KPR Institute of Engineering and Technology

Learn Beyond (Autonomous, NAAC "A")

Avinashi Road, Arasur, Coimbatore.

Great Place To Work. Certified MAR 2022 - MAR 2023 INDIA

Minor Degree Courses Syllabi
Regulations - 2021

VERTICALS FOR MINOR DEGREE

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 7: MATHEMATICS AND STATISTICS FOR DATA SCIENCE AND MODELING

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21MDG40	Matrix Theory and Linear Algebra	MDC	3	0	0	0	3
2	U21MDG41	Probability Theory and Distributions	MDC	3	0	0	0	3
3	U21MDG42	Statistical Inference	MDC	3	0	0	0	3
4	U21MDG43	Regression Analysis	MDC	3	0	0	0	3
5	U21MDG44	Design and Analysis of Experiments	MDC	3	0	0	0	3
6	U21MDG45	Optimization Techniques	MDC	3	0	0	0	3

VERTICAL 8: INDUSTRIAL IOT

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21MDG46	Sensors and Transducers	MDC	2	0	2	0	3
2	U21MDG47	Programming for IoT	MDC	2	0	2	0	3
3	U21MDG48	Embedded Controllers	MDC	2	0	2	0	3
4	U21MDG49	IoT Protocols and Cloud Computing	MDC	2	0	2	0	3
5	U21MDG50	Mobile Application Development for IoT	MDC	2	0	2	0	3
6	U21MDG51	Automation Using IoT	MDC	2	0	2	0	3

VERTICAL 9: IMAGE PROCESSING TECHNIQUES

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21MDG52	Digital Image Fundamentals	MDC	2	0	2	0	3
2	U21MDG53	Image Enhancement and Restoration	MDC	2	0	2	0	3
3	U21MDG54	Image Segmentation Techniques	MDC	2	0	2	0	3
4	U21MDG55	Pattern Recognition and Classification	MDC	2	0	2	0	3
5	U21MDG56	Image Compression and Security	MDC	2	0	2	0	3
6	U21MDG57	Applications of Image Processing	MDC	2	0	2	0	3

VERTICAL 10: AI FOR EMBEDDED SYSTEM

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21MDG58	Foundation for Embedded Systems	MDC	3	0	0	0	3
2	U21MDG59	Fundamentals of Artificial Intelligence	MDC	3	0	0	0	3
3	U21MDG60	Embedded Hardware for AI	MDC	3	0	0	0	3
4	U21MDG61	AI Software Platforms and Tools	MDC	3	0	0	0	3
5	U21MDG62	Machine Learning for Embedded Systems	MDC	3	0	0	0	3
6	U21MDG63	Deep Learning for Embedded Systems	MDC	3	0	0	0	3
7	U21MDG64	Computer Vision for Embedded Systems	MDC	3	0	0	0	3
8	U21MDG65	Signal Processing for Embedded Systems	MDC	3	0	0	0	3

VERTICAL 11: APPLIED MACHINE LEARNING

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21MDG66	Computational Intelligence	MDC	3	0	0	0	3
2	U21MDG67	Data Preprocessing and Visualization	MDC	3	0	0	0	3
3	U21MDG68	Machine Learning Essentials	MDC	3	0	0	0	3
4	U21MDG69	Neural Networks and Deep Learning	MDC	3	0	0	0	3
5	U21MDG70	Text mining and Analytics	MDC	3	0	0	0	3
6	U21MDG71	Computer Vision and Image Processing	MDC	3	0	0	0	3

VERTICAL 12: SOFTWARE DEVELOPMENT ENGINEERING

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21MDG72	Integrated System Programming	MDC	3	0	0	0	3
2	U21MDG73	Data Intensive Computing Systems	MDC	3	0	0	0	3
3	U21MDG74	Data Management Techniques	MDC	3	0	0	0	3
4	U21MDG75	Algorithms and Problem Solving – I	MDC	3	0	0	0	3
5	U21MDG76	Algorithms and Problem Solving – II	MDC	3	0	0	0	3
6	U21MDG77	Structured Query Language	MDC	3	0	0	0	3

		Category: MDC				
U21MDG40	MATRIX THEORY AND LINEAR ALGEBRA	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To learn and apply various methods for solving systems of linear equations
- To learn vector spaces and subspaces, including their properties and operations
- To learn linear transformations, kernel, image and structure and properties of inner product spaces

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the matrix algebra and apply various methods for solving systems of linear equations (Understand)

CO2: Understand the concept of vector spaces, subspaces, spanning set and bases (Understand)

CO3: Understand the linear transformation and their matrix representation, change of bases (Understand)

CO4: Understand the concepts of inner product space and the orthogonalization process (Understand)

CO5: Understand the concepts of eigenvalues and eigenvectors and their properties (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		
CO2	3	3	-	-	-	-	-	-	-	-	-	-		
CO3	3	3	-	-	-	-	-	-	-	-	-	-		
CO4	3	3	-	-	-	-	-	-	-	-	-	-		
CO5	3	3	-	-	-	-	-	-	-	-	-	-		

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I MATRIX THEORY AND LINEAR SYSTEM 9

Algebra of matrices – Trace and rank of matrix and their properties - Systems in triangular and Echelon form – Gauss elimination – row canonical form – Gauss-Jordan method – Gauss Siedal method – Gauss Jacobi method – LU decomposition method

UNIT II VECTOR SPACES 9

Vector spaces – Subspaces – Linear combinations and spanning sets – Linear dependence and independence – Bases and dimensions

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UNIT III LINEAR TRANSFORMATION 9

Linear transformations – Kernel and Image – Matrix representation of linear operator – Change of bases and similar matrices

UNIT IV INNER PRODUCT SPACES 9

Inner product spaces – Orthogonal sets and bases – Orthogonal projection - Gram-Schmidt orthogonalozation process

UNIT V DECOMPOSITION OF MATRICES 9

Eigenvalues and eigenvectors – Cayley-Hamilton theorem – Spectral decomposition – Singular value decomposition – Quadratic forms

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total 45 Periods

TEXT BOOKS:

1. Gilbert Strang, "Introduction to linear algebra", 5th edition, Wellesley-Cambridge, 2016.
2. David. C. Lay, "Linear algebra and its applications", 5th edition, Pearson, 2019.

REFERENCES:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra – Applications version", 9th edition, John Wiley & Sons, 2005.
2. Steven J. Leon, "Linear Algebra with Applications", 9th edition, Pearson College Division, 2014.
3. Seymour Lipschutz and Marc Lipson, "Theory and problems of Linear algebra", 3rd edition, Tata McGraw-Hill, 2012.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG41	PROBABILITY THEORY AND DISTRIBUTIONS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the mathematical concepts of probability, one and two dimensional random variables and distributions
- To understand the concepts of mathematical expectations
- To understand the concepts of various discrete and continuous distributions

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand probability axioms and the moments of discrete and continuous random variables to core engineering problems (Understand)

CO2: Compare correlation and linear regression with respect to two dimensional random variables (Understand)

CO3: Understand the opportunities, challenges, and issues in designing and implementing green marketing strategies (Understand)

CO4: Use discrete probability distributions including requirements, mean and variance for making decisions (Understand)

CO5: Use continuous probability distributions including requirements, mean and variance for making decisions (Understand)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		
CO2	3	3	-	-	-	-	-	-	-	-	-	-		
CO3	3	3	-	-	-	-	-	-	-	-	-	-		
CO4	3	3	-	-	-	-	-	-	-	-	-	-		
CO5	3	3	-	-	-	-	-	-	-	-	-	-		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I PROBABILITY AND RANDOM VARIABLES 9

Introduction – Random experiments, Basics of probability, Algebra of events, laws of probability – Bayes' law: Application of probability to business and economics – One-dimensional random variables: Discrete and continuous, Distribution functions and its properties

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UNIT II BIVARIATE RANDOM VARIABLES 9

Bivariate random variables: Joint probability functions, marginal distributions, conditional distribution functions, Notion of independence of random variables – Functions of random variables: distribution function technique, transformation technique: one variable and several variables, theory and applications

UNIT III MATHEMATICAL EXPECTATION AND GENERATING FUNCTIONS 9

Expectation, variance and co-variance of random variables – Conditional expectation and conditional variance – Probability generating functions, moment generating functions, characteristic functions, Applications

UNIT IV DISCRERE DISTRIBUTIONS 9

Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Negative Binomial, Multinomial distributions and Discrete Uniform distribution – Definition, properties and applications with numerical problems

UNIT V CONTINUOUS DISTRIBUTIONS 9

Uniform, Exponential, Gamma, Beta distributions (First and second kind), Weibull, Normal distributions – definition, properties and applications – Concept of truncated distributions

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total 45 Periods

TEXT BOOKS:

1. Sheldon Ross, "A first course in probability", Pearson, 2014.
2. Parimal Mukhopadhyay, "An Introduction to the theory of probability", World Scientific, 2012.
3. Irwin Miller, Marylees Miller, and John E. Freund, "Mathematical Statistics", Pearson, 2017.

REFERENCES:

1. Grewal B S, "Higher Engineering Mathematics", 44th edition, Khanna Publication, Delhi, 2017.
2. Milton J S and Arnold J C, "Introduction to Probability and Statistics", 4th edition, Tata McGraw Hill, 2008.
3. V.K. Rohatgi and A.K.MD. Ehsanes Saleh, "An Introduction to probability and statistics", 3rd edition, John Wiley & sons, 2015.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG42	STATISTICAL INFERENCE	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the basic statistical concepts such as populations, samples and statistics
- To learn the properties and significance of large and small sample tests
- To learn non-parametric methods to solve simple problems involving tolerance regions

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the statistical concepts to solve real world problems (Understand)

CO2: Understand methods such as maximum likelihood, method of moments and least squares for point estimation (Understand)

CO3: Understand the testing of hypothesis about population means, variances and to compare two large samples (Understand)

CO4: Understand the testing of hypothesis to conduct small sample tests like the t-test, F-test accurately (Understand)

CO5: Understand the non-parametric tests for hypothesis testing and inference (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		
CO2	3	3	-	-	-	-	-	-	-	-	-	-		
CO3	3	3	-	-	-	-	-	-	-	-	-	-		
CO4	3	3	-	-	-	-	-	-	-	-	-	-		
CO5	3	3	-	-	-	-	-	-	-	-	-	-		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)						3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION 9

Population, sample, parameter and statistic – Sample mean and variance – Sampling distributions – Statistical estimation of parameters, confidence intervals – Applications to statistical quality control and reliability analysis

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UNIT II POINT ESTIMATION 9

Point estimation – Estimator, Estimate, Methods of point estimation – Maximum likelihood (ML) method – Law of large numbers – Central limit theorem – Large sample properties of ML estimator – Applications – Method of moments and method of least squares

UNIT III LARGE SAMPLE TEST 9

Large sample properties – Test of significance – Test for population mean, proportion – Test for equality of two means, proportions - Test of variance

UNIT IV SMALL SAMPLE TEST 9

Students' t-test, test for population mean, quality of two population means, F-test for equality of two population variances - Chi square test for goodness of fit and for independence of attributes

UNIT V NON PARAMETRIC INFERENCE 9

Comparison with parametric inference – Use of order statistics – Sign test – Wilcoxon signed rank test – Mann Whitney test – Run test – Kolmogorov-Smirnov test – Spearman's and Kendall's test – Tolerance region (simple problems only)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total 45 Periods

TEXT BOOKS:

1. Ronald E. Walpole, Raymond H. Meyers and Sharon L. Meyers, "Probability and Statistics for Engineers and Scientists", 9th edition, Pearson Education, 2013.
2. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", 9th edition, Cengage India Pvt. Ltd., 2020.

REFERENCES:

1. Trivedi K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications", 2nd edition, John Wiley & Sons, 2015.
2. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", 6th edition, John Wiley & Sons, 2016.

