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MATDIP301

Third Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Advanced Mathematics – I

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions
2. Mathematics formulae handbook is allowed.

- 1 a. Find the modulus and amplitude of the complex number $1+i\sqrt{3}$. (06 Marks)
- b. Express the complex number $\frac{1}{3+2i}$ in the form $x+iy$. (06 Marks)
- c. Find the multiplication between two complex numbers $-6i(2-3i)$ (08 Marks)
- 2 a. Express the complex number $\frac{1+i}{1-i}$ in the form $x+iy$. (06 Marks)
- b. Find the addition between two complex numbers $(5-2i)+(7+3i)$ (06 Marks)
- c. Define complex number and find the value of x and y , if $x+iy=(1+i)(4-3i)$. (08 Marks)
- 3 a. Find the n^{th} order derivative of $\sin(ax+b)$. (06 Marks)
- b. With the usual notation prove that $\tan\theta = r\frac{d\theta}{dr}$, where θ is the angle between the radius vector and the tangent. (06 Marks)
- c. Obtain the Maclaurin's series expansion of the function $\sin x$. (08 Marks)
- 4 a. Find the n^{th} order derivative of $\cos(ax+b)$. (06 Marks)
- b. Find the angle between the radius vector and the tangent for the polar curve $r = a(1-\cos\theta)$. (06 Marks)
- c. Find the angle of intersection for the polar curves $r = 2\sin\theta$, $r = \sin\theta + \cos\theta$. (08 Marks)

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- 5 a. If $u = x^3 - 3xy^2 + x + e^x \cos y + 1$, then show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$. (06 Marks)
- b. If $u = x^2 - 2y$ and $v = xy$, then find the value of $\frac{\partial(u,v)}{\partial(x,y)}$. (06 Marks)
- c. If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$. (08 Marks)
- 6 a. If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$, then show that $xu_x + yu_y = 1$. (06 Marks)
- b. If $u = x+y$, $v = y+z$, $w = z+x$, then find the value of $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. (06 Marks)
- c. If $u = f(x-y, y-z, z-x)$, then show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$. (08 Marks)
- 7 a. Obtain the reduction formula for $\int \cos^n x \, dx$, where n is positive integer. (06 Marks)
- b. Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy \, dy \, dx$. (06 Marks)
- c. Derive the relationship between Beta and Gamma functions,
$$\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$$
 (08 Marks)
- 8 a. Evaluate $\int_0^1 \int_1^3 xy^2 \, dx \, dy$. (06 Marks)
- b. Prove that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$. (06 Marks)
- c. Evaluate $\int_{-1}^1 \int_{-2}^2 \int_{-3}^3 dx \, dy \, dz$. (08 Marks)

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