| Course Code | 18MAB201T | Course Name | TRANSFORMS AND BOUNDARY VALUE PROBLEMS | Course Category | B | Basic Sciences | L | T | P | C |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 3 | 1 | 0 | 4 |

| Pre-requisite Courses | 18MAB102T | 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 | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| | | Level of Thinking (Bloom) | Expected Proficiency (%) | Expected Attainment (%) |
| CLR-1 : | Describe types of Partial differential equations interpret solutions relate PDE to the respective branches of engineering | | | |
| CLR-2 : | Relate Fourier series expansion in solving problems under RMS value and Harmonic Analysis. | | | |
| CLR-3 : | Infer the most general form to the PDE and relate to half range sine and cosine series, as the case may be | | | |
| CLR-4 : | Evaluate the various types of integral transforms | | | |
| CLR-5 : | Conclude that the purpose of studying z transform is to solve linear difference equations having constant coefficients | | | |
| CLR-6 : | Predicting the importance of PDE, Fourier series, Boundary value problems and Fourier ,Z – transform applications | | | |

| Course Learning Outcomes (CLO): | At the end of this course, learners will be able to: | Learning | | | Program Learning Outcomes (PLO) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| | | 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 : | Determine Partial differential equation | 2 | 85 | 80 | M | H | L | - | - | - | - | - | M | - | - | H | - | - | - |
| CLO-2 : | Explain the expansion of a discontinuous function as an infinite form of trigonometric sine and cosine series. | 2 | 85 | 80 | M | H | - | M | M | - | - | - | M | L | - | H | - | - | - |
| CLO-3 : | Decide a proper form of solution for the differential equations which are of hyperbolic and parabolic type | 2 | 85 | 80 | M | H | - | - | - | - | - | - | M | - | - | H | - | - | - |
| CLO-4 : | justify the relationship between aperiodic signals and linear combination of exponentials. | 2 | 85 | 80 | M | H | - | M | - | - | - | - | M | L | - | H | - | - | - |
| CLO-5 : | Relate signal analysis with that of z transform | 2 | 85 | 80 | M | H | L | - | - | - | - | - | M | - | - | H | - | - | - |
| CLO-6 : | Relate PDE, Fourier series, Boundary value problems, Fourier and Z transforms | 2 | 85 | 80 | L | L | L | H | H | H | L | H | H | H | - | H | - | - | - |

| Duration (hour) | | 12 | 12 | 12 | 12 | 12 |
|---|---|---|---|---|---|---|
| S-1 | SLO-1 | Formation of partial differential equation by eliminating arbitrary constants | Introduction of Fourier series - Dirichlet's conditions for existence of Fourier Series | Classification of second order partial differential equations | Introduction of Fourier Transforms | Introduction of Z-transform |
| | SLO-2 | Formation of partial differential equation by eliminating two or more arbitrary constants | Fourier series –related problems in $(0,2\pi)$ | Method of separation of variables | Fourier Transforms- problems | Z-transform-elementary properties |
| S-2 | SLO-1 | Formation of partial differential equation by eliminating arbitrary functions | Fourier series –related problems in $(-\pi,\pi)$ | One dimensional Wave Equation and its possible solutions | Properties of Fourier transforms | Z-transform- change of scale property, shifting property |
| | SLO-2 | Formation of partial differential equation by eliminating two or more arbitrary functions | Change of interval Fourier series –related problems in $(0,2l)$ | One dimensional Wave Equation-initial displacement with zero initial velocity-type 1 Algebraic function | Standard results of Fourier transform | Z-transform of $a^n, \frac{1}{n}, \frac{1}{n+1}$ |
| S-3 | SLO-1 | Formation of partial differential equation by eliminating arbitrary functions of the form $\phi(u,v)=0$ | Fourier series –related problems in $(-l,l)$ | One dimensional Wave Equation-initial displacement with zero initial velocity-type 2 Trigonometric function | Fourier Sine Transforms - problems | Z-transform of $\frac{1}{n^2}, \frac{1}{(n+1)^2}$ |
| | SLO-2 | Solution of first order non-linear partial differential equations-standard type I F(p,q)=0 | Fourier series –half range cosine series related problems$(0,\pi)$ | One dimensional Wave Equation-initial displacement with zero initial velocity-type 3 – Midpoint of the string is displaced | Fourier Cosine Transforms - problems | Z-transform of $r^n \cos n\theta$ |
| S-4 | SLO-1 | Problem solving using tutorial sheet 1 | Problem solving using tutorial sheet 4 | Problem solving using tutorial sheet 7 | Problem solving using tutorial sheet 10 | Problem solving using tutorial sheet 13 |
| | SLO-2 | | | | | |
| S-5 | SLO-1 | Solution of first order nonlinear partial differential equations-standard type –II Clairaut's form | Fourier series –half range cosine series related problems$(0,l)$ | One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 1 Algebraic function | Properties of Fourier sine Transforms | Z-transform of $r^n \sin n\theta$ |
| | SLO-2 | Solution of first order non-linear partial differential equations-standard type III F(z, p, q)=0 | Fourier series –half range sine series related problems$(0,\pi)$ | One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 2 Trigonometric function | Fourier sine Transforms applications | Initial value theorem |