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG43	REGRESSION ANALYSIS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the linear and nonlinear regression models
- To learn techniques for fitting curvilinear relationships to data
- To identify sources and effects of multicollinerity in regression models

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand and validate simple regression models using t-test, F-test and p-test to ensure their accuracy and reliability (Understand)

CO2: Understand the multiple regression models and assess their fit (Understand)

CO3: Understand and fit curvilinear relationships and perform through residual analysis (Understand)

CO4: Identify and understand the sources and effects of multicollinearity (Understand)

CO5: Understand link functions and linear predictors to build GLMs (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		
CO2	3	3	-	-	-	-	-	-	-	-	-	-		
CO3	3	3	-	-	-	-	-	-	-	-	-	-		
CO4	3	3	-	-	-	-	-	-	-	-	-	-		
CO5	3	3	-	-	-	-	-	-	-	-	-	-		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I SIMPLE REGRESSION ANALYSIS 9

Introduction: Linear and Nonlinear model – Least square methods – Simple linear regression model to describe a linear relationship – Validating simple regression model using t, F and p test

UNIT II MULTIPLE REGRESSION ANALYSIS 9

Multiple regression model to describe a linear relationship – Assessing the fit of the regression line – inferences from multiple regression analysis – problem of over fitting of a model

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UNIT III FITTING CURVES AND MODEL ADEQUACY CHECKING 9

Introduction – fitting curvilinear relationship – residual analysis – PRESS statistics – Detection and treatment of outliers – lack of fit of the regression model – test of lack of fit

UNIT IV MULTICOLLINEARITY 9

Introduction – sources of multicollinearity – Effects of multicollinearity – Multicollinearity diagnostics: examination of correlation matrix – variance inflation factors – Eigen system analysis

UNIT V GENERALIZED LINEAR MODELS 9

Link functions and linear predictors – parameter estimation and inference in the GLM – Prediction and estimation with the GLM – residual analysis

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total 45 Periods

TEXT BOOKS:

1. Douglas C. Montgomery, Elizabeth A. Peck, and G. Geoffrey Vining, "Introduction to linear regression analysis", 3rd edition, Wiley India Pvt. Ltd., 2016.
2. Norman R. Draper, and Harry Smith, "Applied regression analysis", 3rd edition, Wiley India Pvt. Ltd., New Delhi, 2015.

REFERENCES:

1. R.A. Johnson, D.W. Wichern, "Applied multivariate statistical analysis", 6th edition, PHI learning Pvt. Ltd., 2013.
2. Iain Pardoe, "Applied regression modeling", John Wiley and Sons Inc., 2012.

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>200</td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td></td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG44	DESIGN AND ANALYSIS OF EXPERIMENTS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the basic experimental design
- To understand and conduct analysis of covariance and factorial experiments
- To understand the concepts of intra-block analysis of BIBD and PBIBD

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the principles of scientific experimentation and apply them in practical scenarios (Understand)

CO2: Understand and perform multiple comparisons and multiple range sets (Understand)

CO3: Understand and implement factorial experiments (Understand)

CO4: Understand the construction methods, connectedness, and balancing in BIBD (Understand)

CO5: Understand the complex experimental designs like split plot and strip plot designs (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		
CO2	3	3	-	-	-	-	-	-	-	-	-	-		
CO3	3	3	-	-	-	-	-	-	-	-	-	-		
CO4	3	3	-	-	-	-	-	-	-	-	-	-		
CO5	3	3	-	-	-	-	-	-	-	-	-	-		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)					3: Substantial (High)						

SYLLABUS:

UNIT I SIMPLE COMPARITIVE EXPERIMENTS 9

Principles of scientific experimentation – Basic designs: Completely randomized design (CRD), Randomized block design (RBD), and Latin square design (LSD

UNIT II ANALYSIS OF COVARIANCE 9

Multiple comparisons – Multiple range tests – Analysis of covariance – Construction of orthogonal Latin square – Analysis of Graeco Latin squares

UNIT III FACTORIAL EXPERIMENTS 9

Factorial experiments – 2^2, 2^3 and 3^2, 3^3 experiments and their analysis – Fractional replication in Factorial experiments

UNIT IV BALANCED INCOMPLETE BLOCK DESIGN 9

Balanced incomplete block design (BIBD) – Types of BIBD – Simple construction methods – Concept of connectedness and balancing – intra block analysis o BIBD

UNIT V PARTIALLY BALANCED INCOMPLETE BLOCK DESIGN 9

Partially balanced incomplete block design with associate classes – Intra block analysis – Split plot and strip plot design and their analysis

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total 45 Periods

TEXT BOOKS:

1. Douglas C. Montgomery, "Design and analysis of experiments", 9th edition, John Wiley and sons, 2017.
2. Angela Dean and D.D. Daniel Voss, "Design and analysis of experiments", 2nd edition, Springer International Publishing, 2017.

REFERENCES:

1. John Lawson, "Design and analysis of experiments with R", 1st edition, CRC Press, 2015.
2. M.N. Das, N.C. Giri, "Design and analysis of experiments", 3rd edition, New age International Pvt. Ltd., 2017.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG45	OPTIMIZATION TECHNIQUES	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the linear programming models and sensitivity analysis
- To understand the concepts of primal and dual linear programming problems
- To understand the transportation and assignment models

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand and apply the basic principles and assumptions of linear programming (Understand)

CO2: Understand the simplex method for solving LP problems with two or more variables (Understand)

CO3: Understand how changes in constraints and objective functions affect the optimal solution (Understand)

CO4: Understand the dual simplex method and interpret the economic significance of duality (Understand)

CO5: Understand the procedure to solve transportation problems including finding basic feasible and optimal solutions (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		
CO2	3	3	-	-	-	-	-	-	-	-	-	-		
CO3	3	3	-	-	-	-	-	-	-	-	-	-		
CO4	3	3	-	-	-	-	-	-	-	-	-	-		
CO5	3	3	-	-	-	-	-	-	-	-	-	-		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I LINEAR PROGRAMMING 9

Introduction – Properties, Basic assumptions – Mathematical formulation of linear programming – Constraints – Graphical analysis of LP

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UNIT II LINEAR PROGRAMMING MODELS 9

Simplex method: Basic and formulation of simplex method – Simplex Method with two variables – Simplex method with more than two variables – Big M method

UNIT III SENSITIVITY ANALYSIS 9

Graphical sensitivity analysis – Algebraic sensitivity analysis: Changes in right hand side, Objective function

UNIT IV DUAL LINEAR PROGRAMMING 9

Introduction – Primal and dual problem – Dual problem properties – Dual simplex method – Relations between direct and dual problem - Economic interpretation of duality

UNIT V TRANSPORTATION AND ASSIGNMENT MODELS 9

Introduction – Transportation problem – Balanced and unbalanced - methods of basic feasible solution – Optimal solution – MODI method – Assignment problem – Hungarian method

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total 45 Periods

TEXT BOOKS

1. Hamdy Taha, "Operations research", 10th edition, Prentice hall India, 2019.
2. P.K. Gupta and D.D. Hira, "Operations research", S. Chand & Co., 2007.

REFERENCES:

1. S.D. Sharma, "Operations research", Nath & Co., Meerut, 2000.
2. P. Sankara Iyer, "Operations research", Tata McGraw-Hill, 2008.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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Industrial IoT

U21MDG46	SENSORS AND TRANSDUCERS	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental principles of sensors and transducers
- To acquire the knowledge about different types of sensors and transducers
- To understand the various sensors available for developing an application

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the fundamental characteristics of sensors and transducers (Understand)
CO2: Construct the mechanical modules using sensors (Apply)
CO3: Design electrical and electronics systems using sensors (Apply)
CO4: Implement real time models using transducers (Apply)
CO5: Build the embedded system for real-time applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	2	2	2	-	-	-	1	-	-	1		
CO3	3	2	2	2	2	-	-	-	1	-	-	1		
CO4	3	2	2	2	2	-	-	-	1	-	-	1		
CO5	3	2	2	2	2	-	-	-	1	-	-	1		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I SENSOR AND TRANSDUCER BASICS 6

Need for sensors in the modern world – Classification of active and passive sensors – Static and dynamic characteristics of sensors – Zero I and II order sensors – Environmental factors and reliability of sensors

UNIT II SENSORS FOR MECHANICAL SYSTEMS 6

Sensor for displacement measurement – Flow sensor-level indicators – Pressure in fluids – Wire and film strain gauges – Piezo-electric sensors and LVDT

UNIT III SENSORS FOR ELECTRICAL AND ELECTRONICS SYSTEMS 6

Principles of working of temperature and humidity sensors – Flex sensor – Proximity sensor – RTD – LDR and photo diode

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UNIT IV TRANSDUCERS 6

Electro-acoustic Transducers – Construction and working of microphones-carbon – Condenser and moving coil microphone – Construction and working of loud speakers – PMMC and horn type – Devices used for improving sound quality

UNIT V APPLICATION DEVELOPMENT USING SENSORS AND ACTUATORS 6

Case Studies – Sensor based humidity maintenance of a mushroom farm – Displacement measurement using LVDT – Room temperature measurement and control using thermal sensor – Smart dust bin using PIR sensor

LIST OF EXPERIMENTS (INDICATIVE)

1. Development of an application with three LEDs to follow the cycle all off, red on, green on and blue on for each clap
2. Design of Voice operated door opening and closing using carbon microphone
3. Use Light Dependent Resistor (LDR) as a light operated switch to on/off a device
4. Development of PIR sensor based walking guide for blind people
5. Controlling of a 230V device using a threshold temperature, with a temperature sensor
6. Design a device to monitor the humidity level of the green house
7. Design of a contactless water level controller for RO water industry
8. Vibration level monitoring and controlling system for industrial motors
9. Automatic street lighting system using optical sensor
10. Automatic hand dryer system using IR sensor and DC motor

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Jon S. Wilson, Sensor Technology Hand book, 1st edition, Newnes Publisher, 2016
2. Patranabis, Sensors and Actuators, 2nd edition, PHI, 2013

REFERENCES:

1. Shawhney A. K. "A Course In Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai & Sons, 11th edition, 1999
2. Gaofeng Zhou, Yannian Wang and Lujun Cui., "Biomedical Sensor, Device and Measurement Systems", 1st edition, Intech open Publishers, 2015
3. Murthy.D.V.S, "Transducers and Instrumentation", Prentice Hall of India,2001
4. https://www.journals.elsevier.com/sensors-and-actuators
5. https://www.sciencedirect.com/handbook/handbook-of-sensors-and-actuators
6. https://www.classcentral.com/course/swayam-sensors-and-actuators-14285

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG47	PROGRAMMING FOR IOT	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the architecture and components of IoT systems
- To gain proficiency in programming languages commonly used in IoT development
- To learn to interface with sensors and actuators

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the concepts of IoT and various controllers (Understand)
CO2: Build an IoT models using Arduino controllers (Apply)
CO3: Develop the embedded systems using sensors and actuators (Apply)
CO4: Design an IoT systems using communication protocols (Apply)
CO5: Implement IoT project environment for real time applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	2	2	1	-	-	-	1	-	-	1		
CO3	3	2	2	2	1	-	-	-	1	-	-	1		
CO4	3	2	2	2	1	-	-	-	1	-	-	1		
CO5	3	2	2	2	1	-	-	-	1	-	-	1		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I INTRODUCTION TO IoT AND EMBEDDED CONTROLLERS 6

Overview of IoT – Components – Architecture – Applications and challenges in IoT – IoT hardware platforms – Arduino, Node MCU

UNIT II PROGRAMMING WITH ARDUINO IDE 6

Introduction to Arduino IDE – Libraries – Arduino controllers and its architecture – Basic programming constructs – Compiling and execution

UNIT III INTERFACING WITH ARDUINO CONTROLLERS 6

Overview of sensors and actuators – Analog and digital sensors – Switches and actuators

UNIT IV INTERFACING WITH COMMUNICATION PROTOCOLS 6

Overview on IoT communication protocols – Arduino controller interfacing with Wi-Fi – Bluetooth module

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UNIT V PROJECT DEVELOPMENT AND CASE STUDIES 6

Real time IoT project design – Testing and debugging IoT systems – Case studies of successful IoT implementations

LIST OF EXPERIMENTS (INDICATIVE)

