\ -1 & 0 & 3 \end{bmatrix}$ and B = $\begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & 2 \\ 3 & 0 & 2 \end{bmatrix}$ find $2A - 3B$. **[3 Marks]**

(c) Show that the matrix $\begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ is the inverse matrix of the matrix $\begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$. **[10 Marks]**

Q3

(a) By using the integration by parts, find the indefinite integral **[6 Marks]**

$\int x^2 e^{3x} dx$.

(b) Evaluate following the definite integrals. **[8 Marks]**

(i) $\int_0^{\frac{\pi}{3}} \frac{\cos x + \cos x \tan^2 x}{2\sec^2 x} dx$ (ii) $\int_0^2 x(x^2-1)^7 dx$

(c) Find the partial fractions of $\frac{3}{(x-1)(x+1)^2}$.

[6 Marks]

Hence, find the indefinite integral $\int \frac{3}{(x-1)(x+1)^2} dx$.

Q4

(a) Evaluate the limit $\lim_{x\to 0} \frac{\cos x - 1}{x}$ **[4 Marks]**

(b) Find the first derivative of each of the following functions.

(i) $f(x) = 4x^4 - 2x + 3\tan x + 7$ **[4 Marks]**

(ii) $f(x) = \frac{4x^2 - 2x + 7}{x^3}$ **[4 Marks]**

(iii) $f(x) = [\ln \sqrt{x+1}]$ **[4 Marks]**

(iv) $f(x) = \sin 5x^3 + 2x$ **[4 Marks]**

Q5

(a) A pulley belt of length 300 cm takes 2 s to make a complete revolution. If the radius of the pulley is 150 mm, then find the angular velocity of a point on the rim of the pulley.

[4 Marks]

(b) Find the value of

(i) Sin x + Sin 2x + Sin 4x, when $x = 60^0$ **[4 Marks]**

(ii) Cos 4x – Cos 3x + Cos x, when $x = 120^0$ **[4 Marks]**

(c) Prove that

$$\frac{Tan\theta}{1+Sec\theta} - \frac{Tan\theta}{1-Sec\theta} = 2Co\sec\theta.$$ **[8 Marks]**

Q6

(a) Let $A = \begin{bmatrix} 1 & 4 & 5 \\ 0 & 3 & 2 \\ -1 & 0 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & 2 \\ 3 & 0 & 2 \end{bmatrix}$. Find $A^T B^T$ **[4 Marks]**

(b) Convert the following angles to given units.

(i) 102.4761^0 to Minutes, Seconds form. **[3 Marks]**

(ii) $57^0 27' 6''$ to decimal form. **[3 Marks]**

(c) Prove the following identity. **[10 Marks]**

$$\frac{(\tan x + \sec x - 1)}{(\tan x - \sec x + 1)} = \frac{(1+\sin x)}{\cos x}$$

Q7

(a) If P, Q and R are Boolean variables, then construct a truth table for (P→Q) ∧ (Q→R).

[4 Marks]

(b) Using the results of boolean algebra, minimize the following expressions.

(i) $(a + b)(a + b') = a.$ **[3 Marks]**

(ii) $(a(b + z(x + a')))' = a' + b'(z' + x')$ **[3 Marks]**

(c) If R, S, T, U and F are Boolean variables, then

(i) Simplify the following truth table by using Karnaugh map **[5 Marks]**

(ii) Write down the simplified expression. **[5 Marks]**

R	S	T	U	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

Q8

(a)

(i) Using Newton's backward interpolation formula and the following table, calculate an approximation value for f (7.5) correct to 9 decimal places.

[8 Marks]

x	1	2	3	4	5	6	7	8
y=f(x)	1	8	27	64	125	216	343	512

(ii) Assume that the equation $x^3 - 2x - 5 = 0$ has a root near 2. Using Newton-Raphson method, calculate an approximation value for the above root correct to 9 decimal places. **[8 Marks]**

(b) A girl thinks that she can read 240 pages of a book every day. However, in one week (7 days) she has read only 200 pages. Calculate the percentage error.

[4 Marks]

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