

Exam Topic Area: Mathematics

Questions on the exam will be thought-provoking, but can be solved with a thorough understanding of the foundations of the topic area. Question difficulty will generally be at the level of challenging undergraduate material, and often require understanding and application of multiple concepts to come to the correct solution.

Questions will test the student on fundamental mathematics, more specifically integral and differentiation calculus, multivariable calculus, ordinary differential equation and matrix algebra.

Reference List:

- Stewart, J. *Calculus, Early Transcendentals*, 8th ed., Cengage Learning, Boston, MA, 2016.
- Kreyszig, E. *Advanced Engineering Mathematics*, 10th ed., Wileys & Sons, Danvers, MA, 2011.

Questions will be drawn from the following list of topics, within the frame of the above reference list:

- Limits, continuity, derivatives
- Differentiation of basic functions, product rule, quotient rule, chain rule, implicit differentiation
- Find maxima and minima, mean value, L'Hôpital rule
- Definite and indefinite integrals, fundamental theorem of calculus
- Integration of basic functions, integration by parts, partial fractions
- Infinite sequences and series, integral, convergence and comparison tests, power series, Taylor series
- Linear and nonlinear 1st-order ODEs, linear 2nd- and higher-order ODEs, phase-plane portraits for 2nd-order ODEs
- Definition and fundamental properties of Laplace transforms, Laplace transforms of basic functions, solving ODEs using Laplace transforms
- Vector differential calculus, gradient, divergence, curl
- Vector product, inner product, divergence of vectors
- Vector integral calculus, integral theorem, divergence theorem, Stokes' theorem
- Path, surface, and volume integrals
- Matrices, determinants, systems of linear equations
- Eigenvalues, eigenvectors, diagonalization, quadratic forms
- Vector, vector spaces, rank of a matrix
- Symmetric, skew-symmetric, and orthogonal matrices

Undergraduate courses offered in this area:

Courses listed here are for your reference only and may be helpful for relearning/reviewing the material. Questions on the exam are limited by the topics list and reference list, not by the material covered in these courses. Roughly speaking, the exam is expected to have one question per course.

- MA 113 – CALCULUS I
- MA 114 – CALCULUS II
- MA 213 – CALCULUS III
- MA 214 – CALCULUS IV
- MA 322 – MATRIX ALGEBRA AND ITS APPLICATIONS