Semester - VI

Course Code	Course Title							
116U01C601	Digital Signal and Image Processing							
	TH		P	TUT				Total
Teaching Scheme(Hrs.)	03		--	--				03
Credits Assigned	03		--	--				03
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	--	--	--	--	100

Course prerequisites:

Basic mathematical background of matrices and complex numbers and programming skills

Course Objectives:

1. Comprehension of fundamentals of Digital Signal Processing 1-D and 2-D
2. Application of various enhancement methods in time/spatial and frequency domain
3. Analysis of Digital image using segmentation, Morphological operation
4. Evaluation methods for synthesis of the image for information interpretation and for application development

Course Outcomes:

At the end of successful completion of the course the student will be able to

CO1: Interpret fundamentals of discrete time signals and systems and signal manipulation methods.
CO2: Apply various spatial and frequency domain enhancement techniques for 1-D signals and 2-D images.
CO3: Analyze signals and images in frequency domain using various image transforms
CO4: Evaluate extracted analyzed information for synthesis of digital signals and images.
CO5: Design and develop applications based on 1-D & 2-D digital signals and images.

Module No.	Unit No.	Details	Hrs.	CO
1	**Discrete Time Signals and Systems**		**09**	**CO 1**
	1.1	Introduction to digital signals and systems, Properties and operations on digital signals.		
	1.2	Classification of signals, system, LTI system		
	1.3	Convolution in time domain (linear & circular), Correlation.		
	Self-Learning Topic: Correlation (Circular)			
2	**Fundamentals of Digital Image and Spatial Domain Enhancement**		**09**	**CO2**
	2.1	Digital image Representation, Elements of digital image processing systems, sampling and quantization, basic relationships between pixels, mathematical operations on images.		
	2.2	Spatial domain enhancement techniques: Point processing, Neighbourhood processing, spatial domain filtering, zooming.		
	2.3	Spatial enhancement: Global processing: Histogram Equalization.		
	Self-Learning Topic: Histogram specification			
3	**Image Transform: Frequency Domain Representation and Enhancement**		**10**	**CO3**
	3.1	Introduction , DFT and its properties, radix-2 algorithm(2- DFT), FFT algorithm: divide and conquer approach, Decimation in Time(DIT)-FFT		
	3.2	Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Haar Transform, Principal component Analysis (PCA/ Hotelling Transform), Introduction to Wavelet Transform		
	3.3	Low Pass and High Pass Frequency domain filters: Ideal, Butterworth, Homomorphic filter		
	Self-Learning Topic: Discrete Sine Transform (DST)			

4	**Image Segmentation and Representation**		**08**	**CO4**
	4.1	Image segmentation based on discontinuities: point, line and edge detection (Laplacian, Cany), edge linking, Thresholding (Global, local, optimum), Region based segmentation, edge based segmentation: Hough Transform.		
	4.2	Boundary descriptors: Signature, Chain code, Shape number, Moments		
5	**Introduction to Morphology and Image Compression**		**10**	**CO 5**
	5.1	Morphological operations: Dilation, Erosion, Opening, Closing, Hit or Miss Transform, Boundary extraction		
	5.2	Introduction, redundancies: coding, inter-pixel, psycho-visual, compression ratio, fidelity criteria Lossless compression techniques: Run length coding, Arithmetic coding, Huffman coding, Differential PCM		
	5.3	Lossy Compression techniques: Improved grey scale quantization, Vector quantization, Transform coding, JPEG.		
	Self-Learning Topic: Morphological operation - Thinning and Thickening			
		Total	**45**	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	John G. Proakis and D.G. Manolakis	*Introduction to Digital signal processing*	Pearson	Fourth edition, 2015
2.	A. NagoorKani	*Digital Signal Processing*	McGraw Hill Publications	2nd edition
3.	R. C. Gonsales and R. E. Woods	*Digital Image Processing*	Pearson Education	Second edition
4.	A.K. Jain	*Fundamentals of Image processing*	Prentice Hall of India Publication	--
5.	S.Jayaraman, S Esakkirajan, T Veerakumar	*Digital Image Processing*	McGraw Hill	2018 Edition

Term-Work will consist of Practical experiments covering the entire syllabus. Students will be graded based on continuous assessment of their term work

Course Code	Course Title						
116U01L601	Digital Signal and Image Processing Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Digital Signal and Image Processing". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title			
116U01C602	**Information Security**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	**03**	**--**	**--**	**03**
Credits Assigned	**03**	**--**	**--**	**03**

Examination Scheme	**Marks**							
	CA		**ESE**	**TW**	**O**	**P**	**P&O**	**Total**
	ISE	**IA**						
	30	**20**	**50**	**--**	**--**	**--**	**--**	**100**

Course Prerequisites (if any):
Basics of Operating System and Computer Network

Course Objectives:

1. To understand the fundamentals of Information Security
2. To acquire knowledge on malicious and non-malicious programme errors and apply counter measures
3. To understand the various web attack
4. To apply different techniques to secure data in transit across data networks
5. To study and analyse the ethical issues

