Advanced Linear Algebra ,Vector Calculus and Statistics

Course Code	21MATEC/EE41	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 = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To understand the concepts eigenvalues, eigenvectors, vector space, Linear transformation.
2.	To get acquainted with the orthogonal, orthonormal vectors, Gram Schmidt 's process, singular value decomposition and quadratic forms.
3.	To Understand various operations involving scalar and vector fields.
4.	To get familiar with different types of vector integral.

Pre-requisites: Basic Linear Algebra, vector algebra and vector calculus, basic statistics

Unit – I	Contact Hours = 8 Hours
Vector Spaces, sub spaces, null spaces, column spaces, linear transformation. Linearly independent sets and bases, coordinate systems, dimension of a vector space, Rank, change of bases. Case study: Fourier transform as linear transformation and change of basis. Case study: Vectors in Hilbert Spaces.	

Unit – II	Contact Hours = 8 Hours
Orthogonality and Orthonormality: Inner product, length and orthogonality of vectors, orthogonal set of vectors, orthogonal projection, Gram Schmidt's Process. Quadratic forms, Singular value decomposition(SVD). Case study: Principal Component Analysis (PCA)	

Unit – III	Contact Hours = 8 Hours
Applications of Vector Calculus Applications of vector differentiation : Gradient , Divergence and Curl. Applications of vector integration : Green's Theorem , Stoke's Theorem and Gauss divergence theorem.	

Unit – IV	Contact Hours = 8 Hours
Correlation and Regression: Karl Pearson coefficient of correlation, Regression: Lines of regression Problems. Multiple correlation and regression. Partial correlation and regression.	

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.	

Flipped Classroom Details

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

Books	
	Text Books:
1.	David C. Lay, Linear Algebra and Its Applications, Pearson Publications, 2016 onwards.
2.	Seymour Lipschutz, Dennis Spellman and Murray R. Spiegel, Schaum's Outline for Vector Analysis, McGraw Hill Publication, 2009 and onwards.
	Reference Books:
1.	B. S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012and onwards
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition,2006 and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)
1.	https://nptel.ac.in/courses/111105122 (**Applications of Vector Calculus**)
2.	https://nptel.ac.in/courses/111105042 (**Correlation and Regression**)

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 Tests (OBT)
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 the various concepts connected with vector spaces.**	Ap	1	
2.	**Understand the orthogonality of vectors and related concepts.**	Un	1	
3.	**Use the various terminologies connected with vector/scalar functions and their applications.**	Ap	1	
4.	**Understand the relationships between numerical data.**	Un	1	
5.	**To get acquainted with sampling concepts.**	Un	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.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

Rubrics:Levels	Target
1 (Low)	60% of the students score Less than 50 % of the total marks.
2 (Medium)	60% of the students score 50 – 70 % of the total marks.
3 (High)	60% of the students score More than 70 % of the total marks.

CO	CO-PO Mapping (Planned)												CO-PSO Mapping (Planned)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1															
2															
3															
4															
5															
Mention the levels: 1, 2, 3															

Discrete Mathematical Structures and Graph Theory

Course Code:	22MATS41	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.	Get acquainted with fundamentals and all laws of logic and quantifiers.
2.	Get familiar with relations and their closures, Posets and Lattices.
3.	Understand the theory of recurrence relations and generating functions.
4.	Get acquainted with basic concepts of graphs, trees and their applications..

Pre-requisites : Relations, Functions ,Permutations and combinations, Algebra.

Unit – I	Contact Hours = 8 Hours
Fundamentals of Logic: Basic connectives and Truth tables, Logical equivalence- Laws of Logic, Logical Implication-Rules of Inference. Quantifiers- Universal and Existential Quantifiers.	

Unit – II	Contact Hours = 8 Hours
Relations: Types and Properties of Relations (revision), n-ary Relations and Their Applications. Computer recognition-Zero One Matrices and Directed graphs, Transitive, closure, Warshall's algorithm, Equivalence relation and Partitions, Posets and Hasse Diagrams, Lattices.	

Unit – III	Contact Hours = 8 Hours
Recurrence relations: Definition, Homogeneous recurrence relations, Non Homogeneous recurrence relations. Solution of homogeneous and non homogeneous recurrence relations. Generating functions. Solution of recurrence relation by generating function.	

Unit – IV	Contact Hours = 8 Hours
Graph Theory I: Definitions and Examples, Subgraphs, Matrix Representation of graphs. Complements and Graph Isomorphism, Connectivity, Euler Trails and Circuits, Shortest path: Dijkartas algorithm. Planar Graphs, Hamiltonian Paths and Cycles.	

Unit –V	Contact Hours = 8 Hours

Graph Theory II: Coloring covering and matching: Chromatic number, chromatic polynomial, uniquely colorable graphs , coloring planar graphs :Five color theorem ,Four color theorem. Covering minimal covering, Matching Halls theorem.