1. Create an Arduino Uno Project to Blink the Built-in LED
2. Develop a Traffic Light Control System Simulation using Arduino
3. Design a System to Control an LED with a Push Button using Arduino
4. Interface Temperature Sensors with Arduino for Real-Time Data Monitoring
5. Build a Servo Motor Control System using Arduino
6. Implement Bluetooth Data Transfer with Arduino
7. Establish a Wi-Fi Enabled Communication Network using Arduino
8. Control an Actuator via Arduino Cloud Platform
9. Design a System to Control Electrical Appliances using Arduino
10. Develop a Remote Actuator Control System Based on Sensor Data using Arduino

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Arshdeep Bahga and Vijay Madisetti, " Internet of Things: A Hands-on Approach", Universities Press, 2015
2. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Morgan Kaufmann publications, 2016

REFERENCES:

1. Simon Monk, "Programming Arduino: Getting Started with Sketches", 2nd edition, McGraw-Hill, 2016
2. Agus Kurniawan, "NodeMCU Development Workshop", PE Press, 2015
3. Michael Margolis, Brian Jepson, Nicholas Robert Weldin, "Arduino Cookbook", 3rd edition, O'Reilly Media, 2020

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG48	EMBEDDED CONTROLLERS	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To know the features and applications of embedded controllers
- To understand the hardware interfacing concepts for IoT applications.
- To acquire the knowledge of embedded controllers for IoT systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify the suitable GPIO interfacing with NodeMCU (Understand)
CO2: Demonstrate the interfacing with GPIO pins of Raspberry Pi (Apply)
CO3: Use real time sensor data acquisition and control module for IoT applications (Apply)
CO4: Build the IoT communication network for real time applications (Apply)
CO5: Develop the smart systems for real time applications (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	2	2	2	-	-	-	1	-	-	1		
CO3	3	2	2	2	2	-	-	-	1	-	-	1		
CO4	3	2	2	2	2	-	-	-	1	-	-	1		
CO5	3	2	2	2	2	-	-	-	1	-	-	1		

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I NODEMCU 6

NodeMCU features and specifications – Pin configuration – Overview on Arduino IDE – Interfacing with LED, push button and switches

UNIT II RASPBERRY Pi 6

Raspberry Pi features and specifications – Architecture of Pi board – Overview of Thonny IDE – Interfacing with LED, push button and switches

UNIT III HARDWARE INTERFACING WITH NodeMCU AND PI 6

Digital sensors – Analog sensors –Switches and motors – Display devices

UNIT IV INTERFACTING WITH COMMUNICATION PROTOCOLS 6

MQTT protocol – Wi-Fi – Blue tooth – Cloud Platforms – Controlling devices via cloud

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UNIT V CASE STUDIES 6

Irrigation system – IoT enabled energy meter – Wi-Fi controlled robot car – Vehicle parking system – Real time health monitoring system

LIST OF EXPERIMENTS (INDICATIVE)

1. Design and implement a Wi-Fi controlled led lighting system using NodeMCU
2. Design a real-time air quality monitoring system using NodeMCU
3. Implement a smart security camera system using Raspberry PI
4. Interface switches, motors, and display devices with NodeMCU
5. Design and implement a voice-activated smart mirror using Raspberry Pi
6. Implement a comprehensive home automation system using NodeMCU
7. Design accurate range detection using ultrasonic sensors using Raspberry Pi
8. Establish Wi-Fi and Bluetooth communication between NodeMCU and Raspberry PI.

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Gehlot, A., Gupta, L. R., Rathour, N., "IoT Based Projects: Realization with Raspberry Pi, NodeMCU and Arduino", BPB Publications, 2020.
2. Dr. Umesh Dutta, Nilansh Khurana, Devdutt, "The Internet of Things Using NODEMCU", Blue Rose Publishers, 2021

REFERENCES:

1. Ziemann, V., "A Hands-On Course In Sensors Using the Arduino and Raspberry Pi, United States, CRC Press, 2018.
2. Bhadoria, S., Oliva Ramos, R., "Raspberry Pi 3 Home Automation Projects: Bringing Your Home to Life Using Raspberry Pi 3, Arduino, and ESP8266", United Kingdom: Packt Publishing, 2017.
3. Molloy, D., "Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux", United Kingdom: Wiley, 2016.
4. Parikh, D., "Raspberry Pi and MQTT Essentials: A Complete Guide to Helping You Build Innovative Full-scale Prototype Projects Using Raspberry Pi and MQTT Protocol", United Kingdom: Packt Publishing, 2022

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG49	IOT PROTOCOLS AND CLOUD COMPUTING	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the fundamentals of IoT communication protocols
- To learn the access methodologies of different IoT protocols.
- To explore cloud services that can be utilized to build scalable and efficient IoT solutions

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the basics of IoT protocols and communication models (Understand)

CO2: Build the network models using IoT protocols (Apply)

CO3: Develop wireless communication environment for IoT applications (Apply)

CO4: Apply the AWS cloud fundamentals and services for real time IoT applications (Apply)

CO5: Implement end-to-end cloud based IoT deployment (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	2	3	3	-	-	-	1	-	-	1		
CO3	3	2	2	3	3	-	-	-	1	-	-	1		
CO4	3	2	2	3	3	-	-	-	1	-	-	1		
CO5	3	2	2	3	3	-	-	-	1	-	-	1		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I COMMUNICATION MODELS 6

Introduction to protocols – Communication models – Machine-to-Machine (M2M) communication – Network topologies – TCP/IP suite IPv6 and 6LoWPAN

UNIT II NETWORK MODELS 6

Introduction to network protocols – Message Queuing Telemetry Transport (MQTT) – Constrained Application Protocol (CoAP) – Advanced Message Queuing Protocol (AMQP) – Comparison of MQTT, CoAP and AMQP

UNIT III APPLICATION LAYER AND WIRELESS COMMUNICATION PROTOCOLS 6

HTTP and HTTPS – Websockets – Extensible Messaging and Presence Protocol (XMPP) – Wi-Fi Bluetooth – Zig-bee – Low-Power Wide-Area Network(LPWAN) – LoRaWAN – NB-IoT

UNIT IV CLOUD COMPUTING AND SERVICES 6

Introduction to cloud computing – AWS fundamentals – IAM – Amazon EC2 – Auto scaling and load balancing – AWS Lambda – AWS IoT, storage and database services

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UNIT V CLOUD DEPLOYMENT 6

Introduction to docker container – Introduction to Kubernetes – Kafka for end-to-end IoT pipeline – Jenkins – Real time Deployment

LIST OF EXPERIMENTS (INDICATIVE)

1. Implement a basic MQTT communication between an IoT device and a server
2. Implement CoAP for communication between resource-constrained devices
3. Implement secure communication using TLS/DTLS in an IoT setup
4. Develop real-time communication system using HTTP and Web Sockets
5. Develop LPWAN communication setup for long-range communication
6. Develop a cloud-based solution for continuously monitoring and analyzing humidity and temperature data from multiple sensors
7. Implement a cloud-based object counting system that uses real-time data processing to count and track objects
8. Deploy applications in real-time using Docker and Kubernetes

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Maciej Kranz, "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry", 1st edition, wiley, 2016
2. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management and Security", 1st edition, CRC Press, 2017

REFERENCES:

1. Rajkamal, "Internet of Things: Architecture, Design Principles And Applications", 2nd edition , McGraw Hill Higher Education, 2017
2. Ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", 1st edition, O'Reilly, 2011
4. Piper, Ben, and David Clinton, "AWS Certified Solutions Architect Official Study Guide: Associate Exam", 1st edition, Sybex, 2016

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EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th colspan="2">End Semester Examinations</th></tr>
<tr><td colspan="2">Assessment I
(Theory)
(100 Marks)</td><td colspan="2">Assessment II
(Practical)
(100 Marks)</td><td rowspan="2">Theory Examinations (Examinations will be conducted for 100 Marks)</td><td rowspan="2">Practical Examinations (Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)</td><td>Test</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td><td></td><td></td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>25</td></tr>
<tr><td colspan="4">50</td><td colspan="2">50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

Head of the Department,
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U21MDG50	MOBILE APPLICATION DEVELOPMENT FOR IOT	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the basics of MIT APP Inventor
- To acquire the knowledge of app development for real time applications
- To familiarize the app development concepts for IoT systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the basic concepts of app development for the given applications (Understand)
CO2: Develop the simple mobile app for IoT applications (Apply)
CO3: Examine the advanced features and APIs of MIT app inventor (Apply)
CO4: Build a suitable app for real time applications IoT applications (Apply)
CO5: Create the optimized mobile app for commercial applications (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1		
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CO3	3	2	3	3	3	-	-	-	1	-	-	1		
CO4	3	2	3	3	3	-	-	-	1	-	-	1		
CO5	3	3	3	3	3	-	-	-	1	-	-	1		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I APP DEVELOPMENT BASICS 6

Overview – MIT App inventor – Environment setup – Understanding the designer and blocks editor – Basic components and properties – Layouts and user interface design

UNIT II BASIC APP DEVELOPMENT 6

Click counter App – Simple multimedia app – Handling media files and permissions – Lists and List Pickers – Data storage

UNIT III ADVANCED FEATURES AND APIs 6

Web components – Integrating an external API – Location-based Services – Advanced UI components – Chat App

UNIT IV COMPLEX APP DEVELOPMENT AND PUBLISHING 6

Bluetooth components – App monetization – User authentication – Performance pptimization – Preparing app assets – App publishing

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UNIT V CASE STUDIES 6

Recipe App with voice instructions – Public transport tracker – Expense tracker – Garden plant care App – Inventory management

LIST OF HANDS-ON PROJECTS (INDICATIVE)

1. Develop a Scalable Note-Taking Mobile App
2. Implement an Interactive Quiz Application with Real-Time Analytics and User Insights
3. Design and Develop a Comprehensive Weather Monitoring Application
4. Create a Student Attendance Management System
5. Develop Travel Guide Mobile Application

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Walter, D., Sherman, M., "Learning MIT App Inventor: A Hands-On Guide to Building Your Own Android Apps", United Kingdom: Pearson Education, 2014.
2. Timbah, L, "Beginner Mobile App Development Using MIT App Inventor", Malaysia: Amazon Digital Services LLC, 2020

REFERENCES:

1. Lang, K., "Become an App Inventor: The Official Guide from MIT App Inventor: Your Guide to Designing, Building, and Sharing Apps", United States: Candlewick Press, 2022.
2. Wolber, D., Abelson, H., Spertus, E., Looney, L.,"App Inventor 2: Create Your Own Android Apps", United States: O'Reilly Media, 2014.
3. Logan, L., "Learn to Program with App Inventor: A Visual Introduction to Building Apps", United States: No Starch Press, 2019.
4. Guthals, S., "Building a Mobile App: Design and Program Your Own App!.", 1st edition, United States: Wiley, 2017

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th colspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (Theory) (100 Marks)</th><th colspan="2">Assessment II (Practical) (100 Marks)</th><th rowspan="2">Theory Examinations (Examinations will be conducted for 100 Marks)</th><th rowspan="2">Practical Examinations (Examinations will be conducted for 100 Marks)</th></tr>
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<tr><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>25</td></tr>
<tr><td colspan="4">50</td><td colspan="2">50</td></tr>
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</table>

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U21MDG51	AUTOMATION USING IOT	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental principles of Industry 4.0 and applications
- To acquire the knowledge about different versions of Industrial 4.0
- To design and develop the various real time applications using Industrial IoT

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the fundamental concepts of Industry 4.0 (Understand)

CO2: Apply concepts of smart business perspectives in modern industries (Apply)

CO3: Apply cyber-physical systems for advanced analysis and collaborative product management (Apply)

CO4: Implement cybersecurity measures for secure and efficient operations (Apply)

CO5: Apply the Industrial IoT concept to develop real time applications (Apply)

CO- PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	2	2	2	-	-	-	1	-	-	1		
CO3	3	2	2	2	2	-	-	-	1	-	-	1		
CO4	3	2	2	2	2	-	-	-	1	-	-	1		
CO5	3	2	2	2	2	-	-	-	1	-	-	1		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I BASICS OF INDUSTRY 4.0 6

Introduction: Sensing and actuation – Communication – Part I, Part II – Networking – Part I, Part II – Globalization and emerging issues

UNIT II LEAN PRODUCTION SYSTEMS 6

The Fourth Revolution – LEAN production systems – Smart and connected business perspective – Smart factories

