**Course Learning Syllabus** (// includes Learning Outcomes & Learning Plan & Assessment Plan)

| Course Code | 18MAB102T | Course Name | ADVANCED CALCULUS AND COMPLEX ANALYSIS | Course Category | B | Basic Sciences | L | T | P | C |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 3 | 1 | 0 | 4 |

| Pre-requisite Courses | 18MAB 101T | Co-requisite Courses | Nil | Progressive Courses | Nil |
|---|---|---|---|---|---|
| Course Offering Department | Mathematics | | Data Book / Codes / Standards | | Nil |

| Course Learning Rationale (CLR): | The purpose of learning this course is to: | Learning | | | | Program Learning Outcomes (PLO) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLR – 1: | Evaluate Double and Triple Integral and apply them in problems in Engineering Industries | 1 | 2 | 3 | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| CLR – 2: | Evaluate Surface, Volume Integral. Application of Gauss theorem, Stokes and Green's theorem in Engineering fields | | | | | | | | | | | | | | | | | | | |
| CLR – 3: | Transform Engineering problems into ODE, PDE and Integrals and solve them using Laplace / Complex analytic methods | | | | | | | | | | | | | | | | | | | |
| CLR – 4: | To know the properties of Complex functions and apply them in all Engineering fields | | | | | | | | | | | | | | | | | | | |
| CLR – 5: | Evaluate Improper integrals involving complex functions using Residue Theorem and apply them in Engineering fields | | | | | | | | | | | | | | | | | | | |
| CLR – 6: | Identify how Engineering problems can be transformed into simple mathematical constructs and solve the same | | | | | | | | | | | | | | | | | | | |
| Course Learning Outcomes (CLO): | At the end of this course, learners will be able to: | Level of Thinking (Bloom) | Expected Proficiency (%) | Expected Attainment (%) | | Engineering Knowledge | Problem Analysis | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethics | Individual & Team Work | Communication | Project Mgt. & Finance | Life Long Learning | PSO - 1 | PSO - 2 | PSO - 3 |
| CLO – 1: | Evaluate Multiple Integrals using change of variables | 3 | 95 | 90 | | H | - | H | - | - | - | - | - | H | - | - | H | - | - | - |
| CLO – 2: | Apply techniques of vector calculus in problems involving Science and Engineering Solving Ordinary Differential Equations | 3 | 90 | 85 | | H | - | - | H | H | - | - | - | - | - | - | - | - | - | - |
| CLO – 3: | Apply techniques of Laplace Transforms and inverse transform for problems in Science and Engineering | 2 | 85 | 80 | | - | H | - | - | - | - | - | - | H | - | - | H | - | - | - |
| CLO – 4: | Apply complex analytic functions and its properties in solving problems | 3 | 80 | 80 | | H | H | - | H | - | - | - | - | H | - | - | H | - | - | - |
| CLO – 5: | Evaluate improper integrals using Residue Theorem involving problems in Science and Engineering | 2 | 80 | 90 | | - | H | H | - | - | - | - | - | H | - | - | H | - | - | - |
| CLO – 6: | Create Mathematical constructs for Engineering problems and identify solutions to solve them. | 3 | 90 | 80 | | H | - | H | - | - | - | - | - | H | - | - | H | - | - | - |