Flipped Classroom Details

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

Books	
	Text Books:
1.	Kolman, Busby, Ross "Discrete Mathematical Structures", 6th Edition Prentice Hall of India, 2010 onwards
2.	Ralph Grimaldi, "Discrete and Combinatorial Mathematics 4th Edition 2003 onwards
	Reference Books:
1.	Kenneth Rosen "Discrete Mathematics and Its Applications with Combinatorics and Graph Theory (SIE)	7th Edition onwards
2.	Narsingh Deo ,"Graph theory and its Applications"
	E-resource's (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/111/106/111106086/(DMS)
2.	https://www.digimat.in/nptel/courses/video/111106102/L19.html(GT)
3	https://www.javatpoint.com/graph-theory-tree-and-forest (GTTrees)

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 Tests (OBT)/Matlab
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			
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1. **Understand** and **Apply** the Logic of mathematics in the field of Computer science.	**Un, Ap**	1	
2. **Explain** and **Analyze** different Relations and their closures. Posets and lattices.	**Un, Ap**	1	
3. **Apply** theory of solution of recurrence relations to solve them.	**Un, Ap**	1	
4. **Apply** the concepts related to graphs their relevant applications..	**Un,Ap**	1	

Scheme of Continuous Internal Evaluation (CIE):

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 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 Carries 20 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**	**PO1 0**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√														
2	√														
3	√														
4	√														

PROBABILITY AND STATISTICS

Course Code	22ESCEC/EE41	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 = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	**Understand** joint probability distributions, including joint probability density functions, mass functions, and distributions of discrete and continuous random variables.
2.	**Familiarize** Statistical inference (estimation and hypothesis testing) from the standpoint of statistical decision making..
3.	**Identify** the use of correlation and regression techniques,

Pre-requisites: Basic Linear Algebra, Vector Algebra and Vector Calculus, Basic Statistics

Unit – I	Contact Hours = 8 Hours

Probability and Distributions

Random Variables (RV), Discrete and Continuous Random variables, (DRV,CRV) Probability Distribution Functions (PDF) and Cumulative Distribution Functions(CDF), Expectations, Mean, Variance. Binomial, Poisson, Exponential and Normal Distributions. Practical examples.

Unit – II	Contact Hours = 8 Hours

Joint PDF and Stochastic Processes

Discrete Joint PDF, 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 – III	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 – IV	Contact Hours = 8 Hours

Statistical Decision Theory: Decision making process, Decision rules: decisions under uncertainity, Maximax Principle, Maximin Principle, Hurwicz Principle, Laplace Principle,Savage principle, Decision Under Risk: Maximum Likelihood Principle, Expected Payoff, Expected opportunity Loss or Expected Regret. Problems. Decision using posterior probabilities (Bayesian rule) Expected value sample Information (EVSI), Decision Trees. Problems**.**

Unit – V	Contact Hours = 8 Hours

Correlation and Regression

Karl Pearson coefficient of correlation, Regression: Lines of regression Problems. Multiple correlation and regression. Partial correlation and regression.

Flipped Classroom Details

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

Books	
	Text Books:
1.	B.V.Ramana –Engineering Mathematics, Tata Mcgraw Hill Publishing Company Limited 2004 and onwards.
2.	N.D.Vohra –Business Statistics, Mcgraw Hill Publishing Company Limited 2014 and onwards.
	Reference Books:
1.	Fundamentals of Mathematical Statistics, Gupta S C and V. K. Kapoor, Sultan Chand and Sons, 2009 and onwards.
2.	B. S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012 and onwards
	E-resources (NPTEL/SWAYAM.. Any Other)
1.	https://nptel.ac.in/courses/111102014 **(Stochastic Process)**
2.	https://nptel.ac.in/courses/111105042 (**Correlation and Regression**)

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 Tests (OBT)
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.	**Apply various discrete and continuous probability distributions and to study various real life situations and skills of analyzing multivariate probability distributions**.	Ap	1	
2.	**Use large sample and small sample tests of significance, to compute inference based on given data**	Un	1	
3.	**Use the suitable type of decision and the analysis among various techniques in the field under uncertainty.**	Ap	1	
4.	**Use techniques for investigating the relationship between two quantitative variables**	Un	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. |

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
1	✓														
2	✓														
3	✓														
4	✓														
Mention the levels: 1, 2, 3															

Operation Research and Statistical Theory

Course Code:	22MATCV/ME/AE41	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

Unit – II	Contact Hours = 8 Hours

Unit – III	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 – IV	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 –V	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.	

Flipped Classroom Details

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

Books	
	Text Books:
1.	B. S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012 and onwards.
2.	B.V.Ramana –Engineering Mathematics, Tata Mcgraw Hill Publishing Company Limited 2004 and onwards.
	Reference Books:
1.	Fundamentals of Mathematical Statistics by S.C.Gupta and V.K.Kapoor., Sultan Chand and Sons, 2009 and onwards.
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
	E-resource's (NPTEL/SWAYAM… Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/111/102/111102111/ (Prob and Stochastic)
2.	https://archive.nptel.ac.in/courses/111/104/111104147/(Sampling and Linear regression)

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 Tests (OBT)/Matlab
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			
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	Learning Level	PO(s)	PSO(s)
1. To **UNDERSTAND** correlation and regression .	Un	1	1
2. To **UNDERSTAND** the concept of random variable and various probability distributions connected with discrete and continuous random variable.	Un	1	1
3. To **APPLY** methods to test a hypothesis.	Ap	1	1
4. To **APPLY** the concepts related to sampling distribution to practical problems.	Ap	1	1
5. To **UNDERSTAND** the joint discrete probability distributions and Markov chain.	Un	1	1

Scheme of Continuous Internal Evaluation (CIE):

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 CIE: 40 OUT OF 100**					

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1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

CO	**CO-PO Mapping (Planned)**												**CO-PSO Mapping(Planned)**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	√										2	1			
2	√										2	1	√		
3	√										2	1	√		
4	√										2	1	√		
1-low 2-medium 3-high															