UNIT III CYBER PHYSICAL SYSTEMS 6

Cyber physical systems and next generation sensors – Collaborative platform and product lifecycle management – Augmented reality and virtual reality – Artifical intelligence – Big data and advanced analysis

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UNIT IV CYBER SECURITY 6

Cyber security in Industry 4.0 – Basics of Industrial IoT – Industrial Processes – Part I, Part II – Industrial sensing and actuation – Industrial internet systems

UNIT V APPLICATION DOMAINS OF INDUSTRY 4.0 6

Healthcare – Power plants – Inventory management and quality control

LIST OF EXPERIMENTS (INDICATIVE)

1. Implement MQTT protocol for wireless communication between devices.
2. Implement secure communication protocols in an industrial IoT setup.
3. Design and implement a system for monitoring and analyzing machine vibration levels
4. Design and implement an IoT-based soil moisture monitoring system
5. Implement the fabric defect detection using photo diode.
6. Implement a system to control the speed of a fan based on temperature readings.
7. Develop a building intrusion detection system using ultrasonic sensors.
8. Develop an IoT system for remote patient monitoring

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Sudip Misra, Chandana Roy, Anandarup Mukherjee, "Introduction To Industrial Internet of Things and Industry 4.0" 1st edition, CRC Press, 2020

REFERENCES:

1. Giacomo Veneri and Antonio Capasso, "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0", 1st edition, Packt Publishing, 2018
2. Suresh A., "Industrial IoT Application Architectures and Use Cases", 1st edition, Taylor & Francis Ltd, 2019
3. Alasdair Gilchrist," Industry 4.0: The Industrial Internet of Things" , 1st edition, Apress, 2019
4. Rajkamal, "Internet of Things (IOT): Architecture and Design Principles", 2nd edition, McGraw Hill Education (India) Private Limited, 2022
5. Dr. Amit Mehta, Mr. Jay Bulani, et al, "Introduction to Industry 4.0", 1st edition, Taran Publication, 2024

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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Image Processing Techniques

U21MDG52	DIGITAL IMAGE FUNDAMENTALS	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental of image fundamentals and acquisition systems
- To acquire the knowledge on color image fundamentals.
- To understand the use of mathematical tools and transforms.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Summarize the concepts of digital image processing (Understand)

CO2: Outline the fundamentals of image acquisition techniques (Understand)

CO3: Apply suitable mapping techniques for color image processing (Apply)

CO4: Apply geometric transformations such as translation, scaling, rotation, affine transformations, and warping (Apply)

CO5: Implement different algorithms using image transforms (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	2	2	-	-		
CO2	2	-	-	2	2	-	-	2	2	2	-	-		
CO3	3	2	1	2	2	-	-	2	2	2	-	-		
CO4	3	2	1	2	2	-	-	2	2	2	-	-		
CO5	3	2	1	2	2	-	-	2	2	2	-	-		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I INTRODUCTION TO DIGITAL IMAGE PROCESSING 6

Definition and importance of digital images – Historical background and applications – Pixels, resolution and Intensity – Elements of visual perception – Applications and significance of Image processing systems – Components of image processing system – Hardware and software

UNIT II IMAGE ACQUISITION AND SAMPLING 6

Principles of image formation – Types of image sensors – Sensor characteristics and performance – Image acquisition techniques – Analog and digital imaging systems – Frame grabbers and digitizers Time-lapse and high-speed imaging – Sampling theory quantization – Pixel relationships – Image geometry

UNIT III COLOR IMAGE FUNDAMENTALS 6

Color transformation and conversion – Color image processing – Color spaces and color science – Pseudo-color conversion – Mapping gray scale values to color values – Linear and non-linear color mapping – Custom color maps and design

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UNIT IV MATHEMATICAL TOOLS USED IN IMAGE PROCESSING 6

Arithmetic Operations – Image addition subtraction multiplication and division – Scalar operations – Image averaging – Logical operations – Bitwise operations – Thresholding – Image masking – Geometric transformations – Translation – Scaling rotation – Affine transformations – Warping

UNIT V IMAGE TRANSFORMS 6

Types of Transforms – Discrete Fourier Transform (DFT) – Discrete Cosine Transform (DCT) – Discrete Wavelet Transform (DWT) – Applications – Algorithms

LIST OF EXPERIMENTS (Using Simulation Tool)

1. Pixel manipulation and resolution adjustment
2. Intensity Transformations of Images
3. Interpolation techniques
4. Sampling and reconstruction of images
5. Enhancement of color images
6. Conversion between different color spaces (RGB, HSV, YCbCr)
7. Image arithmetic operations
8. Image geometric transformations
9. Image compression by implementing DCT
10. Image Denoising using Wavelet Transform

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Gonzalez R C, Woods R E, "Digital Image Processing", 4th edition, Pearson, 2018
2. Anil K Jain, "Fundamentals of Digital Image Processing", 2nd edition, Prentice Hall, 2012

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, "Digital Image Processing Using MATLAB", 3rd edition, Pearson Publication, 2017
2. John C. Russ and J. Christian Russ, "Introduction to Image Processing and Analysis", 1st edition, CRC Press, 2018

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th colspan="2" rowspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (Theory) (100 Marks)</th><th colspan="2">Assessment II (Practical) (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)</td><td>Test</td><td rowspan="2">Theory Examinations (Examinations will be conducted for 100 Marks)</td><td rowspan="2">Practical Examinations (Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>25</td></tr>
<tr><td colspan="4">50</td><td colspan="2">50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG53	IMAGE ENHANCEMENT AND RESTORATION	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE-REQUISITES:

- U21MDG52 : Digital Image Fundamentals

COURSE OBJECTIVES:

- To Understand the fundamentals of image enhancement and restoration
- To acquire the knowledge of various image enhancement techniques like filtering, transformation, and histogram processing
- To learn image restoration techniques like denoising, deblurring, and inpainting

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Select appropriate image enhancement techniques for manipulation of images in spatial domain (Apply)

CO2: Apply suitable image enhancement techniques for manipulation of images in frequency domain (Apply)

CO3: Implement image de-noising to restore the image (Apply)

CO4: Apply suitable image deburring techniques to recover the degraded image (Apply)

CO5: Examine the multiscale image processing using Wavelet and Curvelet analysis (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	2	-	-	2	2	2	-	-		
CO2	3	2	-	2	2	-	-	2	2	2	-	-		
CO3	3	2	2	2	2	-	-	2	2	2	-	-		
CO4	3	2	-	2	2	-	-	2	2	2	-	-		
CO5	3	3	2	2	2	-	-	2	2	2	-	-		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I SPATIAL DOMAIN TECHNIQUES 6

Image transformation – Contrast stretching, histogram equalization and gamma correction – Histogram processing – Histogram equalization and specification – Spatial filtering

UNIT II FREQUENCY DOMAIN TECHNIQUES 6

Frequency domain filtering – Homomorphic filter – Image smoothing – Image sharpening – Selective filtering

UNIT III IMAGE DE-NOISING METHODS 6

Noise Models – Spatial filtering for noise removal – Periodic noise reduction – Linear, position-invariant degradations – Gaussian, wavelet and Curvelet de-noising

UNIT IV IMAGE DE-BLURRING TECHNIQUES 6

Inverse filter – Wiener filter – Constrained least square filtering – Geometric mean filter – Image inpainting – Interpolation and patch-based methods

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UNIT V ADVANCED IMAGE ENHANCEMENT AND RESTORATION TECHNIQUES 6

Adaptive filtering and transformation – Multiscale image processing – Wavelet and Curvelet analysis – Introduction to image segmentation and object recognition

LIST OF EXPERIMENTS (Using Simulation Tool)

1. Image filtering and transformation
2. Gamma correction for image enhancement
3. Histogram equalization
4. Image sharpening
5. Image denoising
6. Image deblurring
7. Multiscale image processing
8. Object detection for real time application
9. Implementation of image interpolation
10. Implementation of wiener filtering for image restoration

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 4th edition, Pearson Education, 2018
2. Bahadir Kursat, Gunturk, "Image Restoration: Fundamentals and Advances" 1st edition, CRC press, 2016

REFERENCES:

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Original edition, Pearson Education, 2014
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Original edition, Pearson Education, 2013
3. Jayaraman S, Veerakumar T, Esakkirajan S, "Digital Image Processing", Original edition, Tata McGraw Hill, 2017

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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		Category: MDC				
U21MDG54	IMAGE SEGMENTATION TECHNIQUES	L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21MDG52 : Digital Image Fundamentals

COURSE OBJECTIVES:

- To understand the concepts of image segmentation and representation
- To acquire the knowledge of feature extraction and description
- To learn the advanced image segmentation techniques and its real time applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Summarize the concepts of image segmentation (Understand)

CO2: Apply the suitable thresholding techniques for image segmentation (Apply)

CO3: Implement the various region-based image segmentation techniques (Apply)

CO4: Use morphological processing for image segmentation (Apply)

CO5: Develop feature extraction algorithm for real time applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	2	2	-	-		
CO2	3	2	1	2	2	-	-	2	2	2	-	-		
CO3	3	2	2	2	2	-	-	2	2	2	-	-		
CO4	3	2	1	2	2	-	-	2	2	2	-	-		
CO5	3	2	-	2	2	-	-	2	2	2	-	-		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I INTRODUCTION TO SEGMENTATION 6

Point, line and edge detection – Local processing – Global processing – Boundary representation and description

UNIT II THRESHOLDING TECHNIQUES 6

Global thresholding – Adaptive thresholding – Multilevel thresholding – Color image thresholding – optimization techniques

UNIT III REGION BASED SEGMENTATION 6

Region growing – Region splitting and merging – Watershed segmentation – Graph based segmentation – Similarity measures – Statistical models

UNIT IV MORPHOLOGICAL IMAGE PROCESSING 6

Erosion – Dilation – Opening – Closing – Top hat and bottom hat transformation – Reconstruction – Structuring elements

UNIT V FEATURE BASED SEGMENTATION 6

Color – Texture – Shape – Contour features – LBP – SIFT – PCA – LDA – Case studies

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LIST OF EXPERIMENTS (Using Simulation Tool)

1. Perform edge detection using different edge detection techniques
2. Implement and compare different thresholding techniques for image segmentation
3. Perform Image segmentation using region-based approaches
4. Implement graph cut algorithm for image segmentation
5. Perform image dilation and erosion operations
6. Perform morphological processing for any satellite image using image open and close operations
7. Extract texture features for contour detection
8. Extract and analyse different features using colour histograms
9. Perform Scale Invariant Feature Transform for a given binary image
10. Implement Image Stitching and Mosaicking

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods
Total: 60 Periods

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson, Education, Inc., 4th edition, 2019
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press, 4th edition, 2019

REFERENCES:

1. Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Pearson Education India, 3rd edition, 2020
2. Chris Solomon, Toby Breckon, Fundamentals of Digital Image Processing: A Practical Approach with examples in Matlab", Wiley-Blackwell, 2010
3. Anil K Jain, Fundamentals of Digital Image Processing", Prentice Hall, Reprint 2022
4. John C.Russ, "The Image Processing Handbook", CRC Press,2007

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG55	PATTERN RECOGNITION AND CLASSIFICATION	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21MDG52 : Digital Image Fundamentals

COURSE OBJECTIVES:

- To understand the fundamental principles of pattern recognition.
- To apply the knowledge of supervised and unsupervised learning techniques for classification and clustering.
- To apply the concept of neural networks and deep learning models for real-world pattern recognition tasks.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Summarize the concepts of pattern recognition methods (Understand)

CO2: Develop supervised learning algorithms for classification tasks (Apply)

CO3: Apply clustering techniques and dimensionality reduction methods for image classification (Apply)

CO4: Implement convolutional neural networks (CNNs) for pattern recognition tasks (Apply)

CO5: Design deep learning models for pattern classification tasks (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	2	2	-	-		
CO2	3	2	2	2	2	-	-	2	2	2	-	-		
CO3	3	2	1	2	2	-	-	2	2	2	-	-		
CO4	3	2	2	2	2	-	-	2	2	2	-	-		
CO5	3	2	1	2	2	-	-	2	2	2	-	-		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I FUNDAMENTALS OF PATTERN RECOGNITION 6

