# MTH102: Mathematics I

**Programme**: B.Tech. **Year:** Ist Year **Semester :** Odd
**Course:** Core/Math **Credits:** 4 **Hours :** 40

**Course Context and Overview (100 words):**

The main purpose of this course is to provide students the fundamental concepts of real number system, calculus, differentiation, integration and their applications, which would enable them to devise engineering solutions for given real world situations they may encounter in their profession. This course is a continuation of the mathematics undertaken in 10+2 level and provides students with the necessary mathematical tools to solve analytical problems adequately. Calculus is clearly essential for any undergraduate student of any engineering discipline. It gives the student ability & background to go beyond routine manipulations of formulas and develops the tendency to think deductively, analyze mathematical situations and extend ideas to new contexts.

**Prerequisites Courses:** None

**Course outcomes(COs):**

| On completion of this course, the students will have the ability to: |
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| **CO1** learn the elementary calculus and its applications to various fields. |
| **C02** use logical notation to define and reason about fundamental mathematical concepts |
| **C03** evaluate elementary mathematical arguments and identify a fallacious reasoning (not just fallacious conclusions) |
| **C04** learn the techniques of integration and differentiation and their use in many areas of science and engineering |

**Course Topics:**

| Topics | Lecture Hours | |
|---|---|---|
| **UNIT - I**<br>**1. Calculas of Functions of One Variable** | | |

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|---|---|---|
| **1.1** Elementary set theory and logic, Real number system: Completeness axiom, density of rationals (irrationals) in R. | 4 | 14 |
| **1.2** Convergence of a sequence, Sandwich theorem, Monotone sequences. Cauchy criterion, Subsequence, Every bounded sequence has a convergent subsequence, convergence of a sequence satisfying Cauchy criterion. | 2 | |
| **1.3** Convergence of series, Geometric and Harmonic series, Absolute convergence, Comparison test, Ratio test, Root test, Examples, Leibniz's theorem, Power series, Radius of convergence, Taylor series, Maclaurin series. | 3 | |
| **1.4** Limits and Continuity of functions, Boundedness of a continuous function on [a,b], Existence of max of a continuous function on [a,b], Intermediate value property, Differentiability, Necessary condition for local maxima, Rolles theorem and Mean value theorem, Cauchy mean value theorem, L'Hospital rule, Increasing and decreasing functions, Convexity, Second derivative test for max and min, Point of inflection, Curve sketching, Taylor's theorem, | 5 | |
| **UNIT - II**<br>**2. Riemann Integration & Applications** | | 8 |
| **2.1** Introduction to Riemann integration, The integral existence theorem for continuous functions and monotone functions, Elementary properties of integral, Fundamental theorems of integral calculus, Improper integral of first & second kind, Comparison test, Absolute convergence. | 5 | |
| **2.2** Applications of definite integral: Area between two curves, polar coordinates, Graphs of polar coordinates, Area between two curves when their equations are given in polar coordinates, Area of surface of revolution, Arc length in various coordinates, | 3 | |
| **UNIT - III**<br>**3. Calculus of Functions of More than One Variable** | | 8 |
| **3.1** Functions of several variables, Continuity, Partial derivatives, differentiability, Continuity, Increment theorem, Chain rule, | 3 | |
| **3.2** Gradient, Directional derivatives,<br>Mixed derivative theorem, Mean value theorem (MVT), Extended MVT, Hessian | 2 | |

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|---|---|---|
| **3.3** Necessary and sufficient conditions for Maxima, Minima and Saddle point, Applications of maxima/ minima for functions of two variables, Lagrange multiplier method | 3 | |
| **UNIT - IV**<br>**4. Multiple Integrals & Applications** | | 10 |
| **4.1** Double integral, Fubini's theorem, Volumes and Areas, Change of variable in a double integral, special case: Polar coordinates, Triple integral, Change of variables in a triple integral, Special cases : Cylindrical and Spherical coordinates, Surface area, | 4 | |
| **4.2** Surface integrals, Line integrals, Vector fields, Divergence and Curl of a vector field | 2 | |
| **4.3** Green, Gauss and Stokes Theorem (without proofs) and their Applications | 4 | |

**Textbook references (IEEE format):**

**Text Book:**

**1.** G. B. Thomas and R. L. Finny, **"Calculus and Analytic Geometry"** 11th Edition, Pearson

**Reference books:**

**1.** Robert G. Bartle and Donald R. Sherbert, **"Introduction to Real Analysis"**, Wiley.

**2.** Ajit Kumar and S. Kumaresan, **"A Basic Course in Real Analysis", CRC Press**

**Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):**

**Evaluation Methods:**

| Item | Weightage |
|---|---|
| Quizzes | 20% |
| Attendance | |
| Midterm Exam | 30% |
| Final Examination | 50% |

**Prepared By:**

**Last Update:** 20th March 2016

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