| *Duration 12 Hours* | | *Learning Unit / Module 1* | *Proposed Date & Hour* | *Conducted Date & Hour* | *Remarks* |
|---|---|---|---|---|---|
| *S-1* | *SLO-1* | *Evaluation of double integration - Cartesian and plane polar coordinates* | | | |
| | *SLO-2* | *Evaluation of double integration - Cartesian and plane polar coordinates* | | | |
| *S-2* | *SLO-1* | *Evaluation of double integration - Cartesian and plane polar coordinates* | | | |
| | *SLO-2* | *Evaluation of double integration - Cartesian and plane polar coordinates* | | | |
| *S-3* | *SLO-1* | *Evaluation of double integration by changing order of integration* | | | |
| | *SLO-2* | *Evaluation of double integration by changing order of integration* | | | |
| *S-4* | *SLO-1* | *Problem solving using Tutorial Sheet – 1* | | | |
| | *SLO-2* | *Problem solving using Tutorial Sheet – 1* | | | |
| *S-5* | *SLO-1* | *Evaluation of double integration by changing order of integration* | | | |
| | *SLO-2* | *Area as a double integral (Cartesian)* | | | |
| *S-6* | *SLO-1* | *Area as a double integral (Cartesian)* | | | |
| | *SLO-2* | *Area as a double integral (polar)* | | | |
| *S-7* | *SLO-1* | *Area as a double integral (polar)* | | | |
| | *SLO-2* | *Triple integration in Cartesian coordinates* | | | |
| *S-8* | *SLO-1* | *Problem solving using Tutorial Sheet – 2* | | | |
| | *SLO-2* | *Problem solving using Tutorial Sheet – 2* | | | |
| *S-9* | *SLO-1* | *Conversion from Cartesian to polar in double integrals* | | | |
| | *SLO-2* | *Conversion from Cartesian to polar in double integrals* | | | |
| *S-10* | *SLO-1* | *Triple integration in Cartesian coordinates* | | | |
| | *SLO-2* | *Triple integration in Cartesian coordinates* | | | |
| *S-11* | *SLO-1* | *Triple integration in Cartesian coordinates* | | | |
| | *SLO-2* | *Volume using triple integral* | | | |
| *S-12* | *SLO-1* | *Problem solving using Tutorial Sheet – 3* | | | |
| | *SLO-2* | *Applications of Multiple Integral in Engineering* | | | |

| Duration 12 Hours | | Learning Unit / Module 2 | Proposed Date & Hour | Conducted Date & Hour | Remarks |
|---|---|---|---|---|---|
| S-1 | SLO-1 | Review of vectors in 2, 3 dimensions | | | |
| | SLO-2 | Gradient, divergence | | | |
| S-2 | SLO-1 | Curl – Solenoidal | | | |
| | SLO-2 | Irrotational fields | | | |
| S-3 | SLO-1 | Vector identities (without proof) – Directional derivatives | | | |
| | SLO-2 | Line integrals | | | |
| S-4 | SLO-1 | Problem solving using Tutorial Sheet – 4 | | | |
| | SLO-2 | Problem solving using Tutorial Sheet – 4 | | | |
| S-5 | SLO-1 | Line integrals | | | |
| | SLO-2 | Surface integrals | | | |
| S-6 | SLO-1 | Surface integrals | | | |
| | SLO-2 | Volume integrals | | | |
| S-7 | SLO-1 | Green's theorem (without proof) | | | |
| | SLO-2 | Green's theorem (without proof) | | | |
| S-8 | SLO-1 | Problem solving using Tutorial Sheet – 5 | | | |
| | SLO-2 | Problem solving using Tutorial Sheet – 5 | | | |
| S-9 | SLO-1 | Gauss divergence theorem (without proof), Verification | | | |
| | SLO-2 | Gauss divergence theorem (without proof), Applications to cubes | | | |
| S-10 | SLO-1 | Gauss divergence theorem (without proof), Applications to parallelopiped | | | |
| | SLO-2 | Stoke's theorem (without proof) – Verification | | | |
| S-11 | SLO-1 | Stoke's theorem (without proof) – Applications to cubes | | | |
| | SLO-2 | Stoke's theorem (without proof) – Applications to parallelopiped only | | | |
| S-12 | SLO-1 | Problem solving using Tutorial Sheet – 6 | | | |
| | SLO-2 | Application of Line and Volume Integrals in Engineering | | | |
| Duration 12 Hours | | Learning Unit / Module 3 | Proposed Date & Hour | Conducted Date & Hour | Remarks |
| S-1 | SLO-1 | Laplace Transforms of standard functions | | | |
| | SLO-2 | Transforms properties | | | |
| S-2 | SLO-1 | Transforms of Derivatives and Integrals | | | |
| | SLO-2 | Transforms of Derivatives and Integrals | | | |

