

Most Repeated Questions in BMATS101 (VTU 2022 CBCS Scheme)

Module 1: Differential Calculus in Polar Coordinates

- 1. Prove that $\tan(\theta) = r \frac{d\theta}{dr}$
- 2. Prove that $\frac{1}{r^2} = \frac{1}{r^2} + \left(\frac{1}{r}\right)\left(\frac{dr}{d\theta}\right)^2$
- 3. Find the angle between curves like $r = a \log(\theta)$ and $r = a / \log(\theta)$
- 4. Show that the curves $r = a(1 + \sin\theta)$ and $r = a(1 - \sin\theta)$ are orthogonal
- 5. Find pedal equations of curves like $r = a / (1 + \cos\theta)$
- 6. Radius of curvature for curves like cycloids or $y^2 = (function of x)$

Module 2: Partial Derivatives & Expansions

- 1. Expand $\log(\sec x)$ or $\log(1 + \sin x)$ using Maclaurin series up to x
- 2. Prove derivative identities like for $u = e^{(ax + by)}f(ax - by)$
- 3. Show: $x(u/x) + y(u/y) + z(u/z) = 0$ for specific u
- 4. Find extreme values of $f(x, y)$, e.g., $x^3 + 3xy^2 - 3y^2 - 3x^2 + 4$
- 5. Evaluate limits using definition-based approaches

Module 3: Differential Equations

- 1. Solve $dy/dx + y/x = x^2y$ (appears in almost every paper)
- 2. Orthogonal trajectories for $x^2/a^2 + y^2/(b^2 + \theta) = 1$ or $r = a(1 + \cos\theta)$
- 3. Solve Clairaut-type equations like $(px - y)(py + x) = a^2p$

Module 4: Number Theory & Cryptography

- 1. Find last digits or remainders for powers like 72013, 1337, etc.
- 2. Solve linear congruences like $11x \equiv 4 \pmod{25}$
- 3. RSA encryption problems with primes (e.g., Encrypt 'STOP' using RSA)
- 4. Use Fermat's Little Theorem or CRT in number theory problems

Module 5: Linear Algebra

- 1. Find rank of given 4x4 matrices (same matrix appears multiple times)
- 2. Solve systems of equations using Gauss-Jordan/Seidel/Elimination
- 3. Use power method to find largest eigenvalue (6 iterations usually)
- 4. Test consistency and solve systems