Introduction – Basic concepts and definitions – Representations of patterns and classes – Statistical and Syntactic pattern recognition – Machine learning algorithms – Overview – Supervised, unsupervised, reinforcement

UNIT II SUPERVISED LEARNING TECHNIQUES 6

K-Nearest Neighbours (K-NN) – Bayesian classifier – Decision trees – Support vector machines (SVM)

UNIT III UNSUPERVISED LEARNING TECHNIQUES 6

Clustering algorithms – K-Means clustering – Density-Based Spatial Clustering of Applications with Noise (DBSCAN) – Dimensionality reduction – Principal Component Analysis (PCA) – t-Distributed Stochastic Neighbor Embedding (t-SNE)

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UNIT IV NEURAL NETWORKS FOR PATTERN RECOGNITION 6

Neural networks – Neuron model and network architectures – Activation functions – Perceptron and Multilayer Perceptron (MLP) – Convolutional Neural Networks (CNNs) – Architecture – Convolution and pooling Layers – Region-Based CNN (R-CNN)

UNIT V DEEP LEARNING FOR PATTERN CLASSIFICATION 6

Transfer learning and pre-trained models – Generative Adversarial Networks (GANs) – Variational Auto-encoders (VAEs) – YOLO (You Only Look Once)

LIST OF EXPERIMENTS (Using Simulation Tool)

1. Implementing K-Nearest Neighbors (K-NN) Algorithm
2. Decision Trees for Classification and Pruning Techniques
3. Support Vector Machines (SVM) for Classification
4. Clustering with K-Means and DBSCAN Algorithms
5. Principal Component Analysis (PCA) for Dimensionality Reduction
6. t-Distributed Stochastic Neighbor Embedding (t-SNE) for Data Visualization
7. Multilayer Perceptron (MLP) Neural Networks for Classification
8. Convolutional Neural Networks (CNNs) for Image Classification
9. Transfer Learning with Pre-trained Models
10. Generative Adversarial Networks (GANs) for Data Augmentation

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Richard O. Duda, Peter E. Hart, and David G. Stork, "Pattern Classification", Wiley, 2nd edition, 2012
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2009
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", The MIT Press, 2016

REFERENCES:

1. Keinosuke Fukunaga, "Introduction to Statistical Pattern Recognition", Elsevier, 2013
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG56	IMAGE COMPRESSION AND SECURITY	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21MDG52 : Digital Image Fundamentals

COURSE OBJECTIVES:

- To learn the concepts of various image compression methods
- To impart knowledge on transform-based compression techniques
- To understand the methods of image encryption, and watermarking techniques

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Summarize the basic concepts of image compression techniques (Understand)

CO2: Apply suitable transform techniques for image compression (Apply)

CO3: Use cryptographic and steganographic methods to secure digital images (Apply)

CO4: Experiment with watermarking strategies for image security (Apply)

CO5: Implement image security in real time applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	2	2	-	-		
CO2	3	2	1	2	2	-	-	2	2	2	-	-		
CO3	3	2	1	2	2	-	-	2	2	2	-	-		
CO4	3	2	1	2	2	-	-	2	2	2	-	-		
CO5	3	2	1	2	2	-	-	2	2	2	-	-		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I BASICS OF IMAGE COMPRESSION 6

Encoder-decoder model – Types of redundancies – Lossy and lossless compression – Huffman coding, arithmetic coding, LZW coding, blocking artifacts, run length coding – Bit-plane encoding, Threshold coding – JPEG – Lossless predictive coding – Lossy predictive coding, motion compensation

UNIT II TRANSFORM-BASED COMPRESSION 6

Mathematical preliminaries for transforms – Karhunen Loeve transform, Discrete cosine transforms, Discrete Walsh transform, Hadamard transform – Transform coding – Sub-band coding – Wavelet based compression

UNIT III IMAGE SECURITY TECHNIQUES 6

Introduction to cryptography – Types – Key cryptographic algorithms – Cryptographic hash functions – Applications of cryptography – Encryption algorithms for images – Block ciphers – Stream ciphers – Chaos-based encryption – Performance metrics – Steganography – Types – Steganographic techniques – Steganalysis

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UNIT IV WATERMARKING TECHNIQUES 6

Introduction to watermarking – Types – Visible, invisible, fragile and robust watermarking techniques – Spatial domain techniques – Frequency domain techniques – Hybrid techniques – Performance evaluation

UNIT V CASE STUDIES 6

Secure image transmission in medical imaging – Forensic analysis of tampered images – Secure image sharing on social media platforms – Preserving historical documents through digital archiving

LIST OF EXPERIMENTS (Using Simulation Tool)

1. Implementation of Huffman coding for lossless image compression
2. Implement Arithmetic Coding for lossless image compression and analyze the efficiency
3. Implement a lossy predictive coding algorithm and evaluate the compression performance
4. Implementation of JPEG compression and analyze the effect of blocking artifacts
5. Apply Discrete Wavelet Transform (DWT) for image compression and compare it with Discrete Cosine Transform (DCT)
6. Implementation of AES encryption for securing an image
7. Implement a basic LSB steganography technique and analyze its effectiveness
8. Implement a chaos-based encryption algorithm for image security
9. Embed and extract an invisible watermark in an image
10. Implement a simple spatial domain watermarking technique and evaluate its robustness

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Edu. 3rd edition, 2007
2. Joshi, MadhuriA, Dandawate, Yogesh H, Raval, Mehul S, Joshi, Kalyani R, Metkar, Shilpa P, "Image and Video Compression: Fundamentals, Techniques, and Applications", United Kingdom: Taylor & Francis, 2014

REFERENCES:

1. Cox, Ingemar, Miller, Matthew, Bloom, Jeffrey, Fridrich, Jessica, Kalker,Ton, "Digital watermarking and Steganography", Netherlands: Elsevier Science, 2007
2. Salomon, David, "Data compression: the complete reference", Germany: Springer London, 2007
3. Stallings, William, "Cryptography and Network Security: Principles and Practice", United Kingdom: Pearson Education, 2016
4. Katzenbeisser, Stefan., Petitcolas, Fabien A. P, "Information Hiding Techniques for Steganography and Digital Watermarking", United Kingdom: Artech House, 2000

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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U21MDG57	APPLICATIONS OF IMAGE PROCESSING	Category: MDC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21MDG52 : Digital Image Fundamentals

COURSE OBJECTIVES:

- To understand the fundamental of medical image acquisition systems
- To acquire the knowledge on the applications of image processing in remote sensing and robotics
- To understand the concepts of biometric recognition and autonomous vehicle design

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply suitable image processing techniques for medical image analysis (Apply)

CO2: Use appropriate image processing techniques for remote sensing applications (Apply)

CO3: Develop suitable algorithm for robotics applications (Apply)

CO4: Implement face recognition and iris recognition for biometric applications (Apply)

CO5: Design suitable algorithms for lane detection and traffic sign recognition applications (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	2	-	-	2	2	2	-	-		
CO2	3	2	-	2	2	-	-	2	2	2	-	-		
CO3	3	2	-	2	2	-	-	2	2	2	-	-		
CO4	3	2	-	2	2	-	-	2	2	2	-	-		
CO5	3	2	-	2	2	-	-	2	2	2	-	-		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I MEDICAL IMAGE PROCESSING 6

Modalities of medical imaging – Computed Tomography (CT) – Ultrasound imaging – Magnetic Resonance Imaging (MRI) – Image segmentation – Fuzzy based techniques – Fuzzy clustering – Fuzzy c-means clustering – Principal Component Analysis (PCA) – Neural network based techniques – Neuron model and network architecture – Learning methods

UNIT II IMAGE PROCESSING IN REMOTE SENSING 6

Data collection – Sensing process – Satellite remote sensing – Aerial photography – Thermal infrared remote sensing – RADR – SAR – LiDAR – Remote sensing of vegetation – Remote sensing of water

UNIT III IMAGE PROCESSING IN ROBOTICS 6

Image formation – Region, line and point features – Stereo vision – Structure and motion – Position based visual servoing – Image based visual servoing

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UNIT IV BIOMETRICS APPLICATIONS 6

Biometric systems – Biometric functionalities – Fingerprint recognition – Matching – Fingerprint indexing – Face recognition – Feature extraction and matching – Iris recognition – Normalization – Encoding and matching

UNIT V IMAGE PROCESSING FOR AUTONOMOUS VEHICLES 6

Man and machine – Visual perception for autonomous driving – Lane detection and traffic sign recognition – Sensor fusion and real-time processing – Safety and security

LIST OF EXPERIMENTS (Using Simulation Tool)

1. Blood Flow Analysis using Doppler Ultrasound Images
2. Brain activity analysis
3. Implement algorithms to compute NDVI from multispectral images
4. Enhance the SAR image and detect the edges
5. Develop control algorithms to guide a robotic arm using visual feedback
6. Implement and visualize basic path planning algorithm to guide robotic movement
7. Develop a real-Time Fingerprint recognition system
8. Implement the face recognition system
9. Implement a lane detection system for autonomous driving
10. Dynamic traffic scenario simulation for autonomous vehicles

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods
Total: 60 Periods

TEXT BOOKS:

1. Sinha G. R, Patel, B. C., "Medical Image Processing: Concepts And Applications", Prentice Hall, 2014
2. John R. Jensen, "Remote Sensing of the Environment : An Earth Resource Perspective", 2nd edition, Pearson Education, 2009

REFERENCES:

1. Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", Springer, 2017
2. Anil K. Jain, Arun A. Ross, and Karthik Nandakumar, "Introduction to Biometrics", Springer, 2011
3. Markus Maurer, J. Christian Gerdes, Barbara Lenz, and Hermann Winner, "Autonomous Driving: Technical, Legal and Social Aspects", Springer, 2016
4. Gonzalez R C, Woods R E, "Digital Image Processing", 3rd edition, Prentice Hall, 2007

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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AI FOR EMBEDDED SYSTEMS

U21MDG58	FOUNDATION FOR EMBEDDED SYSTEMS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge on the building blocks of embedded systems
- To understand the interfacing of peripherals in embedded systems
- To acquire knowledge in the embedded C programming

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Illustrate the architecture and pin configuration of 8086 microprocessor (Understand)

CO2: Explain the architecture and pin configuration of 8051 microcontroller (Understand)

CO3: Understand the interface of 8051 microcontroller with peripheral devices (Understand)

CO4: Illustrate the functional blocks of embedded systems (Understand)

CO5: Development of programs using embedded C (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1		
CO2	2	2	-	-	1	-	-	-	-	-	-	1		
CO3	2	2	-	-	1	-	-	-	-	-	-	1		
CO4	2	2	-	-	1	-	-	-	-	-	-	1		
CO5	2	2	-	-	1	-	-	-	-	-	-	1		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I MICROPROCESSOR **9**

Architecture of 8086 - Pin details - Memory organization - Interrupts - Addressing modes - Instruction set and assembler directives - Assembly language programming

UNIT II MICROCONTROLLER **9**

Architecture of 8051 - Memory details - I/O ports - Timers - Serial port - Interrupts

UNIT III INTERFACING PERIPHERAL DEVICES **9**

ADC interfacing - DAC interfacing - Sensor interfacing - Stepper motor interfacing - LCD interfacing

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UNIT IV EMBEDDED SYSTEMS PROCESSOR 9

Structural units - Embedded Processor - Selection of processor and memory devices - DMA - Watchdog timer and Real time clock - In circuit emulator - Target hardware debugging

UNIT V EMBEDDED C PROGRAMMING 9

C Basics – Header file for projects and ports – Meeting real time constraints – Creating hardware delays –timeout mechanism – simple embedded C programs

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Barry B. Brey, 'The Intel Microprocessors, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, PentiumPro Processor, Pentium II, Pentium III, Pentium IV, Architecture, Programming & Interfacing', Eighth Edition, Pearson Prentice Hall, 2009William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin, "Engineering Circuit Analysis", 8th edition, McGraw-Hill Education, New Delhi, 2013
2. Rajkamal, 'Embedded System – Architecture, Programming and Design', 2nd edition, Mc Graw Hill, 2013

REFERENCES:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and McKinlay Rolin D., 'The 8051 Microcontroller and Embedded Systems using Assembly and C', Pearson, 2nd Edition,2006
2. D. V. Hall : 'Microprocessors Interfacing', TMH 3rd Edition

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21MDG59	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge on the foundational concepts and building blocks of artificial intelligence
- To understand and implement neural network architectures and machine learning/deep learning algorithms
- To develop hands-on skills using AI development tools and frameworks for real-world applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the foundational concepts, history, and applications of artificial intelligence (Understand)

CO2: Apply knowledge of neural network architectures to design and analyze basic neural networks (Apply)

CO3: Analyze machine learning algorithms and evaluate their performance using various metrics and validation techniques (Analyze)

CO4: Understand the principles of deep learning and implement basic deep learning models (Understand)

CO5: Develop and deploy AI algorithms using industry-standard tools and frameworks, and evaluate their ethical implications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1		
CO2	3	2	-	-	1	-	-	-	-	-	-	1		
CO3	3	2	-	-	1	-	-	-	-	-	-	1		
CO4	3	2	-	-	1	-	-	-	-	-	-	1		
CO5	3	2	-	-	1	-	-	-	-	-	-	1		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

History of AI - Terminologies - Differences between AI, machine learning, and deep learning - AI programming languages (Basics: Python)

UNIT II NEURAL NETWORK ARCHITECTURES 9

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Basics of neural networks - Structure and functioning of perceptron - Deep neural networks - Types of neural network architectures - Activation functions – Training, Testing and Validation - Over fitting and regularization techniques.

