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Faculty of Engineering & Technology
Second Semester B.E. (C.B.S.) Examination
APPLIED MATHEMATICS—II
Paper—I

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) Attempt **SIX** questions as follows :
Que. No. 1 **OR** Que. No. 2
Que. No. 3 **OR** Que. No. 4
Que. No. 5 **OR** Que. No. 6
Que. No. 7 **OR** Que. No. 8
Que. No. 9 **OR** Que. No. 10
Que. No. 11 **OR** Que. No. 12

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(2) Figures to the right indicate full marks.
(3) Use of non-programmable calculator is permitted.

1. (a) If $B(n, 3) = \frac{1}{3}$ and n is Positive Integer, find n. 5

(b) Using differentiation under Integral sign, evaluate

$$\int_0^\infty \frac{\tan^{-1} ax}{x(1+x^2)}\,dx.$$ 7

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OR

2. (a) A rod of length 'a' is divided at random into two parts. Find the mean value of the sum of the squares of these two segments. 6

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(b) Evaluate $\int_0^1 (x \log x)^3 dx$. 6

3. (a) Trace the curve $9ay^2 = (x - 2a)(x - 5a)^2$. 6

(b) Find the area of the loop of the curve $ay^2 = x^2(a - x)$. 6

OR

4. (a) If S is the arc of the curve $y^2 = x\left(1 - \frac{x}{3}\right)^2$ measured from the origin to the point (x, y). Show that

$$S^2 = y^2 + \frac{4}{3}x^2$$ 6

(b) Find the volume of the solid generated by revolution of the curve $y = \frac{a^3}{a^2 + x^2}$ about its asymptote. 6

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5. (a) Evaluate $\iint e^{2x+3y} dxdy$, over the triangle bounded by $x = 0$, $y = 0$ and $x + y = 1$. 6

(b) Evaluate $\int_0^a \int_0^x \frac{\cos y}{\sqrt{(a - x)(a - y)}} dydx$ by changing the order of integration. 6

(c) Evaluate $\iint (a^2 - x^2 - y^2)\,dxdy$, over the semicircle $x^2 + y^2 = ax$ in the Positive quadrant by changing into Polar co-ordinates. 6

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OR

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6. (a) Evaluate $\iint r\sin\theta\, dr d\theta$ over the cardioid $r = a(1 + \cos\theta)$ above the initial line. 6

(b) Find the mass of the area between $y = x^3$ and $x = y^2$ if $\rho = k(x^2 + y^2)$. 6

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(c) Evaluate $\int_{-1}^{1}\int_{0}^{2}\int_{x-2}^{x+2}(x + y + z)\,dydxdz$. 6

7. (a) Show that a vector $\bar{d} = x\bar{a} + y\bar{b} + z\bar{c}$, where x, y, z are Scalars can be expressed in the form

$$\bar{d} = \frac{[\bar{d}\,\bar{b}\,\bar{c}]\bar{a} + [\bar{d}\,\bar{c}\,\bar{a}]\bar{b} + [\bar{d}\,\bar{a}\,\bar{b}]\bar{c}}{[\bar{a}\,\bar{b}\,\bar{c}]}$$

where $[\bar{a}\,\bar{b}\,\bar{c}] \neq 0$. 5

(b) The position vector of a point at time t is given by $\bar{r} = e^t(\cos t\, i + \sin t\, j)$. Show that $\bar{a} = 2(\bar{v} - \bar{r})$, where $\bar{a}$, $\bar{v}$ are acceleration and velocity of a Particle. 7

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(c) Find the angle between the tangents to the curve $y = x^2$, $z = x^3$ at (1, 1, 1) and (–1, 1, –1). 6

OR

8. (a) Prove that :

$$(\bar{a} \times \bar{b}) \times (\bar{c} \times \bar{d}) = [\bar{a}\,\bar{c}\,\bar{d}]\bar{b} - [\bar{b}\,\bar{c}\,\bar{d}]\bar{a}.$$ 4

(b) Find the directional derivative of $\phi = 4e^{2x-y+z}$ at the point (1, 1, –1) in the direction towards the point (–3, 5, 6). 7

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(c) Show that $\bar{F} = (x^2 - yz)i + (y^2 - xz)j + (z^2 - xy)k$ is irrotational. Also find its Scalar Potential. 7

9. Using the line integral, compute the work done by the force $\bar{F} = (2y + 3)i + xzj + (yz - x)k$ when it moves a particle from the point (0, 0, 0) to the point (2, 1, 1,) along the curve $x = 2t^2$, $y = t$, $z = t^3$. 7

OR

10. Use Divergence theorem to evaluate $\iint_S \bar{F}\cdot\hat{n}\, ds$ where $\bar{F} = 4xi - 2y^2j + z^2k$ and S is the surface bounding the region $x^2 + y^2 = 4$, $z = 0$, $z = 3$. 7

11. (a) Fit a curve of the form $y = ae^{bx}$ to the following data :

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x	1	2	3	4	5	6
y	14	27	40	55	68	300

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(b) Obtain the function whose first difference is $x^3 + 3x^2 + 5x + 12$. 6

OR

12. (a) Obtain the rank correlation coefficient for the following data :

x	25	28	39	25	24	30	48	45	38	25
y	44	34	28	32	34	29	35	42	24	30

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(b) Solve $(E^2 - 5E + 6)\, y_n = 4^n(n^2 - n + 5)$. 6