

B.Tech. I Semester (Main) Examination, Dec. - 2018

BSC

1FY2-01 Engineering Mathematics - I

Time : 3 Hours

Maximum Marks : 160

Instructions to Candidates:

Attempt all ten questions from Part A, any five questions out of seven from Part B and any four questions out of five from Part C. (Schematic diagrams must be shown wherever necessary). Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Part - A

(Answer should be given up to 25 words only). All questions are compulsory.

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(10×3=30)

1. What is the value of $\Gamma\left(-\frac{1}{2}\right)$.

2. Find the value of $\int_0^{\pi/2} \sin^6 \theta \cos^7 \theta d\theta$.

3. Find whether series $\sum \frac{n}{n+10}$ is convergent or not?

4. Give an example of two divergent series whose sum is convergent.

5. Find sum of Fourier series of $f(x)$ at $x = 2$ where $f(x) = \begin{cases} 0, 0 \leq x < 1 \\ 1, 1 \leq x < 2 \end{cases}$.

6. State Parseval's Theorem.

7. Give an example of two variable function whose both partial derivatives exist but limit does not exist at origin.

8. Find the directions in which $f(x, y) = \frac{x^2}{2} + \frac{y^2}{2}$ increases most rapidly at the point (1,1).
9. Suppose the force field $F = \nabla f$ is the gradient of the function $f(x, y, z) = -\frac{1}{(x^2 + y^2 + z^2)}$. Find the work done by F in moving an object along a smooth curve C joining (1,0,0) to (0,0,2) that does not pass through origin.
10. Find $\iint_S \vec{r} \cdot \hat{n} \, dS$ where S is a closed surface enclosing volume V and $\vec{r} = xi + yj + zk$.

Part - B

(Analytical/Problem solving questions). Attempt any five questions.

(5×10=50)

1. Find volume of the solid generated by the revolution of the curve $x = a \cos^3 \theta, y = a \sin^3 \theta$ about the x-axis.
2. Find Taylor series expansion of $f(x) = \cos 5x^2$ about the point $x = \pi$.
3. Obtain half range sine series for $f(x) = e^x$, in $0 < x < 1$.
4. If resistors of R_1, R_2 and R_3 ohms are connected in parallel to make an R-ohm resistor, find the value of $\partial R / \partial R_2$ when $R_1 = 30, R_2 = 45$ and $R_3 = 90$ ohms.
5. The derivative of $f(x, y)$ at $P_0(1, 2)$ in the direction of $i + j$ is $2\sqrt{2}$ and in the direction of $-2j$ is -3 . What is the derivative of f in the direction of $-i - 2j$?
6. Find the area of the region R in the xy-plane enclosed by the circle $x^2 + y^2 = 4$ above the line $y = 1$ and below the line $y = \sqrt{3}x$. <http://www.rtuonline.com>
7. Find the centroid of the region in the first quadrant that is bounded above by the line $y = x$ and below by the parabola $y = x^2$.

Part - C

(Descriptive/Analytical/Problem Solving/Design question). Attempt any four questions.

(4×20=80)

1. Find the value of $\int_0^{\infty} \cos x^2 \, dx$.

2. Discuss the convergence of the series $\sum \frac{\sqrt{n}}{\sqrt{n^2+1}} x^n$.
3. Find Fourier series representation of $f(x) = \begin{cases} 0, & -\pi \leq x \leq 0 \\ \sin x, & 0 < x < \pi \end{cases}$ and prove that
- $$\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \dots = \frac{1}{2}$$
4. The plane $x + y + z = 1$ cuts the cylinder $x^2 + y^2 = 1$ in an ellipse. Find the points on the ellipse that lie closest to and farthest from origin. <http://www.rtuonline.com>
5. Verify Stoke's theorem for the hemisphere $S: x^2 + y^2 + z^2 = 9, z \geq 0$, its bounding circle $C: x^2 + y^2 = 9, z = 0$, and the field $\vec{F} = y\vec{i} - x\vec{j}$.



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