UNIT III MACHINE LEARNING 9

Supervised vs unsupervised learning - Algorithms: regression, classification, and clustering - Evaluation metrics and model validation - Cross-validation techniques - Feature engineering and selection.

UNIT IV DEEP LEARNING 9

Architecture: Convolutional neural networks (CNNs) - Recurrent Neural Networks (RNNs) - Transfer learning

UNIT V IMPLEMENTATION OF AI 9

AI development tools and frameworks - Implementing AI algorithms (Python) - Case studies: Fraud detection in financial transactions, Disease classification - Model performance evaluation and improvement

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Russell, S. J., & Norvig, P. 'Artificial intelligence: a modern approach'. 4th edition, Pearson, 2016
2. Burkov, A.,. 'The hundred-page machine learning book', Quebec City, QC, Canada: Andriy Burkov, 2019

REFERENCES:

1. Weidman, S.'Deep learning from scratch: Building with python from first principles'. O'Reilly Media, 2019
2. Chollet, Francois. 'Deep learning with Python'. Simon and Schuster, 2021.
3. Artasanchez, Alberto, and Prateek Joshi. Artificial Intelligence with Python: Your complete guide to building intelligent apps using Python 3. x. Packt Publishing Ltd, 2020.

EVALUATION PATTERN:

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21MDG60	EMBEDDED HARDWARE FOR AI	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge on the building blocks of processors for AI
- To understand the edge devices in embedded systems
- To acquire knowledge in the field integration and testing

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Illustrate about hardware architecture for embedded intelligence (Understand)

CO2: Understand the need for processing with TPU and other specialized accelerators (Understand)

CO3: Understand the various edge AI devices (Understand)

CO4: Understand the reprogrammable analog devices and its usage (Understand)

CO5: Illustrate the Integration and Testing of embedded systems (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	-	-	-	-	-	-	-	-	-	1		
CO3	3	2	-	-	-	-	-	-	-	-	-	1		
CO4	3	2	-	-	-	-	-	-	-	-	-	1		
CO5	3	2	-	-	1	-	-	-	-	-		1		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I PROCESSORS FOR AI 9

CPU architectures for ML and DL - Graphics Processing Units (GPUs) for ML and DL Applications - Specific Integrated Circuits (ASICs) for deep learning Field

UNIT II TENSOR PROCESSING UNIT (TPU) 9

TPUs Architecture – Field Programmable Gate Arrays for deep learning Tensor Processing Units and other specialized accelerators

UNIT III EDGE AI DEVICES 9

Embedded Computing basics - Embedded Platforms for prototyping - Devices connected to the Internet/Cloud

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UNIT IV ASIC AND RECONFIGURABLE PROCESSOR 9

ASIC design flow - programmable ASICs - PLDs - reconfigurable processor - Architecture - Reconfigurable Computing

UNIT V INTEGRATION AND TESTING 9

Integrated Development Environment (IDE) - Types of files generated on Cross-Compilation - Disassembler/Decompiler – Simulators - Emulators - Debugging - Target Hardware Debugging - Boundary Scan

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Robert E. Filman, Daniel P. Siewiorek, and Charles P. Thorpe 'Embedded Intelligence: Strategies for Developing and Implementing Intelligent Systems', 2009
2. Joao Cardoso, Michael Hübner, 'Reconfigurable Computing: From FPGAs to Hardware/Software Codesign' Springer, 2011

REFERENCES:

1. Raj Kamal, 'Internet of Things: Architecture and Design', McGraw Hill,2017
2. Frank Vahid and Tony Givargis, 'Embedded Systems Design' – A Unified Hardware/Software Introduction, John Wiley 2006
3. Elicia White, 'Making Embedded Systems', O Reilly Series SPD 2011

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21MDG61	AI SOFTWARE PLATFORMS AND TOOLS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the architecture and implementation of embedded operating systems and real-time operating systems for AI applications
- To gain proficiency in using AI frameworks and libraries for developing and customizing AI models on embedded systems
- To develop practical skills in utilizing development environments, simulation, and testing tools creating and optimizing AI-driven embedded systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the architecture and key features of embedded operating systems and real-time operating systems (Understand)

CO2: Apply knowledge of AI frameworks and libraries to implement and customize AI models for embedded systems (Apply)

CO3: Utilize development environments and tools to effectively develop, debug, and test AI-driven embedded systems (Apply)

CO4: Demonstrate proficiency in using simulation and testing tools for performance profiling and optimization of AI algorithms on embedded devices (Analyze)

CO5: Develop practical AI-driven embedded system projects, considering ethical implications and future trends in embedded AI technology (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1		
CO2	3	2	-	-	1	-	-	-	-	-	-	1		
CO3	3	2	-	-	1	-	-	-	-	-	-	1		
CO4	3	2	-	-	2	-	-	-	-	-	-	1		
CO5	3	2	-	-	1	-	-	-	-	-	-	1		
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I EMBEDDED OPERATING SYSTEMS 9

Overview of embedded operating systems - Key features and architecture of embedded OS - Real-time operating systems (RTOS) - Comparison of embedded OS - Scheduling algorithms - Memory management in embedded systems

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UNIT II AI FRAMEWORKS AND LIBRARIES 9

Overview of AI frameworks (TensorFlow, PyTorch, Keras, Caffe) - Comparison of AI frameworks - Implementing basic AI models using frameworks - Using pre-trained models and transfer learning - Custom model development

UNIT III DEVELOPMENT ENVIRONMENTS AND TOOLS 9

Integrated development environments (IDEs) for AI and embedded development (Keil, MPLAB X) - Code versioning and collaboration tools (GitHub) - Debugging and testing tools - Workflow automation tools

UNIT IV SIMULATION AND TESTING TOOLS 9

Importance of simulation in embedded AI development - simulation tools (MATLAB/Simulink, Proteus, QEMU) - Hardware-in-the-loop (HIL) simulation - Testing frameworks and methodologies

UNIT V SOFTWARE DEVELOPMENT PRACTICES 9

Implementing AI algorithms on embedded devices - case studies of embedded AI applications - Future trends and emerging technologies in embedded AI

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Zhang, Du, and Jeffery JP Tsai; eds, 'Advances in machine learning applications in software engineering'. IGI Global, 2006
2. Moroney, Laurence, 'AI and Machine Learning for Coders'. O'Reilly Media, 2020

REFERENCES:

1. Bertolotti, Ivan Cibrario, and Gabriele Manduchi. 'Real-time embedded systems: open-source operating systems perspective'. CRC press, 2017
2. Vermesan, Ovidiu, Mario Diaz Nava, and Björn Debaillie, eds. Embedded artificial intelligence: Devices, embedded systems, and industrial applications. CRC Press, 2023
3. Kamal I. M. Al-Malah, 'Machine and Deep Learning Using MATLAB: Algorithms and Tools for Scientists and Engineers', John Wiley & Sons, Inc. 2023

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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		Category: MDC				
U21MDG62	MACHINE LEARNING FOR EMBEDDED SYSTEMS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental concepts and applications of machine learning in embedded systems
- To develop proficiency in implementing and optimizing machine learning algorithms on microcontrollers and other embedded platforms
- To gain practical skills in applying model optimization techniques for efficient deployment in resource-constrained environments

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply supervised and unsupervised learning algorithms to embedded systems (Apply)

CO2: Implement reinforcement learning algorithms on embedded platforms (Apply)

CO3: Develop and optimize machine learning models on microcontrollers (Apply)

CO4: Utilize model optimization techniques for efficient embedded system performance (Analyze)

CO5: Deploy machine learning models on embedded devices, analyzing deployment challenges (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1		
CO2	3	2	-	-	1	-	-	-	-	-	-	1		
CO3	3	2	-	-	1	-	-	-	-	-	-	1		
CO4	3	2	-	-	1	-	-	-	-	-	-	1		
CO5	3	2	-	-	1	-	-	-	-	-	-	1		

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I SUPERVISED AND UNSUPERVISED LEARNING **9**

Supervised learning: classification and regression - Unsupervised learning: clustering and dimensionality reduction techniques - Evaluation metrics for supervised and unsupervised learning

UNIT II REINFORCEMENT LEARNING **9**

Key concepts: agents, environments, states, actions, rewards - Types of reinforcement learning: Q-learning, policy gradients - Implementation of reinforcement learning algorithms on embedded systems - Applications of reinforcement learning in embedded systems

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UNIT III IMPLEMENTING ML ALGORITHMS 9

Architectures of processors – selection of processors for machine learning tasks - Implementing machine learning models

UNIT IV MODEL OPTIMIZATION TECHNIQUES 9

Techniques for reducing model size and complexity (pruning, quantization) - Techniques for improving model efficiency (compression, hardware acceleration) - Implementing optimized models on embedded systems - Evaluation and benchmarking of optimized models

UNIT V DEPLOYMENT AND CASE STUDIES 9

Methods for deploying machine learning models on embedded systems - Case studies - Challenges and solutions in deployment - Future trends in machine learning for embedded systems

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Halak, Basel, ed., 'Machine Learning for Embedded System Security'. Springer, 2022
2. Muhammad Shafique, Sudeep Pasricha, 'Embedded Machine Learning for Cyber-Physical, IoT, and Edge Computing: Software Optimizations and Hardware/Software Codesign'. Germany: Springer Nature Switzerland, 2023

REFERENCES:

1. Björn Debaillie, Mario Diaz Nava, Ovidiu Vermesan, 'Embedded Artificial Intelligence: Devices, Embedded Systems, and Industrial Applications'. United States: River Publishers, 2023
2. Moons, Bert., Bankman, Daniel., Verhelst, Marian. 'Embedded Deep Learning: Algorithms, Architectures and Circuits for Always-on Neural Network Processing'. Germany: Springer International Publishing, 2018
3. Warden, Pete., Situnayake, Daniel. 'TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers'. Taiwan: O'Reilly Media, 2019

EVALUATION PATTERN:

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21MDG63	DEEP LEARNING FOR EMBEDDED SYSTEMS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand convolutional and recurrent neural networks on embedded systems
- To develop skills in model compression and optimization techniques for deploying efficient deep learning models on resource-constrained devices
- To gain practical experience in deploying Edge AI and TinyML solutions on embedded devices through hands-on projects and case studies

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement CNNs on embedded systems for image classification and object detection. (Apply)

CO2: Deploy RNNs, including LSTM and GRU, on embedded systems for time-series prediction and speech recognition (Apply)

CO3: Optimize deep learning models for embedded hardware using pruning and quantization (Analyze)

CO4: Utilize Edge AI and TinyML frameworks to deploy deep learning solutions on embedded devices (Apply)

CO5: Develop deep learning projects for embedded systems, considering ethical implications and future trends (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1		
CO2	3	2	-	-	1	-	-	-	-	-	-	1		
CO3	3	2	-	-	1	-	-	-	-	-	-	1		
CO4	3	2	-	-	1	-	-	-	-	-	-	1		
CO5	3	2	-	-	1	-	-	-	-	-	-	1		

