Transforms in Signals

Course Code	22MATEC/EE31	Course type	Theory	Credits L-T-P	3 – 0– 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40Hrs; T = 0Hrs;P = 0Hrs Total = 40Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	Learn Fourier analysis of periodic and non periodic systems.
2.	Get acquainted with discrete and continuous time functions and their Fourier Analysis.
3.	Study the frequency response for circuits using Laplace Transforms

Pre-requisites: Integration and differentiation.

Unit – I	Contact Hours = 8 Hours
Fundamentals and transmission through LTI: Signal (Examples and classification of singles). Basic operations on signals. Basic Continuous –Time Signals and Basic Discreet –Time Signals (Unit step function, Unit impulse function, Ramp function, Exponential signals, Sinusoidal signals, Exponentially damped sinusoidal signals and pulse signals.) System. Properties of system (Linearity, Causality, Time –invariance and Stability.)Response of a linear system(The Zero –input, Zero-state and total response)	

Unit – II	Contact Hours = 8 Hours
Fourier Analysis of continuous time signals: Classification of time functions – continuous, discrete, periodic and non-periodic functions. Fourier analysis of continuous time periodic functions using continuous time Fourier series (CTFS), properties of CTFS (proof not necessary), Numericals. Fourier analysis of continuous time non-periodic functions using continuous time Fourier transform (CTFT), properties of CTFT(proof not necessary), relationship between CTFS and CTFT, numericals pertaining to standard time functions (unit impulse, unit step, right sided and two-sided exponential functions, rectangular function, constant of magnitude, sinusoidal, complex exponential, signum function).	

Unit –III	Contact Hours = 8 Hours
Fourier Analysis of discrete time functions: Fourier analysis of discrete time periodic functions using discrete time Fourier series (DTFS), properties of DTFS(proof not necessary), Numericals. Fourier analysis of discrete time non-periodic functions using discrete time Fourier transform(DTFT), properties of DTFT(proof not necessary), relationship between DTFS and DTFT,Numericals pertaining to standard time functions (unit impulse, unit step, right sided and two-sided exponential functions, rectangular function, constant of magnitude, sinusoidal, complex exponential, signum function).	

Unit – IV	Contact Hours = 8 Hours
Laplace transforms: Definition of Laplace transforms. Region of convergence. Poles and Zeros of rational Laplace Transforms. Properties of Region of convergence. Laplace transforms for common signals. Properties of Laplace transforms (Linearity, time shifting, Shifting in s-domain, time scaling, time-domain integration, Differentiation if time-domain, differentiation in s-domain, convolution) Partial fraction expansion. Unilateral Laplace transform. Initial value theorem, Final value theorem. Waveform synthesis, Relationship between Laplace Transform and Fourier transform. Numerical pertaining to standard continuous time functions.	

Unit –V	Contact Hours = 8 Hours
Z- transforms: Definition.z-transform and ROC of finite duration sequences (Right sided,Left-sided and double –sided sequences), z-transform and ROC of Infinite duration sequences (Positive-time,Negative-side and Double –sided exponential sequence), ROC and stability. Properties of z-transform. **Inverse Z-transforms:** Partial fraction expansion method, long division method and complex inverse integral. Linear constant coefficient difference equations. Relation between Z-transform and, discrete time Fourier transform and Laplace transform.Numerical pertaining to standard discrete time functions.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	DR. D. Ganesh Rao, "Signals and Systems", Sanguine Tech. Publ., 2011.
2.	H. Hsu and R. Ranjan, "SIGNALS AND SYSTEMS ", 2nd edition, Schaum's Outline Series,
3.	P. Z. Peebles, "Probability, Random Variables, and Random Signal Principles ", McGraw Hill, 4th edition, 2017 and onwards.
	Reference Books:
1.	Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd edition, Wiley, 2003 and onwards.
2.	A. Anand Kumar, "Signals and Systems ", 3rd Edition, PHI Learning.
	E-resourses (NPTEL/SWAYAM.. Any Other)
2.	https://nptel.ac.in/courses/117105085 (**Fourier Analysis of discrete time functions**)

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Assignments (OBA)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand and Apply Fourier Analysis for periodic and non periodic signals.**	**Re,Un,Ap**	1	
2.	**Apply DTFS and DTFT to deal with analysis of Discrete Signals.**	**Re,Un,Ap**	1	
3.	**Apply Laplace Transforms and Z transforms to analyze the signals.**	**Re,Un,Ap**	1	

