**LOK JAGRUTI UNIVERSITY (LJU)**

**INSTITUTE OF ENGINEERING AND TECHNOLOGY**

**Department of Chemical Engineering (708)**

**Bachelor of Engineering (B.E.) – Semester – I**

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| **Course Code:** | **017081191** |  | **Teaching Scheme** | | | | |
| **Course Name:** | **Mathematics - I** |  | **Lecture (L)** | **Tutorial (T)** | **Practical (P)** | **Credit** | **Total Hours** |
| **Category of Course:** | Basic Science Course (BSC) |  | **4** | **2** | **0** | **6** | **60** |
| **Prerequisite Course:** | --- |  |

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| **Syllabus** | | | | | |
| **Unit No.** | **Topic** | | **Prerequisite Topic** | **Successive Topic** | **Teaching Hours** |
| **01** | **Basic Algebra** | | | | **1**  **(2%)** |
| 1.1 Indices | | --- | --- |
| 1.2 Surds | | --- |
| 1.3 Expansions and factorization | | Optimization Models (017083602-Unit-3),  Unconstrained Multivariable Optimization: Direct Methods (017083602-Unit-5) |
| 1.4 Logarithm | | --- |
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| **02** | **Trigonometry and Geometry** | | | | **2**  **(3%)** |
| 2.1 Angles | | --- | --- |
| 2.2 Trigonometric functions And Hyperbolic functions | | --- |
| 2.3 Trigonometric functions of sum  and difference of two angles | | --- |
| 2.4 Inverse trigonometric functions | | --- |
| 2.5 Law of sines and cosines | | --- |
| 2.6 Area of geometric curves | | --- |
| 2.7 Volume of geometric curves | | --- |
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| **03** | **Basic Differentiation and Integration** | | | | **3**  **(5%)** |
| 3.1 Basic differentiation by formulae | | --- | Interpretation of Batch Reactor Data (017083601-Unit-2),  Stability(017083501-Unit-5),  Optimization of Unconstrained Functions(017083602-Unit-4), Unconstrained Multivariable Optimization: Indirect Methods (017083602-Unit-6),  Constrained Optimization (017083602-Unit-7),  Shell Momentum Balance and Velocity Distribution in Laminar’s Flow (017083501-Unit-3),  Equation of Changes (017083501-Unit-4),  Shell Energy Balance and Temperature Distribution in Solids (017083501-Unit-6),  Connective Heat Transfer (017083501-Unit-7),  Shell Mass Balance and Concentration Distribution in Solids (017083501-Unit-9) |
| 3.2 Product and quotient rule | | --- |
| 3.3 Chain rule and composite function | | --- |
| 3.4 Basic integration by formulae | | --- | Optimization of Unconstrained Functions (017083602-Unit-4),  Shell Momentum Balance and Velocity Distribution in Laminar’s Flow (017083501-Unit-3),  Equation of Changes (017083501-Unit-4),  Shell Energy Balance and Temperature Distribution in Solids (017083501-Unit-6),  Connective Heat Transfer (017083501-Unit-7),  Concentration Distribution in Solids (017083501-Unit-9) |
| 3.5 Integration by parts | | --- |
| 3.6 Roll’s theorem | | Basic differentiation (017081191-Unit-3) |  |
| 3.7 Lagrange’s theorem | | --- |
| 3.8 Cauchy’s mean value theorem | | --- |
| 3.9 Indeterminate forms and L’Hospital’s rule | | --- |
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| **04** | **Sequence and Series** | | | | **12**  **(20%)** |
| 4.1 Convergence and divergence of sequences | | --- | --- |
| 4.2 Sandwich theorem for sequences | | --- | --- |
| 4.3 Continuous function theorem for sequences, bounded monotonic sequences | | --- | --- |
| 4.4 Convergence and divergence of an infinite series. | | --- | --- |
| 4.5 Geometric series, telescoping series, combining series, harmonic series | | --- | --- |
| 4.6 Integral test and p- series test | | --- | --- |
| 4.7 Comparison test | | p- series test, Geometric series test (017081191-Unit-4) | --- |
| 4.8 Ratio test, Raabe’s test | | --- | --- |
| 4.9 Root test, alternating series test | | --- | --- |
| 4.10 Absolute and conditional convergence | | p- series test, Geometric series test, Comparison test,  Ratio test, Raabe’s test, Root test, alternating series test  (017081191-Unit-4) | --- |
| 4.11 Radius of convergence of a power series | | --- |
| 4.12 Taylor’s series | | Basic differentiation (017081191-Unit-3) | --- |
| 4.13 Maclaurin’s series | | --- |
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| **05** | **Partial Derivatives** | | | | **6**  **(10%)** |
| 5.1 Functions of several variables | | --- | --- |
| 5.2 Geometric interpretation of partial derivatives | | --- | --- |
| 5.3 Limits and continuity of function of several variables | | --- | --- |
| 5.4 First and higher order partial derivatives | | Basic differentiation (017081191-Unit-3) | --- |
| 5.5 Euler’s theorem and modified Euler’s theorem | | Basic differentiation (017081191-Unit-3) | --- |
| 5.6 Total derivatives and chain rule | | First and higher order partial derivatives (017081191-Unit-5) | --- |
| 5.7 Implicit function | | --- |
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| **06** | **Application of Partial Derivatives** | | | | **6**  **(10%)** |
| 6.1 Tangent plane and normal line | | First order partial derivatives (017081191-Unit-5) | --- |
| 6.2 Total differentiation and approximation | | --- |
| 6.3 Extreme values | | First and higher order partial derivatives (017081191-Unit-5) | --- |
| 6.4 Method of Lagrange multipliers. | | --- |
| 6.5 Jacobian | | First order partial derivatives (017081191-Unit-5) | --- |
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| **07** | **Multiple Integral** | | | | **12**  **(20%)** |
| 7.1 Double integral over rectangles and general regions | | Basic integration (017081191-Unit-3) | --- |
| 7.2 Change of order of integration | | Double integral over rectangles and general regions (017081191-Unit-7) | --- |
| 7.3 Double integration in polar coordinates | | Basic integration (017081191-Unit-3) | --- |
| 7.4 Change of variables in double integration by Jacobian | | --- |
| 7.5 Triple integration | | --- |
| 7.6 Area enclosed by plane curve using double integration | | Double integral over rectangles and general regions, Double integration in polar coordinates (017081191-Unit-7) | --- |
| 7.7 Triple integration in cylindrical and spherical co-ordinates | | Triple integration (017081191-Unit-7) | --- |
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| **08** | **Complex Numbers** | | | | **6**  **(10%)** |
| 8.1 Complex numbers | | --- | --- |
| 8.2 Geometrical representation of complex numbers | | --- | --- |
| 8.3 Algebra of complex numbers | | --- | --- |
| 8.4 Different forms of complex numbers | | --- | --- |
| 8.5 Modulus and argument (or amplitude) of complex numbers | | --- | --- |
| 8.6 Properties complex numbers | | --- | --- |
| 8.7 De Moivre’s theorem | | --- | --- |
| 8.8 Circular and hyperbolic functions | | --- | --- |
| 8.9 Logarithm of a complex number | | **---** | --- |
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| **09** | **Vector Calculus-I** | | | | **6**  **(10%)** |
| 9.1 Vector and its properties | | --- | --- |
| 9.2 Parametrization of curves | | --- | --- |
| 9.3 Arc length of curve in space | | Basic integration (017081191-Unit-3) | --- |
| 9.4 Gradient of a scalar point function and surface normal vector | | First order partial derivatives (017081191-Unit-5) | --- |
| 9.5 Directional derivatives | | Gradient (017081191-Unit-9) | --- |
| 9.6 Divergence of vector field | | First order partial derivatives (017081191-Unit-5) | --- |
| 9.7 Curl of vector field | | --- |
| 9.8 Scalar potential function of conservative field | | --- |
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| **10** | **Vector Integral** | | | | **6**  **(10%)** |
| 10.1 Line integral | | Basic integration (017081191-Unit-3) | --- |
| 10.2 Work done | | Line integral (017081191-Unit-10) | --- |
| 10.3 Circulation and Flux | | Line integral (017081191-Unit-10) | --- |
| 10.4 Green’s theorem in the plane(without proof) | | Line integral (017081191-Unit-10), Double integral over rectangles and general regions (017081191-Unit-8) | --- |