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I CONVOLUTIONAL NEURAL NETWORKS (CNNS) 9

Architecture of CNNs - convolution, pooling, activation functions - LeNet, AlexNet, VGG, ResNet - Implementing CNNs on embedded systems

UNIT II RECURRENT NEURAL NETWORKS (RNNS) 9

Architecture of RNNs - sequences, time steps, hidden states - vanilla RNNs, LSTM, GRU - Implementing RNNs on embedded systems

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UNIT III MODEL COMPRESSION AND OPTIMIZATION 9

Model compression techniques - Pruning, quantization, and knowledge distillation - Techniques for optimizing deep learning models - Implementing compressed models on embedded hardware

UNIT IV Edge AI and TinyML 9

Edge AI and TinyML - Key challenges and benefits of deploying deep learning models at the edge - Frameworks and tools for Edge AI (TensorFlow Lite, PyTorch Mobile) - Implementing Edge AI solutions on embedded devices

UNIT V DEPLOYMENT AND CASE STUDIES 9

Case studies of deep learning applications on embedded devices - building and deployment of a deep learning model on an embedded system - Future trends and emerging technologies

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods
Total 45 Periods

TEXT BOOKS:

1. Moons, Bert., Bankman, Daniel., Verhelst, Marian, 'Embedded Deep Learning: Algorithms, Architectures and Circuits for Always-on Neural Network Processing' Germany: Springer International Publishing, 2018
2. Gupta, Atul Krishna., Nandyala, Siva Prasad., 'Deep Learning on Microcontrollers: Learn how to Develop Embedded AI Applications Using TinyML'. India: BPB Publications., 2023

REFERENCES:

1. Shankar Shanthamallu, Uday., Spanias, Andreas., 'Machine and Deep Learning Algorithms and Applications'. Switzerland: Springer International Publishing, 2022
2. Björn Debaillie, Mario Diaz Nava, Ovidiu Vermesan, 'Embedded Artificial Intelligence: Devices, Embedded Systems, and Industrial Applications' United States: River Publishers, 2023
3. Lin, Sen., Zhou, Zhi., Zhang, Zhaofeng., Chen, Xu., Zhang, Junshan. 'Edge Intelligence in the Making: Optimization, Deep Learning, and Applications'. Switzerland: Morgan & Claypool Publishers, 2020
4. Karim, Md. Rezaul, 'Hands-On Deep Learning for IoT: Train Neural Network Models to Develop Intelligent IoT Applications' United Kingdom: Packt Publishing, 2019

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
Learn Beyond

U21MDG64	COMPUTER VISION FOR EMBEDDED SYSTEMS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand fundamental computer vision concepts and applications in embedded systems
- To gain practical skills in image processing, feature extraction, and object recognition on embedded devices
- To develop expertise in deploying deep learning models and integrating learning techniques for computer vision projects on embedded platforms

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the basic concepts and principles of computer vision, including image formation and sensing (Understand)

CO2: Apply digital image processing techniques such as filtering, enhancement, edge detection, and segmentation on embedded devices (Apply)

CO3: Implement feature extraction methods and object recognition techniques on embedded platforms (Apply)

CO4: Develop and deploy convolutional neural network models for real-time image classification and detection on embedded systems (Apply)

CO5: Develop computer vision projects for embedded systems, considering ethical implications and future trends (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1		
CO2	3	2	-	-	1	-	-	-	-	-	-	1		
CO3	3	2	-	-	1	-	-	-	-	-	-	1		
CO4	3	2	-	-	1	-	-	-	-	-	-	1		
CO5	3	2	-	-	1	-	-	-	-	-	-	1		

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I COMPUTER VISION **9**

Basic concepts of computer vision, image sensing and formation, different types of cameras and imaging devices, and applications of computer vision in embedded systems

UNIT II IMAGE PROCESSING TECHNIQUES **9**

Fundamentals of digital image processing - image filtering and enhancement techniques, edge detection, and image segmentation - feature detection and extraction methods

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UNIT III FEATURE EXTRACTION AND OBJECT RECOGNITION 9

Feature extraction methods - keypoint detection and descriptors - SIFT and SURF, object recognition techniques and their implementation on embedded platforms

UNIT IV DEEP LEARNING FOR COMPUTER VISION 9

Convolutional neural networks (CNNs) for image analysis, training and deploying CNNs on embedded devices, transfer learning and fine-tuning - real-time image classification and detection techniques

UNIT V DEPLOYMENT AND CASE STUDIES 9

Case studies of computer vision applications- autonomous vehicles, agriculture, industrial process - future trends

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Kisacanin, Branislav., Bhattacharyya, Shuvra S.., Chai, Sek. "Embedded Computer Vision". Germany: Springer London, 2009
2. Branislav Kisačanin, Margrit Gelautz, "Advances in Embedded Computer Vision" Germany: Springer International Publishing, 2014

REFERENCES:

1. Vijayalakshmi, S. R.., Muruganand, S.. "Embedded Vision: An Introduction". India: Mercury Learning and Information, 2019
2. Lin, Sen., Zhou, Zhi., Zhang, Zhaofeng., Chen, Xu., Zhang, Junshan. 'Edge Intelligence in the Making: Optimization, Deep Learning, and Applications'. Switzerland: Morgan & Claypool Publishers, 2020
3. Karim, Md. Rezaul, 'Hands-On Deep Learning for IoT: Train Neural Network Models to Develop Intelligent IoT Applications' United Kingdom: Packt Publishing, 2019

EVALUATION PATTERN:

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
Learn Beyond

U21MDG65	SIGNAL PROCESSING FOR EMBEDDED SYSTEMS	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire knowledge on the speech signal processing
- To understand the digital image and video processing
- To apply signal processing in the real time case studies

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the basic techniques of speech recognition (Understand)

CO2: Illustrate the categorization of signals and representation of signals (Understand)

CO3: Explain the various speech analysis techniques (Understand)

CO4: Relate the fundamentals of various image and video processing techniques (Understand)

CO5: Applications of speech understanding and recognition (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1		
CO2	3	2	-	-	1	-	-	-	-	-	-	1		
CO3	3	2	-	-	1	-	-	-	-	-	-	1		
CO4	3	2	-	-	1	-	-	-	-	-	-	1		
CO5	3	2	-	-	1	-	-	-	-	-	-	1		
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

SYLLABUS:

UNIT I SIGNALS AND REPRESENTATION **9**

Continuous time - discrete time signal - Analog and Digital Signal Processing - Examples of Simple Functions - Signal Operations - Time Shifting - Time Scaling - Time Reversal - Amplitude Shift - Simple Symmetries - Even and Odd Functions

UNIT II SPEECH SIGNAL PROCESSING **9**

Human Speech Production System - Speech Generation - Speech Perception - Model of Human Speech - Audio Indexing - Classic Information Retrieval Problem

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UNIT III SPEECH ANALYSIS 9

Speech Signal - Speech Production - Filter Models of Speech Production - Speech Signal Representation - Short-time Fourier Analysis - Parametric Representation of the Spectral Analysis - Front-end Analysis for Automatic Speech Recognition

UNIT IV DIGITAL IMAGE AND VIDEO PROCESSING 9

Gray Level Image Processing – Tools for Image Fourier Analysis- Binary Image Processing - Basic Linear Filtering for Image Enhancement - Nonlinear Filtering for Image Analysis and Enhancement - Methods for Image Restoration and Identification

UNIT V APPLICATIONS 9

Case Study: Chat bot - Voice-to-Text applications - Story Teller - NLP Search Engine

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods
Total 45 Periods

TEXT BOOKS:

1. Soumya Sen, Anjan Dutta, Nilanjan Dey, 'Audio Processing and Speech Recognition, Concepts, Techniques and Research Overviews,' Springer briefs in Applied sciences and technology, 2019
2. R.K. Rao Yarlagadda, 'Analog and Digital Signals and Systems', Springer 2010

REFERENCES:

1. Noelia Alcaraz Meseguer, 'Speech Analysis for Automatic Speech Recognition' Norwegian University of Science and Technology,2009.
2. A. Murat Tekalp, 'Digital Video Processing', Second Edition, Prentice Hall, 2015

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SOFTWARE DEVELOPMENT ENGINEERING

U21MDG72	INTEGRATED SYSTEM PROGRAMMING	Category: MDC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce students to various Instruction set architectures and their differences
- To equip students with the skills to handle deadlock mechanisms in computing systems
- To impart object-oriented programming principles in Java to develop comprehensive projects

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe and differentiate between different instructions set architectures (Understand)

CO2: Exemplify with handling deadlock mechanisms (Apply)

CO3: Implement various searching, sorting, and hashing techniques (Apply)

CO4: Develop Java programs using Inheritance principle (Apply)

CO5: Employ object-oriented programming concepts to develop Java projects (Apply)

CO-PO MAPPING

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1		
CO2	3	1	-	-	-	-	-	-	-	-	-	2		
CO3	3	2	2	2	-	-	-	-	-	-	-	2		
CO4	3	2	2	2	2	-	-	-	-	-	-	2		
CO5	3	2	3	3	2	2	-	-	2	2	2	3		
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

SYLLABUS:

UNIT I COMPUTER HARDWARE 9

Architecture of a CPU – Memoryhierarchy and performance considerations – Harddisk drives (HDD), Solid State Drives (SSD), and hybrid storage – BIOS/UEFI and firmware – Ethernetstandards and network cabling – Instructionsets and assembly language basics

UNIT II OPERATING SYSTEM 9

Process Management: Processes, threads and state transitions – MemoryManagement: paging, segmentation, page replacement algorithms – FileSystems: Directory structures and operations – I/O Systems: polling, interrupts, DMA – Deadlockcharacterization, prevention, and avoidance

UNIT III PROGRAMMING PARADIGM AND TECHNIQUES 9

Programming languages and their classifications – Variables, data types, and operators – Basiccontrol structures – Functionsand Modular Programming – Recursion – Organizingcode into modules and functions – StandardLibrary Functions – Errorhandling techniques

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UNIT IV BASICS OF OBJECT ORIENTED PRORAMMING 9

Principles of OOP: encapsulation, inheritance, polymorphism – Classesand Objects: definition, attributes, and methods – Constructorsand destructors – Encapsulation: Access specifiers, Getter and setter – Inheritance: method over riding

UNIT V POLYMORPHSM IN OBJECT ORIENTED PROGRAMMING 9

Polymorphism: Method overloading – Overloadingconstructors – Overloadingstatic methods – AbstractClasses and Interfaces – DynamicMethod Dispatch

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total 45 Periods

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Elsevier Science, 4th Edition, 2014
2. Abraham Silberschatz, Peter B. Galvin, and Greg Gagne, "Operating System Concepts", 8th Edition, Wiley, 2018
3. Herbert Schildt, "Java: A Beginner's Guide", 6th Edition, McGraw-Hill Education, 2018

REFERENCES:

1. I. Craig, "The Interpretation of Object-Oriented Programming", Springer London, 3rd Edition, 2007
2. Saifee Vohra, "Object Oriented Programming with C++", 2nd Edition, bookrent.in Impression, 2015

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SOFTWARE DEVELOPMENT ENGINEERING

		Category: MDC				
U21MDG73	DATA INTENSIVE COMPUTING SYSTEMS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce cloud computing principles and architectures relevant to Industry 4.0
- To provide hands-on experience with Hadoop architecture and ecosystem
- To develop skills to analyze time series data and perform ANOVA

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the fundamental principles of cloud computing and its relevance to Industry 4.0, including various cloud architectures (Understand)

CO2: Apply the architecture of Hadoop, including its components and ecosystem (Apply)

CO3: Examine the architecture and data model of Neo4j and implement the graph databases (Apply)

CO4: Conduct ANOVA to compare multiple groups and determine the significance (Apply)

CO5: Analyze time series data using techniques such as Autocorrelation Function (Analyze)

CO–PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2		
CO2	2	2	2	2	3	-	-	-	-	-	-	2		
CO3	3	2	2	2	3	-	-	-	-	-	-	2		
CO4	3	2	2	2	3	-	-	-	-	-	-	2		
CO5	3	3	2	2	3	-	-	-	-	-	-	2		
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)					