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs/Math tools	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains three parts **A(30 marks),B(50 marks) and C (20 marks).**Student has to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√														
2	√														
3	√														
Mention the levels: 1, 2, 3															

FUNDAMENTALS OF STATISTICS AND PROBABILITY FOR DATA SCIENCE

Course Code:	**22MATS31**	**Course type**	Theory	**Credits L-T-P**	3 – 0– 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
At the end of the course students should be able to	
1.	Fit a suitable curve for the data using regression.
2.	Get knowledge about various probability distributions involving discrete /continuous random variable.
3.	Get familiar with various sampling distributions and estimation of various parameters.
4.	Get acquainted with various hypothesis testing techniques.
5.	Understand Joint discrete PDF and various stochastic processes.

Pre-requisites : Basic statistics, Basic probability.

Unit – I	**Contact Hours = 8 Hours**
Correlation and Regression: Curve fitting by least square method. Fitting the curve , $y = a+bx$, , $y = ax^b$, $y = a+bx+cx^2$.Karl Pearson coefficient of correlation, Linear Regression: Problems. Multiple correlation and regression. Partial correlation and regression.	

Unit – II	**Contact Hours = 8 Hours**
Random Variable: Revision of basic probability, conditional probability upto Bayes theorem. Discrete and Continuous Random Variable, (DRV,CRV) Probability Distribution Functions (PDF) and Cumulative Distribution Functions(CDF), Expectations, Mean, Variance. Binomial, Poisson, Exponential and Normal Distributions. Practical examples.	

Unit –III	**Contact Hours = 8 Hours**
Joint PDF and Stochastic Process: Discrete Multivariable Joint PDF, Multivariable Conditional Joint PDF, Expectations (Mean, Variance and Covariance). Definition and classification of stochastic processes. Discrete state and discrete parameter stochastic process, Unique fixed probability vector, Regular Stochastic Matrix, Transition probability, Markov chain.	

Unit – IV	**Contact Hours = 8 Hours**
Hypothesis Testing : Null and alternate hypothesis, Critical region, Sampling, Sampling errors, Level of significance and confidence limits ,Testing hypothesis of mean, Testing hypothesis of variance, Testing hypothesis of proportion.	

Unit – V	Contact Hours = 8 Hours
Sampling distribution: Sampling distribution, Sampling distribution of means, Test of significance for small and large samples. 't' and 'chi square' distributions, F- distribution. Practical examples.	

Unit No.	Self-Study Topics
1	Regression models, Regression strategies.
2	Discrete and Continuous Random vectors in different areas such as Mutual funds, lottery draw, decision making, decision trees etc…
3	Restate the research question as research hypothesis and a null hypothesis about the populations and determine the characteristics of the comparison distribution.
4	Eliminating variability during gathering statistical data.
5	Monte Carlo Simulation.

Books	
	Text Books:
1.	B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 42th Ed., 2021 onwards.
2.	Erwin Kreyszig: "Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
	Reference Books:
1.	B.V. Ramana**: "**Higher Engineering Mathematics"McGraw-Hill Education, 11thEd., 2004 onwards.
2.	Srimanta Pal &Subodh C. Bhunia: "Engineering Mathematics"Oxford University Press, 3rd Ed., 2016 onwards
3	N.P Bali and Manish Goyal:"A textbook of Engineering Mathematics Laxmi Publications, 10th Ed., 2022 onwards
4	C. Ray Wylie, Louis C. Barrett: **"**Advanced Engineering Mathematics"McGraw –Hill Book Co., New york, 6thEd., 2017 onwards
5	H. K. Dass and Er. RajnishVerma**:** Higher Engineering Mathematics"S. Chand Publication, 3rd Ed., 2014.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/111106111
3	https://nptel.ac.in/courses/111104025
4	https://nptel.ac.in/courses/117105085
5	https://nptel.ac.in/courses/111105042

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)
3.	Flipped Classes	3.	Course Seminar
4.	Practice session/Demonstrations in Labs	4.	Quizzes
5.	Virtual Labs (if present)	5.	Semester End Examination

Course Outcome (COs)				
Learning Levels: **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand regression analysis for data analysis.	**Re,Un,Ap**	**1**	
2.	Apply the knowledge of Discrete and Continuous Random vectors in different areas such as Mutual funds, lottery draw, decision making, decision trees etc…	**Re,Un,Ap**	**1**	
3.	Apply knowledge of Sampling distribution and Hypothesis Testing to conduct basic statistical analysis of data.	**Re,Un,Ap**	**1**	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs/Python	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for CIE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains three parts **A(30 marks),B(50 marks) and C (20 marks).**Student has to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries20 Marks.

