

M.A. Semester - I (External)  
Mathematics  
MAT406 Short Essays

The Syllabus for MAT406 Short Essays will consist of syllabi of all papers MAT401 to MAT405.

The short essays such as the following may be asked around which student will have to write essays (Two out of five) of about 1000 words (including formulae and relevant equations).

1. Maxima and Minima of Functions of Several Variables
2. Implicit Function Theorem & Inverse Function Theorem
3. Convexity
4. Complete Metric Spaces
5. Characterizations of Compact Metric Spaces
6. Cauchy Sequences in Metric Spaces
7. Cauchy- Riemann Equations in Complex Analysis
8. Cauchy & Cauchy- Goursat Theorem in Complex Analysis
9. Exponential and Logarithmic Functions
10. General Solution of Second order Linear Equation  $y'' + P(x)y' + Q(x)y = 0$  near ordinary points
11. Legendre Polynomials and their properties
12. General Solution of Bessel's Equation
13. Explain the definition of Riemann Integration on bounded functions on  $[a, b]$  and give some useful characterisations of Riemann Integrable functions. Further discuss the need to introduce Lebesgue Integration
14. Explain gradually how the concept of length for intervals can be used to define measure for arbitrary set of reals. Provide appropriate illustrations in support of your arguments.
15. Existence of Non-measurable Sets and Non-measurable functions.

M.A. Semester - II (External)  
Mathematics  
MAT412 Short Essays

The Syllabus for MAT412 Short Essays will consist of syllabi of all papers MAT407 to MAT411.

The short essays such as the following may be asked around which student will have to write essays (Two out of five) of about 1000 words (including formulae and relevant equations).

1. Discuss signed curvature for plane curves. Discuss curvature, torsion and the Frenet-Serret equations for space curves.
2. Discuss smooth surfaces, their tangent planes and their orientability.
3. Discuss the First Fundamental Form and its relation to lengths of curves on surfaces, isometrics of surfaces and surface area.
4. Applications of factor group.
5. Structure of Finite Abelian groups.
6. Burnside's theorem and applications.
7. Power Series in Complex Analysis
8. Applications of Residues in finding certain Integrals.
9. Bilinear transformations (Linear Fractional Transformations (Möbius Transformations)).
10. Charpit's method for finding a complete integral of a first order p.d.e.  $f(x,y,z,p,q) = 0$ .
11. Explain the geometry of solutions of quasi-linear equations.
12. The Dirichlet (exterior and interior) problem for a circle.
13. Explain the meaning of pointwise convergence and convergence in measure for a sequence of functions. Discuss how these two concepts of convergence are linked to each other.
14. Discuss the results regarding the structure of measurable functions.
15. Write a short note on dense subsets of  $L_p[a, b]$ .

M.A. Semester - III (External)  
Mathematics  
MAT506 Short Essays

The Syllabus for MAT506 Short Essays will consist of syllabi of all papers MAT501 to MAT505.

The short essays such as the following may be asked around which student will have to write essays (Two out of five) of about 1000 words (including formulae and relevant equations).

1. Explain: 'On a finite dimensional vector space all norms are equivalent'.
2. For  $T \in B(N)$ , give different definitions of  $\|T\|$  and discuss their equivalence.
3. What is parallelogram law? Explain how it can be used to characterise Hilbert spaces among all complex Banach spaces.
4. Maximal ideals of  $C[0,1]$ .
5. Prime and irreducible elements in algebraic number fields.
6. Finite fields.
7. Fundamental theorem of arithmetic.
8. Euler's function  $\phi(n)$ .
9. Möbius function  $\mu(n)$ .
10. Applications of Linear Programming
11. MODI's Method for transportation problem and Degeneracy
12. Methods for optimizing Non Linear Programming problems
13. Discuss differential forms, the exterior differential of differential forms and the operation # for differential forms.
14. Discuss the divergence theorem.
15. Discuss the transformation of integrals under regular transformations  $\bar{g} : \Delta \rightarrow D, \bar{g}$  onto,  $\Delta$  and  $D$  open subsets of  $E^n$ .

M.A. Semester - IV (External)  
Mathematics  
MAT512 Short Essays

The Syllabus for MAT512 Short Essays will consist of syllabi of all papers MAT507 to MAT511.

The short essays such as the following may be asked around which student will have to write essays (Two out of five) of about 1000 words (including formulae and relevant equations).

1. Spectral theorem for normal operators on  $H$ .
2. Compact operators on  $B(N)$ .
3. Classification of spectral values of operators on  $B(N)$ .
4. Write a short note on the uniqueness theorem.
5. Write a short note on the size of Fourier coefficients of  $C^k$  functions, absolutely continuous functions and functions of finite variation.
6. Explain: "Continuity is enough for cesaro sumability but not for pointwise summability of the Fourier series".
7. Laplace transform.
8. Fourier transform.
9.  $Z$  – transform.
10. EOQ models with and without shortages.
11. Characteristics of Queuing System.
12. Basic of Simulation with example.
13. Discuss the Second Fundamental Form, the normal curvature of a curve on a surface, and the principal curvatures of the surface.
14. Discuss the Gaussian and Mean Curvatures and the Gauss map.
15. Discuss the Gauss-Bonnet theorem.