| | | | | | | |
|---|---|---|---|---|---|---|
| **S-6** | SLO-1 | *Solution of first order non-linear partial differential equations-standard type-IV separation of variable f(x, p) = g(y, q)* | *Fourier series –half range sine series related problems* $(0, l)$ | *Wave Equation-initial displacement with non-zero initial velocity Type 3 split function* | *Properties of Fourier cosine Transforms* | *Finial value theorem* |
| | SLO-2 | *Lagrange's linear equation: Method of grouping* | *Parseval's Theorem (without proof)-related problems in Fourier series* | *One dimensional heat equation and its possible solutions* | *Fourier cosine Transforms applications* | *Inverse Z-transform- long division method* |
| **S-7** | SLO-1 | *Lagrange's linear equation: Method of multipliers* | *Parseval's Theorem (without proof)-related problems in cosine series* | *One dimensional heat equation related problems* | *Convolution of two function* | *Inverse Z-transform, related problems, long division method* |
| | SLO-2 | *More problems in Lagrange's linear equation: Method of multipliers* | *Parseval's Theorem (without proof)-related problems in sine series* | *One dimensional heat equation -Steady state conditions* | *Convolution Theorem* | *Inverse Z-transform, Partial fraction method* |
| **S-8** | SLO-1 | *Problem solving using tutorial sheet 2* | *Problem solving using tutorial sheet 5* | *Problem solving using tutorial sheet 8* | *Problem solving using tutorial sheet 11* | *Problem solving using tutorial sheet 14* |
| | SLO-2 | | | | | |
| **S-9** | SLO-1 | *Linear Homogeneous partial differential equations of second and higher order with constant coefficients-CF and PI Type 1:* $e^{ax+by}$ | *Introduction to Harmonic Analysis* | *One dimensional heat equation -Steady state conditions more problems* | *Parseval's Identity for Fourier transform* | *Inverse Z-transform, Partial fraction method related problems* |
| | SLO-2 | *PI Type2.: sin(ax+by) or cos(ax+by)* | *Harmonic Analysis for finding harmonic in* $(0,2\pi)$ | *One dimensional heat equation -Steady state conditions with zero velocity* | *Parseval's Identity for Fourier sine & cosine transforms* | *Inverse Z-transform - residue theorem method* |
| **S-10** | SLO-1 | *Type 3: PI of polynomial* | *Harmonic Analysis for finding harmonic in* $(0,2l)$ | *One dimensional heat equation -Steady state conditions with zero velocity more problems* | *Parseval's Identity for Fourier sine & cosine transforms applications* | *Inverse Z-transform - residue theorem method-problems* |
| | SLO-2 | *Type 4 Exponential shifting* $e^{ax+by}f(x,y)$ | *Harmonic Analysis for finding harmonic in periodic interval* $(0,T)$ | *One dimensional heat equation -Steady state conditions with zero velocity more related problems* | *Fourier Transforms Using Differentiation property* | *Convolution theorem (without proof)* |
| **S-11** | SLO-1 | *Linear Homogeneous partial differential equations of second and higher order with constant coefficients type 5 General rule* | *Harmonic Analysis for finding cosine series* | *Steady state conditions and Non-zero boundary conditions- related problems* | *Solving integral equation* | *Convolution theorem applications* |
| | SLO-2 | *Applications of Partial differential equations in Engineering* | *Harmonic Analysis for finding sine series* | *Steady state conditions and Non-zero boundary conditions- more problems* | *Self-reciprocal using Fourier Transform, sine and cosine transform* | *Solution of linear difference equations with constant coefficients using Z-transform* |
| **S-12** | SLO-1 | *Problem solving using tutorial sheet 3* | *Problem solving using tutorial sheet 6* | *Problem solving using tutorial sheet 9* | *Problem solving using tutorial sheet 12* | *Problem solving using tutorial sheet 15* |
| | SLO-2 | *Problem solving using tutorial sheet 3* | *Problem solving using tutorial sheet 6* | *Problem solving using tutorial sheet 9* | *Problem solving using tutorial sheet 12* | *Problem solving using tutorial sheet 15* |

| | | |
|---|---|---|
| **Learning Resources** | *1. B. H. Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,2006*<br>*2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015*<br>*3. Veerarajan T., Transforms and Partial Differential Equations, Tata McGraw-Hill, New Delhi,2012* | *4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 3rd Edition, 2010*<br>*6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, for third semester, Laxmi Publications, 3rd Edition, 2014* |

**Learning Assessment**

| | Bloom's Level of Thinking | Continuous Learning Assessment (50% weightage) | | | | | | | | Final Examination (50% weightage) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLA – 1 (10%) | | CLA – 2 (15%) | | CLA – 3 (15%) | | CLA – 4 (10%)# | | | |
| | | 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. Maheshwaran, CTS, Chennai, maheshwaranv@yahoo.com* | *1. Dr. K. C. Sivakumar, IIT, Madras, kcskumar@iitm.ac.in* | *1. Dr. A. Govindarajan, SRMIST* |
| *2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com* | *2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com* | *2. Prof. Ganapathy Subramanian K S, SRMIST* |