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓														
2	✓														
3	✓														
Tick mark the CO, PO and PSO mapping															

Advanced Calculus and Statistics

Course Code	**22MATC31**	**Course type**	**Theory**	**Credits L-T-P**	3 - 0- 0
Hours/week: L-T-P	3 - 0 - 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

	Course learning objectives
1.	**Fit suitable curve for the data using regression analysis.**
2.	**Get familiar with various probability distributions involving discrete variables.**
3.	**Get familiar with various probability distributions involving discrete continuous variables.**
4.	**Get acquainted with concept of functionals.**
5.	**Learn Fourier Analysis of periodic/aperiodic systems.**

Required Knowledge of : Differentiation, Integration, Basic Statistics

Unit – I	**Contact Hours = 8 Hours**
Correlation and Regression: Curve fitting by least square method: y= a+bx, $y=ax^b$, $y=a+bx+cx^2$, . Karl Pearson coefficient of correlation, Lines of regression Problems. Multiple correlation and regression. Partial correlation and regression.	

Unit – II	**Contact Hours = 8 Hours**
Random Variable I: Revision of basic probability, conditional probability upto Bayes theorem. Discrete Random Variable, (DRV,CRV) Probability Distribution Functions (PDF) and Cumulative Distribution Functions(CDF), Expectations, Mean, Variance. Binomial, Poisson and Geometric Distribution. Practical examples.	

Unit – III	**Contact Hours = 8 Hours**
Random Variable II: Continuous Random Variable, (DRV,CRV) Probability Distribution Functions (PDF) and Cumulative Distribution Functions(CDF), Expectations, Mean, Variance. Exponential, Normal and Uniform Distributions. Practical examples.	

Unit –I V	**Contact Hours = 8 Hours**
Fourier Series: Periodic functions. Drichlet's conditions, Fourier series, Half range Fourier sine and cosine series. Practical examples, Harmonic analysis.	

Unit –V	**Contact Hours = 8 Hours**
Calculus of variations: Concept of a Functional, Extremal of a Functional, Euler's equation and equivalents. Standard problems. **Applications**: Geodesics, Hanging chain, Minimal surface of revolution and Brachistochrone problem.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	Self-Study Topics
1	Regression models, Regression strategies.
2	Discrete and Continuous Random vectors in different areas such as Mutual funds, lottery draw etc…
3	Discrete and Continuous Random vectors in different areas such as decision making, decision trees etc…
4	Basic theorems on Real Analysis, Parsvel Identities.
5	Multivariable Calculus and Linear Algebra concepts.

Books	
	Text Books:
1.	B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 42thEd., 2021 onwards.
2.	Erwin Kreyszig: "Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
	Reference Books:
1.	B.V. Ramana**: "**Higher Engineering Mathematics"McGraw-Hill Education, 11thEd., 2004 onwards.
2.	Srimanta Pal &Subodh C. Bhunia: "Engineering Mathematics"Oxford University Press, 3rd Ed., 2016 onwards
3	N.P Bali and Manish Goyal:"A textbook of Engineering Mathematics"Laxmi Publications, 10th Ed., 2022 onwards
4	C. Ray Wylie, Louis C. Barrett: **"**Advanced Engineering Mathematics"McGraw −Hill Book Co., New york, 6thEd., 2017 onwards
5	H. K. Dass and Er. RajnishVerma**:** "Higher Engineering Mathematics"S. Chand Publication, 3rd Ed., 2014.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/111106111
2	https://nptel.ac.in/courses/111104025
3	https://nptel.ac.in/courses/117105085
4	https://nptel.ac.in/courses/111105042

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)
3.	Flipped Classes	3.	Course Seminar
4.	Practice session/Demonstrations in Labs	4.	Quizzes
5.	Virtual Labs (if present)	5.	Semester End Examination

Course Outcome (COs)				
Learning Levels: **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply the knowledge of random variables and regression analysis in fields such as machine learning.	**Re,Un,Ap**	**1**	
2.	**Develop** frequency bond series from time bond functions using Fourier series.	**Re,Un,Ap**	**1**	
3.	Apply the concept of functional to solve complex optimization problems.	**Re,Un,Ap**	**1**	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs/Python	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for CIE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains three parts **A(30 marks),B(50 marks) and C (20 marks).**Student has to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each Question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries20 Marks.

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓														
2	✓														
3	✓														
Tick mark the CO, PO and PSO mapping															