CHITTAGONG UNIVERSITY OF ENGINEERING & TECHNOLOGY

B. Sc. Engineering Level-1 Term-I, Final Examination 2020

Subject	:	Civil Engineering		
Paper	:	Engineering Mathematics – I (Math-101)		
Time	:	2 Hours 30 Minutes	Full Marks :	200
Date	:	23/11/2021		

(This examination is conducted according to the decision of 135th Academic Council Meeting)

Answer any TWO questions from EACH section. Use separate script for EACH section. The figures in the right margin indicate full marks. Use standard value if needed.

SECTION-A

Q.1. (a) Discuss the continuity at x=1 and differentiability at x=2 of the function (18)

$$f(x) = \begin{cases} x\,; & x < 1 \\ 2 - x\,; & 1 \le x \le 2 \\ -2 + 3x - x^2\,; & x > 2 \end{cases}$$

(b) Find the limit (12)

$$\lim_{x \to 0} \left(1 + {}^{x}\!/_{2}\right)^{2/x}$$

(c) If $x = \sin\left(\frac{1}{m} \ln y\right)$, show that (20)

$(1 - x^2) y_{n+2} - (2n + 1) x y_{n+1} - (n^2 + m^2) y_n = 0$

Q.2. (a) Discuss the applicability of Rolle's theorem to the function (16)

$$f(x) = \begin{matrix} x^2 + 1\,; & 0 \le x \le 1 \\ 3 - x\,; & 1 < x \le 2 \end{matrix}$$

(b) Expand $(\sin^{-1} x)^2$ in a series of ascending powers of x. (16)

(c) If $u = \tan^{-1} \frac{x^3 + y^3}{x + y}$ is a homogeneous function, then show that (18)

$x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin 2u$

Q.3. (a) If $F(x, y, z) = 0$, show that (20)

$\left(\frac{\partial x}{\partial y}\right)_z \left(\frac{\partial y}{\partial z}\right)_x \left(\frac{\partial z}{\partial x}\right)_y = -1$, where partial derivatives is computed by considering the other remaining variables constant.

(b) Prove that mth power of the subtangent varies as nth power of the sub normal of the curve $x^{m+n} = a^{m+n} y^{2n}$ (15)

(c) Find the maximum and minimum value of the function (15)

$$f(x, y) = x^3 + y^3 - 3x - 12y + 20$$

SECTION-B

Q.4. (a) Integrate following integrals (any three) (24)

i) $\int \frac{e^x(1+x)}{cos^2(xe^x)} dx$

ii) $\int \frac{\log(\log x)}{x} dx$

iii) $\int \frac{1}{\sqrt{x^2-4x+3}} dx$

iv) $\int \frac{xe^x}{(1+x)^2} dx$

(b) If $I_n = \int_0^{\pi/4} tan^n n dn$, then show that the reduction formula $I_n + I_{n-2} = \frac{1}{n-1}$. Hence find the value of I_5 (16)

(c) Evaluate the definite integrals (10)

$$\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\sin x}} dx$$

Q.5. (a) Test the convergence of the following integral (12)

$$\int_2^{\propto} \frac{x^2 - 1}{\sqrt{x^2 + 16}} dx$$

(b) Find the area of the parabola $y^2 = 4ax$ cut off by the letus rectum. (18)

(c) Find the volume of the solid generated by the revolution of an ellipse round its major axis is $\frac{4\pi ab^3}{5}$ (20)

Q.6. (a) Simplify $(\bar{A} + \bar{B}).(\bar{B} + \bar{C}) \times (\bar{C} + \bar{A})$ (10)

(b) Find the volume of the parallelepiped whose edges are represented by (12)

$$\vec{A} = 2\hat{\imath} - 3\hat{\jmath} + 4\hat{k}, \vec{B} = \hat{\imath} + 2\hat{\jmath} - \hat{k}, \vec{C} = 3\hat{\imath} - \hat{\jmath} + 2\hat{k}$$

(c) Find the workdone in moving an object along a straight line from (3,2,1) to (2,-1,4) in a force field given by $\vec{F} = 4\hat{\imath} - 3\hat{\jmath} + 2\hat{k}$ (14)

(d) A force given by $\vec{F} = 3\hat{\imath} + 2\hat{\jmath} - 4\hat{k}$ is applied at the point (1,-1,2). Find the moment of $\vec{F}$ about the point (2,-1,3). (14)

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