| | | | | | |
|---|---|---|---|---|---|
| *S-3* | *SLO-1* | *Initial value theorems (without proof) and verification for some problems* | | | |
| | *SLO-2* | *Final value theorems (without proof) and verification for some problems* | | | |
| *S-4* | *SLO-1* | *Problem solving using Tutorial Sheet – 7* | | | |
| | *SLO-2* | *Problem solving using Tutorial Sheet – 7* | | | |
| *S-5* | *SLO-1* | *Inverse Laplace transforms using partial fractions* | | | |
| | *SLO-2* | *Inverse Laplace transforms using partial fractions* | | | |
| *S-6* | *SLO-1* | *Inverse Laplace transforms using second shifting theorem* | | | |
| | *SLO-2* | *LT using Convolution theorem – problems only* | | | |
| *S-7* | *SLO-1* | *LT using Convolution theorem – problems only* | | | |
| | *SLO-2* | *ILT using Convolution theorem – problems only* | | | |
| *S-8* | *SLO-1* | *Problem solving using Tutorial Sheet – 8* | | | |
| | *SLO-2* | *Problem solving using Tutorial Sheet – 8* | | | |
| *S-9* | *SLO-1* | *LT of periodic functions – problems only* | | | |
| | *SLO-2* | *LT of periodic functions – problems only* | | | |
| *S-10* | *SLO-1* | *Solve linear second order ordinary differential equations with constant coefficients only* | | | |
| | *SLO-2* | *Solve linear second order ordinary differential equations with constant coefficients only* | | | |
| *S-11* | *SLO-1* | *Solution of Integral equation and integral equation involving convolution type* | | | |
| | *SLO-2* | *Solution of Integral equation and integral equation involving convolution type* | | | |
| *S-12* | *SLO-1* | *Problem solving using Tutorial Sheet – 9* | | | |
| | *SLO-2* | *Application of Laplace Transform in Engineering* | | | |
| ***Duration 12 Hours*** | | ***Learning Unit / Module 4*** | ***Proposed Date & Hour*** | ***Conducted Date & Hour*** | ***Remarks*** |
| *S-1* | *SLO-1* | *Definition of Analytic Function – Cauchy Riemann equations* | | | |
| | *SLO-2* | *Cauchy Riemann equations* | | | |
| *S-2* | *SLO-1* | *Properties of analytic functions* | | | |
| | *SLO-2* | *Determination of analytic function using Milne Thomson's method* | | | |
| *S-3* | *SLO-1* | *Determination of analytic function using Milne Thomson's method* | | | |
| | *SLO-2* | *Determination of analytic function using Milne Thomson's method* | | | |
| *S-4* | *SLO-1* | *Problem solving using Tutorial Sheet – 10* | | | |
| | *SLO-2* | *Problem solving using Tutorial Sheet – 10* | | | |
| *S-5* | *SLO-1* | *Conformal mappings: Magnification* | | | |
| | *SLO-2* | *Conformal mappings: Rotation* | | | |
| *S-6* | *SLO-1* | *Conformal mappings: Inversion* | | | |
| | *SLO-2* | *Conformal mappings: Inversion* | | | |

