

CBCS SCHEME

18MATDIP31

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Third Semester B.E. Degree Examination, Aug./Sept.2020

Additional Mathematics – I

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Prove that $(1+i)^n + (1-i)^n = 2^{\frac{n}{2}+1} \cos \frac{n\pi}{4}$ (08 Marks)
- b. Express the complex number $(2+3i) + \frac{1}{1-i}$ in the form $a+ib$. (06 Marks)
- c. Find the modulus and amplitude of the complex number $1 - \cos\alpha + i \sin\alpha$. (06 Marks)

OR

- 2 a. If $\vec{A} = i + 2j - 3k$, $\vec{B} = 3i - j + 2k$ show that $\vec{A} + \vec{B}$ is perpendicular to $\vec{A} - \vec{B}$. Also find the angle between $2\vec{A} + 3\vec{B}$ and $\vec{A} + 2\vec{B}$. (08 Marks)
- b. Show that the vectors $i - 2j + 3k$, $2i + j + k$, $3i + 4j - k$ are coplanar. (06 Marks)
- c. Find the sine of the angle between $\vec{A} = 4i - j + 3k$ and $\vec{B} = -2i + j - 2k$. (06 Marks)

Module-2

- 3 a. Obtain the Maclaurin's series expansion of $\sin x$ upto term containing x^4 . (08 Marks)
- b. If $u = \sin^{-1} \left[\frac{x^2 + y^2}{x - y} \right]$ prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \tan u$. (06 Marks)
- c. If $u = f(x - y, y - z, z - x)$ prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$. (06 Marks)

OR

- 4 a. Prove that $\log(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots$ by using Maclaurin's series. (08 Marks)
- b. If $x = r \cos \theta$, $y = r \sin \theta$ find $\frac{\partial(x,y)}{\partial(r,\theta)}$. (06 Marks)
- c. If $z = e^{ax+by} f(ax-by)$ then show that $b \frac{\partial z}{\partial x} + a \frac{\partial z}{\partial y} = 2abz$. (06 Marks)

Module-3

- 5 a. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$ (08 Marks)
- b. Find the unit vector normal to the surface $x^2y + 2xz = 4$ at $(2, -2, 3)$. (06 Marks)
- c. Show that the vector $(-x^2 + yz)i + (4y - z^2x)j + (2xz - 4z)k$ is solenoidal. (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8 = 50, will be treated as malpractice.

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OR

- 6 a. A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = 2t + 3$ where t is the time. Find the components of its velocity and acceleration at $t = 1$ in the direction $i + j + 3k$. (08 Marks)
- b. Find the values of a , b , c such that $\vec{F} = (x + y + az)i + (bx + 2y - z)j + (x + cy + 2z)k$ is irrotational. (06 Marks)
- c. Find $\text{div} \vec{F}$ and $\text{curl} \vec{F}$ where $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$. (06 Marks)

Module-4

- 7 a. Obtain the reduction formula for $\int_0^{\pi/2} \cos^n x \, dx$, $n > 0$. (08 Marks)
- b. Evaluate $\int_0^1 \frac{x^9}{\sqrt{1-x^2}} \, dx$ (06 Marks)
- c. Evaluate $\iint xy(x+y) \, dx \, dy$ over the area between $y = x^2$ and $y = x$. (06 Marks)

OR

- 8 a. Obtain the reduction formula for $\int_0^{\pi/2} \sin^n x \, dx$, $n > 0$. (08 Marks)
- b. Evaluate $\int_0^{\infty} \frac{x^2}{(1-x^2)^{7/2}} \, dx$ (06 Marks)
- c. Evaluate $\int_0^a \int_0^x \int_0^{x+y} e^{x+y+z} \, dz \, dy \, dx$ (06 Marks)

Module-5

- 9 a. Solve $y(\log y)dx + (x - \log y)dy = 0$ (08 Marks)
- b. Solve $x \frac{dy}{dx} + y = x^3 y^6$ (06 Marks)
- c. Solve $(xy^2 - e^{1/x^3})dx - x^2 y \, dy = 0$ (06 Marks)

OR

- 10 a. Solve $(5x^4 + 3x^2 y^2 - 2xy^3) \, dx + (2x^3 y - 3x^2 y^2 - 5y^4) \, dy = 0$ (08 Marks)
- b. Solve $\frac{dy}{dx} + x \sin 2y = x^3 \cos^2 y$ (06 Marks)
- c. Solve $(xy^3 + y)dx + 2(x^2 y^2 + x + y^4) \, dy = 0$ (06 Marks)
