# Transform Calculus

## SWAYAM Prabha Course Code: S11

| PROFESSOR'S NAME | Prof. Adrijit Goswami |
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| DEPARTMENT | Mathematics |
| INSTITUTE | IIT Kharagpur |
| COURSE OUTLINE | Laplace Transform : Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties,Laplace Transform of derivatives and integrals, Differentiation and integration of transforms, Periodic function, Unit step functions, Bessel functions, Dirac delta-function, error function. Inverse Laplace transform, convolution theorem, Evaluation of integrals by Laplace Transform. Solution of ordinary differential equations with the initial and boundary conditions, Integral equations.<br><br>Fourier Series :  Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity.<br><br>Fourier Transform: Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self reciprocity of Fourier Transform, convolution theorem.<br><br>Application of Laplace Transform and Fourier Transform techniques to linear p.d.es:  Applications of Laplace Transform to initial and boundary value problems. Applications of Fourier Transform to initial and boundary value problems. |

## COURSE DETAILS

| S. No | Module ID/ Lecture ID | Lecture Title/Topic | Duration |
|---|---|---|---|
| 1 | S11-Mod1 | Introduction to Integral Transform Laplace | 0:28:11 |

| 2 | S11-Mod2 | Existence of Laplace Transform | 0:32:07 |
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| 3 | S11-Mod3 | Shifting Properties of Laplace Transform | 0:29:23 |
| 4 | S11-Mod4 | Laplace Transform of Derivative and Integration of a Function-I | 0:29:03 |
| 5 | S11-Mod5 | Laplace Transform of Derivative and Integration of a Function-II | 0:31:21 |
| 6 | S11-Mod6 | Explanation of Properties of Laplace Transform using Examples | 0:31:03 |
| 7 | S11-Mod7 | Laplace Transform Periodic Function | 0:28:53 |
| 8 | S11-Mod8 | Laplace Transform some Special Functions | 0:28:02 |
| 9 | S11-Mod9 | Error Function, Dirac Delta Function and their Laplace Transform | 0:30:42 |
| 10 | S11-Mod10 | Bessel Function and its Laplace Transform | 0:28:04 |
| 11 | S11-Mod11 | Introduction to Inverse Laplace Transform | 0:32:42 |
| 12 | S11-Mod12 | Properties of Inverse Laplace Transform | 0:27:33 |
| 13 | S11-Mod13 | Convolution and its Applications | 0:31:45 |
| 14 | S11-Mod14 | Evaluation of Integrals using Laplace Transform | 0:29:04 |
| 15 | S11-Mod15 | Solution of Ordinary Differential Equation with Constant Coefficient using Laplace Transform | 0:27:55 |
| 16 | S11-Mod16 | Solution of Ordinary Differential Equation with Variable Coefficient using Laplace Transform | 0:30:30 |
| 17 | S11-Mod17 | Solution of Simultaneous Ordinary Differential Equations using Laplace Transform | 0:30:19 |
| 18 | S11-Mod18 | Introduction to Integral Equation and its Solution Process | 0:29:25 |
| 19 | S11-Mod19 | Introduction to Fourier Series | 0:28:55 |
| 20 | S11-Mod20 | Fourier Series for Even and Odd Functions | 0:28:43 |
| 21 | S11-Mod21 | Fourier Series of Functions having arbitrary period Part - I | 0:30:49 |
| 22 | S11-Mod22 | Fourier Series of Functions having arbitrary period Part - II | 0:26:39 |

| 43 | S11-Mod43 | Introduction to Partial Differential Equation | 0:28:30 |
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| 44 | S11-Mod44 | Solution of Partial Differential Equations using | 0:31:24 |

| 23 | S11-Mod23 | Half Range Fourier Series | 0:28:25 |
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| 24 | S11-Mod24 | Parseval's Theorem and its applications | 0:30:23 |
| 25 | S11-Mod25 | Complex form of Fourier Series | 0:29:16 |
| 26 | S11-Mod26 | Fourier Integral Representation | 0:28:11 |
| 27 | S11-Mod27 | Introduction to Fourier Transform | 0:29:08 |
| 28 | S11-Mod28 | Derivation of Fourier Cosine Transform and Fourier sine Transform of Functions | 0:29:45 |
| 29 | S11-Mod29 | Evaluation of Fourier Transform of various Functions | 0:30:28 |
| 30 | S11-Mod30 | Linearity Property and Shifting Properties of Fourier Transform | 0:29:17 |
| 31 | S11-Mod31 | Change of Scale and Modulation Properties of Fourier Transform | 0:29:11 |
| 32 | S11-Mod32 | Fourier Transform of Derivative and Integral of a Function | 0:31:20 |
| 33 | S11-Mod33 | Applications of Properties of Fourier Transform Part - l | 0:33:44 |
| 34 | S11-Mod34 | Applications of Properties of Fourier Transform Part - ll | 0:30:11 |
| 35 | S11-Mod35 | Fourier Transform of convolution of two functions | 0:29:21 |
| 36 | S11-Mod36 | Parseval's Identity and its Application | 0:31:01 |
| 37 | S11-Mod37 | Evaluation of definite Integrals using Properties of Fourier Transform | 0:30:43 |
| 38 | S11-Mod38 | Fourier Transform of Dirac Delta Function | 0:29:18 |
| 39 | S11-Mod39 | Representation of a function as a Fourier Integral | 0:31:57 |
| 40 | S11-Mod40 | Applications of Fourier Transform to Ordinary Differential Equations Part - l | 0:31:19 |
| 41 | S11-Mod41 | Applications of Fourier Transform to Ordinary Differential Equations Part - ll | 0:29:45 |
| 42 | S11-Mod42 | Solution of Integral Equations using Fourier Transform | 0:30:36 |

| | | Laplace Transform | |
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| 45 | S11-Mod45 | Solution of Heat Equation and wave Equation Using Laplace Transform | 0:30:53 |
| 46 | S11-Mod46 | Criteria for choosing Fourier Transform, Fourier Sine Transform, Fourier Cosine Transform in Solving Partial Differential Equations | 0:30:53 |
| 47 | S11-Mod47 | Solution of Partial Differential Equations using Fourier Cosine Transform and , Fourier Sine Transform | 0:28:34 |
| 48 | S11-Mod48 | Solution of Partial Differential Equations using Fourier Transform Part - l | 0:35:19 |
| 49 | S11-Mod49 | Solution of Partial Differential Equations using Fourier Transform Part - ll | 0:33:21 |
| 50 | S11-Mod50 | Solving Problems on Partial Differential Equations using Transform Techniques | 0:32:39 |
| 51 | S11-Mod51 | Introduction to Finite Fourier Transform | 0:28:39 |
| 52 | S11-Mod52 | Solution of Boundary Value Problems using Finite Fourier Transform- I | 0:25:37 |
| 53 | S11-Mod53 | Solution of Boundary Value Problems using Finite Fourier Transform- II | 0:34:00 |
| 54 | S11-Mod54 | Introduction to Mellin Transform | 0:31:25 |
| 55 | S11-Mod55 | Properties of Mellin Transform | 0:31:01 |
| 56 | S11-Mod56 | Examples of Mellin Transform - I | 0:30:01 |
| 57 | S11-Mod57 | Examples of Mellin Transform - II | 0:28:25 |
| 58 | S11-Mod58 | Introduction to Z - Transform | 0:30:05 |
| 59 | S11-Mod59 | Properties of Z - Transform | 0:29:40 |
| 60 | S11-Mod60 | Evaluation of Z – Transform of some functions | 0:29:47 |

**References if Any:**