SYLLABUS:

UNIT I INFRASTRUCTURE 9

Cloud, Data Intensive systems and Industry 4.0 – Cloud Architecture – Virtualization–Data Virtualization – Storage Virtualization – Network Virtualization: SAS,SAN – File Systems – Big Data Characteristics – Use cases – Data Analytics Life cycle – Case study

UNIT II STORAGE PLATFORMS 9

NoSQL – Key-value store –Hadoop Architecture – Map Reduce programming – Spark-Column-oriented stores – HBase architecture–Hive

UNIT III DOCUMENT STORES 9

MongoDB architecture – examples; Graph stores – Neo4j architecture – examples; Realtime Processing – Storm

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UNIT IV THEORY AND METHODS-I 9

Preprocessing – Statistical measures – Hypothesis testing – ANOVA –Feature selection – PCA Regression – linear, logistic – LDA – Association Rule Mining – Text Analysis

UNIT V THEORY AND METHODS-II 9

Clustering – Partitioning and hierarchical approaches – Classification – KNN, Decision trees, Naïve Bayes, SVM– Time Series Analysis – ACF, AR, MA, ARMA, ARIMA – Stream Analysis

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Alok Srivastava, "Data Science and Big Data Analytics: A Hands-on Approach", Wiley, 2nd Edition, EMC Education Services, 2015
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, USA, 2013

REFERENCES:

1. Nathan Marz and James Warren, "Big Data - Principles and Best Practices of Scalable Realtime Data Systems", MEAP Began, USA, 2012
2. Venkata Josyula, Malcolm Orr & Greg Page, "Cloud Computing: Automating the Virtualized Data Center", CISCO Press, USA, 2011
3. https://onlinecourses.nptel.ac.in/noc20_cs92/preview

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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B.E. / B.Tech. – MDC – R2021– CBCS

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SOFTWARE DEVELOPMENT ENGINEERING

		Category: MDC				
		L	T	P	J	C
U21MDG74	DATA MANAGEMENT TECHNIQUES	3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts and differences between linear and non-linear data structures
- To gain the use of stacks and queues through suitable real-world applications
- To know how and apply various searching, sorting, and hashing techniques effectively

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the concept of linear and non-linear data structures (Understand)

CO2: Demonstrate stack and queue with suitable applications (Apply)

CO3: Implement various searching, sorting, and hashing techniques (Apply)

CO4: Analyze non-linear tree data structures (Apply)

CO5: Implement various problems in graph data structures (Apply)

CO–PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	2	1	-	-	-	-	-	-	-	2		
CO3	3	2	2	1	-	-	-	-	-	-	-	2		
CO4	3	2	2	1	-	-	-	-	-	-	-	2		
CO5	3	2	3	2	-	-	-	-	-	-	-	2		
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

SYLLABUS:

UNIT I INTRODUCTION TO DATA STRUCTURES 9

Definition and importance of data structures – Overview of abstract data types (ADTs) – Array representation and operations – Comparison of arrays and linked lists in terms of performance

UNIT II LINEAR DATA STRUCTURES – LIST 9

Linked list-based implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of linked list

UNIT III LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations – Applications – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue

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UNIT IV NON-LINEAR DATA STRUCTURES – TREES 9

Tree ADT – Tree traversals – Binary Tree ADT – Expression trees – Implementation of expression tree – Applications of trees – Binary search tree ADT – Operations in binary search tree

UNIT V NON-LINEAR DATA STRUCTURES – GRAPHS 9

Introduction to Graph – Types of graph – Graph traversal – Breadth-first traversal – Depth-first traversal – Topological Sort – Minimum spanning tree algorithms – Shortest path algorithm – Dijkstra's algorithm

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Reema Thareja, "Data structures using C", 1st Edition, Oxford University Press, 2018
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2017

REFERENCES:

1. John P. Grillo, James Douglas Robertson, "Data Management Techniques", W.C. Brown, W.C. Brown Publisher, 2011
2. A. M. Grenzebach, "Data Management Techniques and Considerations", 3rd Edition, University of Waterloo, 2018

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SOFTWARE DEVELOPMENT ENGINEERING

		Category: MDC				
		L	T	P	J	C
U21MDG75	ALGORITHM AND PROBLEM SOLVING – I	3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain the object-oriented programming concepts necessary to develop simple Java programs
- To understand the utilization of Input Output classes for efficient data handling
- To know how to use Collections to manage and manipulate data effectively

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe the object-oriented programming concepts to develop simple java programs (Understand)

CO2: Develop Java programs with Input Output classes (Apply)

CO3: Implement Java programs with Collections (Apply)

CO4: Analyze non-linear data structures – trees (Apply)

CO5: Implement various problems in graph data structures (Apply)

CO–PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1		
CO2	3	2	1	-	-	-	-	-	-	-	-	1		
CO3	3	2	1	-	1	-	-	-	-	-	-	2		
CO4	3	2	1	1	1	-	-	-	-	-	-	2		
CO5	3	2	2	2	1	2	-	-	-	-	-	2		

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I INTRODUCTION TO JAVA PROGRAMMING 9

Setting up Java Development Environment (JDK, IDEs) – Java Basics: Variables, data types, and operators – Control flow: if-else statements, switch-case statements, loops (for; while, do-while) – Arrays and array manipulation

UNIT II OBJECT-ORIENTED PROGRAMMING (OOP) IN JAVA 9

Classes and objects – Encapsulation, inheritance, and polymorphism – Java Standard Library – String manipulation and String Builder, String Buffer – Exception handling – Input/output operations

UNIT III JAVA COLLECTIONS FRAMEWORK 9

Core Interfaces – Set Interface and Implementations – Map Interface and Implementations – Queue and Dequeue Interfaces – Concurrency and Thread Safety

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UNIT IV ADVANCED TREES 9

AVL Trees – B-trees and B+-trees – Splay Trees – Randomized Binary Search Trees – Segment Trees – Binary Indexed Trees – Tries and Radix Trees

UNIT V ADVANCED GRAPH ALGORITHMS 9

Graph representation – MinimumSpanning Trees: Prim's algorithm, Kruskal's Algorithm – Shortest Paths Algorithms: Bellman-Ford algorithm, Floyd-Warshall algorithm – MaximumFlow Algorithms: Edmonds-Karp algorithm, Push-relabel algorithm

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Harel, David, and Yishai Feldman, "Algorithmics: The Spirit of Computing", 3rd Edition, Boston: Addison-Wesley, 2004
2. Kleinberg, Jon, and Éva Tardos, "Algorithm Design", Boston: Addison-Wesley, 2006

REFERENCES:

1. Sedgewick, Robert, and Kevin Wayne, "Algorithms", 4th Edition, Upper Saddle River, NJ: Addison-Wesley Professional, 2011
2. Schildt, Herbert, "Java: The Complete Reference", 11th Edition, New York: McGraw-Hill Education, 2018

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SOFTWARE DEVELOPMENT ENGINEERING

		Category: MDC				
U21MDG76	ALGORITHM AND PROBLEM SOLVING – II	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain proficiency in implementing and using advanced data structures
- To understand the evaluation the time and space complexity of operations within advanced data structures
- To apply optimization techniques like amortized analysis and persistence to enhance algorithms

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Demonstrate proficiency in implementing and using advanced data structures (Apply)

CO2: Evaluate the time and space complexity of operations in advanced data structures (Apply)

CO3: Apply techniques like amortized analysis and persistence to optimize algorithms (Apply)

CO4: Identify and formulate optimization problems suitable for greedy algorithmic solutions (Apply)

CO5: Implement various problems in dynamic programming (Apply)

CO–PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	-	-	-	-	-	1		
CO2	3	2	2	2	-	-	-	-	-	-	-	1		
CO3	3	2	2	2	2	-	-	-	-	-	-	2		
CO4	3	2	3	3	-	-	-	-	-	-	-	2		
CO5	3	2	3	3	-	2	-	-	-	-	-	2		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I ADVANCED JAVA LANGUAGE FEATURES 9

Generics: Generic classes, methods, wildcards, and bounded types – Enumerationsand their usage in Java – Annotations: Built-in annotations, custom annotations, and annotation processing – Threads and Multithreading

UNIT II FUNCTIONAL PROGRAMMING IN JAVA 9

Lambda expressions and functional interfaces – Stream API: Intermediate and terminal operations, parallel streams, and collectors – Optional class and its usage – Design patterns: Creational, structural, and behavioural patterns (e.g., Singleton, Factory, Observer)

UNIT III DATABASE CONNECTIVITY AND ORM 9

JDBC (Java Database Connectivity): Establishing connections, executing SQL queries, and

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handling transaction – Object-Relational Mapping (ORM) frameworks – Hibernate, JPA (Java Persistence API)– Servlets – Java Server Pages (JSP): Handling HTTP requests, session management, and MVC architecture

UNIT IV GREEDY ALGORITHMS FOR OPTIMIZATION PROBLEMS 9

Fractional Knapsack Problem – Interval Scheduling and Interval Partitioning – Construction of Huffman trees – Coin Change Problem – Subset Sum Problem – Job Scheduling

UNIT V DYNAMIC PROGRAMMING TECHNIQUES 9

Longest Common Subsequence (LCS) – 0/1 Knapsack Problem – String Processing Problems – Optimal Binary Search Trees – Shortest Paths in Directed Acyclic Graphs – Analyzing performance and space complexity

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

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Total				40	60
				100	

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B.E. / B.Tech. – MDC – R2021– CBCS

SOFTWARE DEVELOPMENT ENGINEERING

		Category: MDC				
		L	T	P	J	C
U21MDG77	STRUCTURED QUERY LANGUAGE	3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To know the basic concepts and principles of database management systems
- To understand SQL queries for creating, manipulating, and controlling databases
- To grasp normalization techniques, ACID properties, and concurrency control to design efficient and reliable databases

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the basic concepts of the database management systems (Understand)

CO2: Formulate SQL queries to create, manipulate and control the database (Apply)

CO3: Apply normalization technique to design database (Apply)

CO4: Employ ACID properties and concurrency control techniques to ensure transactional consistency and Integrity (Apply)

CO5: Apply query optimization strategies (Apply)

CO–PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2		
CO2	3	2	1	2	2	-	-	-	-	-	-	2		
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CO4	3	2	1	2	2	-	-	-	-	-	-	2		
CO5	3	2	2	2	2	-	-	-	-	-	-	2		
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I INTRODUCTION TO DATABASE AND E-R MODEL 9

Database – System Applications – Purpose of Database Systems – View of Data-Database Languages – Database Architecture – Database Schema and Diagram – Relational Algebra – ER Diagrams – Entities, Attributes, Relationships, Constraints, Keys – Extended ER features

UNIT II STRUCTURED QUERY LANGUAGE 9

Basics of SQL, DDL, DML,DCL,TCL – creation, alteration, defining constraints – Functions – Aggregate functions, Built-in functions – Views – Joins – Procedure

UNIT III NORMAL FORMS 9

Functional dependencies – Normalization – Normal forms based on primary keys (1NF, 2NF, 3NF, BCNF, 4NF, 5NF) – Triggers – Cursor

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UNIT IV TRANSACTION PROCESSING 9

Introduction to transactions – States of transaction– ACID Properties – Concurrent executions – Serializability – Log Based Recovery – Need for Concurrency – Lock based protocols – SQL for Concurrency – Two Phase Commit Protocol – Deadlocks

UNIT V INDEX AND QUERY PROCESSING 9

Indexing and Hashing – B+ tree Index Files – B Tree Index Files – Query Processing and optimization

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", 6th Edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson, 2017

REFERENCES:

1. Pramod J. Sadalage and Marin Fowler, "NOSQL Distilled: A Brief guide to merging world of Polyglot persistence", 2nd Edition, Addision Wesley, 2012
2. Ramakrishnan and Gehrke, "Database Management Systems", 3rd Edition, McGraw Hill, 2003
3. https://nptel.ac.in/courses/106/105/106105175/
4. https://www.edureka.co/mongodb-certification-training
5. https://www.coursera.org/learn/introduction-to-nosql-databases

EVALUATION PATTERN:

Continuous Internal Assessments					
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