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| **Proposed Theory + Practical Evaluation Scheme by Academicians  (% Weightage Category Wise and it’s Marks Distribution)** | | | | | |
| **L :** | **4** | **T:** | **2** | **P:** | **0** |
| **Note : In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.  Each Test will be of 25 Marks. Each Test Syllabus Weightage: Range should be 20% - 30%** | | | | | |
| **Group (Theory or Practical)** | **Group (Theory or Practical) Credit** | **Total Subject Credit** | **Category** | **% Weightage** | **Marks Weightage** |
| Theory | **6** | **6** | MCQ | 15% | 15 |
| Theory | Theory Descriptive | 0% | 0 |
| Theory | Formulas and Derivation | 10% | 10 |
| Theory | Numerical | 75% | 75 |
| **Expected Theory %** | **100%** | **Calculated Theory %** | **100%** | **100** |
| Practical | **0** | Individual Project | 0% | 0 |
| Practical | Group Project | 0% | 0 |
| Practical | Internal Practical Evaluation (IPE) | 0% | 0 |
| Practical | Viva | 0% | 0 |
| Practical | Seminar | 0% | 0 |
| **Expected Practical %** | **0%** |  | **Calculated Practical %** | **0%** | **0** |
| **Overall %** | **100%** |  |  | **100%** | **100** |

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| **Course Outcome** | |
|  | *Upon completion of the course students will be able to* |
| CO1 | Evaluate exponential, trigonometric and hyperbolic functions of a complex number and To apply the various tests of convergence to sequence, series and the tool of power series for learning advanced Engineering Mathematics. |
| CO2 | Apply the knowledge to solve some practical problems, such as constrained optimization problems and other problems involving Partial differentiation |
| CO3 | Evaluate a double integral in polar coordinates. Reverse the order of integration for a double integral. Evaluate a triple integral to find volume in rectangular coordinates, cylindrical coordinates, and spherical coordinates. To compute the areas and volumes using multiple integral techniques. |
| CO4 | Calculate directional derivatives and gradients. Apply gradient to solve problems involving normal vectors to level surfaces. Explain the concept of a vector integration a plane and in space. |
| **Suggested Reference Books** | |
| 1 | Calculus with Early Transcendental Functions, James Stewart, Cengage Learning. |
| 2 | Thomas’ Calculus, Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education. |
| 3 | Higher Engineering Mathematics, B.S.Grewal, Khanna Publishers. |
| 4 | Advanced Engineering Mathematics, Erwin Kreysig, Wiley Publication. |

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| **List of Open Source Software/Learning website** | |
| 1 | https://nptel.ac.in |