Roll No. 2400100 7034 .

Total Pages: 04

007102

December 2024

B.Tech. (Electrical) (First Semester)

Mathematics-1 (Calculus and Differential

Equations) (BSC103C)

Time: 3 Hours] [Maximum Marks: 75

Note: It is compulsory to answer all the questions

(1.5 marks each) of Part A in short. Answer

any four questions from Part B in detail.

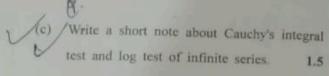
Different sub-parts of a question are to be
attempted adjacent to each other.

Part A

Evaluate the integral $\int_0^1 x^5 (1-x^3)^{10} dx$. 1.5 Use Taylor's Theorem to express the polynomial $2x^3 + 7x^2 + x - 6$ in powers of (x-2).

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(d) Prove that
$$div\left(\frac{\vec{r}}{r^3}\right) = 0$$
. 1.5

(e) Evaluate
$$\iint e^{2x+3y} dx dy$$
 over the triangle $x = 0$, $y = 0$ and $x + y = 1$.

Solve the differential equation: 1.5
$$(2xy + e^y)dx + (x^2 + xe^y)dy = 0.$$

(h) Define Clairaut's equation. Also find the general solution of the equation
$$p = \log(px - y).$$
1.5

$$\int_0^{\pi/2} \int_0^{a\cos\theta} r\sin\theta \, dr d\theta$$

Solve by the method of separation of variables
$$x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} = 0$$
. 1.5

Part B

- Show that the equation of the evolute of the parabola $x^2 = 4ay$ is $4(y 2a)^3 = 27ax^2$. 8
 - Verify Rolle's Theorem for the function $f(x) = x^3 3x^2 x 3$ in [1, 3] and also find the appropriate value of c.
- 3. (a) Discuss the convergence of the series : 8 $\frac{a+x}{1!} + \frac{(a+2x)^2}{2!} + \frac{(a+2x)^3}{3!} + \dots \infty$

(b) Find the Fourier series expansion of
$$f(x) = x + x^2$$
 for $-\pi < x < \pi$. Deduce that:

$$\frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \dots$$