| | | | | | |
|---|---|---|---|---|---|
| S-7 | SLO-1 | Conformal mappings: Reflection | | | |
| | SLO-2 | Conformal mappings: Reflection | | | |
| S-8 | SLO-1 | Problem solving using Tutorial Sheet – 11 | | | |
| | SLO-2 | Problem solving using Tutorial Sheet – 11 | | | |
| S-9 | SLO-1 | Bilinear Transformation | | | |
| | SLO-2 | Bilinear Transformation | | | |
| S-10 | SLO-1 | Bilinear Transformation | | | |
| | SLO-2 | Bilinear Transformation | | | |
| S-11 | SLO-1 | Cauchy's integral theorem (without proof) | | | |
| | SLO-2 | Cauchy's integral theorem applications | | | |
| S-12 | SLO-1 | Problem solving using Tutorial Sheet – 12 | | | |
| | SLO-2 | Application of Bilinear transformation and Cauchy's Integral in Engineering | | | |
| **Duration 12 Hours** | | **Learning Unit / Module 5** | **Proposed Date & Hour** | **Conducted Date & Hour** | **Remarks** |
| S-1 | SLO-1 | Cauchy's integral formulae – Problems | | | |
| | SLO-2 | Cauchy's integral formulae – Problems | | | |
| S-2 | SLO-1 | Cauchy's integral formulae – Problems | | | |
| | SLO-2 | Taylor's expansions with simple problems | | | |
| S-3 | SLO-1 | Taylor's expansions with simple problems | | | |
| | SLO-2 | Laurent's expansions with simple problems | | | |
| S-4 | SLO-1 | Problem solving using Tutorial Sheet – 13 | | | |
| | SLO-2 | Problem solving using Tutorial Sheet – 13 | | | |
| S-5 | SLO-1 | Laurent's expansions with simple problems | | | |
| | SLO-2 | Singularities | | | |
| S-6 | SLO-1 | Types of Poles and Residues | | | |
| | SLO-2 | Types of Poles and Residues | | | |
| S-7 | SLO-1 | Cauchy's residue theorem (without proof) | | | |
| | SLO-2 | Contour integration: Unit circle | | | |
| S-8 | SLO-1 | Problem solving using Tutorial Sheet – 14 | | | |
| | SLO-2 | Problem solving using Tutorial Sheet – 14 | | | |

| | | | | | |
|---|---|---|---|---|---|
| *S-9* | *SLO-1* | *Contour integration: Unit circle* | | | |
| | *SLO-2* | *Contour integration: Unit circle* | | | |
| *S-10* | *SLO-1* | *Contour integration: semicircular contour* | | | |
| | *SLO-2* | *Contour integration: semicircular contour* | | | |
| *S-11* | *SLO-1* | *Contour integration: semicircular contour* | | | |
| | *SLO-2* | *Contour integration: semicircular contour* | | | |
| *S-12* | *SLO-1* | *Problem solving using Tutorial Sheet – 15* | | | |
| | *SLO-2* | *Application of Contour integration in Engineering* | | | |

| | |
|---|---|
| ***Learning Resources*** | 1. B. H. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.<br>2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.<br>3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.<br>4. Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill, New Delhi, 11th Reprint, 2010.<br>5. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.<br>6. N.P. Bali and Manish Goyal, A Text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008. |

**Learning Assessment**

| Bloom's Level of Thinking | | Continuous Learning Assessment (50% weightage) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLA – 1 (10%) | | CLA – 2 (15%) | | CLA – 3 (15%) | | CLA – 4 (10%) | | Final Examination (50% weightage) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| Level 1 | Remember | 40 % | - | 30 % | - | 30 % | - | 30 % | - | 30 % | - |
| | Understand | | | | | | | | | | |
| Level 2 | Apply | 40 % | - | 40 % | - | 40 % | - | 40 % | - | 40 % | - |
| | Analyze | | | | | | | | | | |
| Level 3 | Evaluate | 20 % | - | 30 % | - | 30 % | - | 30 % | - | 30 % | - |
| | Create | | | | | | | | | | |
| | Total | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

# CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

**Course Designers**

| Experts from Industry | Experts from Higher Technical Institutions | Internal Experts |
|---|---|---|
| 1. Mr. V. Maheswaran, CTS, Chennai, maheshwaranv@yahoo.com | 1. Dr. K. C. Sivakumar, IIT Madras, ksskumar@iitm.ac.in | 1. Dr. A. Govindarajan, SRM IST. |
| 2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com | 2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com | 2. Dr. Srinivasan, SRM IST. |

**Staff Signature** **HOD / Mathematics**