Course Outcomes:

At the end of successful completion of the course the student will be able to

CO1: Explain various security goals, threats, vulnerabilities and controls
CO2: Apply various cryptographic algorithms for software security
CO3: Identify and analyse web attacks
CO4: Illustrate and Compare network security mechanisms
CO5: Interpret legal and ethical issues in security

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction**		7	CO1
	1.1	What Is Computer Security?, Threats, Harm, Vulnerabilities, Controls		
	1.2	Use of Cryptography in System Security: Problems Addressed by Encryption, Terminology, DES: The Data Encryption Standard, Public Key Cryptography, Public Key Cryptography to Exchange Secret Keys, Error Detecting Codes, Trust, Certificates: Trustable Identities and Public Keys, Digital Signatures—All the Pieces		
2	**Software Security**		10	
	2..1	Unintentional (Non-malicious) Programming: Oversights - Buffer Overflow, Incomplete Mediation, Time-of-Check to Time-of-Use, Undocumented Access Point Off-by-One, Error Integer Overflow, Unterminated Null-Terminated String, Parameter Length, Type, and Number, Unsafe Utility Program, Race Condition		CO2
	2.2	Malicious Code—Malware- Malware—Viruses, Trojan Horses, and Worms, Technical Details: Malicious Code		
	2.3	Countermeasures: Countermeasures for Users, Countermeasures for Developers, Countermeasure Specifically for Security, Countermeasures that Don't Work		
3	**Web Attack**		10	CO3
	3.1	**Browser Attacks**: Browser Attack Types, How Browser Attacks Succeed: Failed Identification and Authentication		
	3.2	**Web Attacks Targeting Users** - False or Misleading Content, Malicious Web Content, Protecting Against Malicious Web Pages		
	3.3	**Obtaining User or Website Data**- Code Within Data, Website Data: A User's Problem, Foiling Data Attacks		
	3.4	**Email Attacks** - Fake Email, Fake Email Messages as Spam, Fake (Inaccurate) Email Header Data, Phishing, Protecting Against Email Attacks		
	3.5	Open Web Application Security Project		

4	**Network Security**		13	
	4.1	Threats to Network Communications - Interception: Eavesdropping and Wiretapping, Modification, Fabrication: Data Corruption, Interruption: Loss of Service Port Scanning Wireless Network Security - WiFi Background Vulnerabilities in Wireless Networks, Failed Countermeasure: WEP (Wired Equivalent Privacy), Stronger Protocol Suite: WPA (WiFi Protected Access)		
	4.2	Denial of Service- How service is Denied, Flooding Attacks, Network Flooding Caused by Malicious Code, Network Flooding by Resource Exhaustion, Denial of Service by Addressing Failures, Traffic Redirection, DNS Attacks, Exploiting Known Vulnerabilities Physical Disconnection Distributed Denial of-Service- Scripted Denial-of-Service Attacks, Bots, Botnets, Malicious Autonomous Mobile Agents, Autonomous Mobile Protective Agents		CO4
	4.3	Firewalls - What Is a Firewall? , Design of Firewalls, Types of Firewalls, Personal Firewalls, Comparison of Firewall, Types Example Firewall, Configurations Network Address Translation (NAT), Data Loss Prevention		
5	**Legal Issues and Ethics**		05	CO5
	5.1	Protecting Programs and Data- Copyrights, Patents, Trade Secrets, Special Cases		
	5.2	Ethical Issues in Computer Security - Differences Between the Law and Ethics, Studying Ethics, Ethical Reasoning		
Self Learning Component: Database Security, Operating System Security,				
		Total	45	

Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies	Security in Computing	Prentice Hall,	Fifth,
2.	Behrouz A Fourouzan, Debdeep Mukhopadhyay	Cryptography and Network Security	McGraw Hill	2nd edition
3.	William Stallings	Cryptography and Network Security: Principles and Practice	Pearson	5th edition
4.	Bernard Menezes	Network Security and Cryptography	Cengage Learning	2nd edition
5.	Mark Stamp	Information Security Principles and Practice	Wiley	2nd Edition

Course Code	Course Title						
116U01L602	Information Security Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "System Security". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01C603	**Artificial Intelligence**							
	TH		**P**		**TUT**		**Total**	
Teaching Scheme(Hrs.)	**03**		**--**		**--**		**03**	
Credits Assigned	**03**		**--**		**--**		**03**	
Examination Scheme	**Marks**							
	CA		**ESE**	**TW**	**O**	**P**	**P&O**	**Total**
	ISE	**IA**						
	30	**20**	**50**	**--**	**--**	**--**	**--**	**100**

Course Prerequisites (if any):
Data structures, analysis of algorithms

Course Objectives:
1. The objective of the course is to present an overview of artificial intelligence principles and approaches.
2. To enable students to develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.
3. The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program.

Course Outcomes
At the end of successful completion of the course the student will be able to

CO1: Design AI solution with appropriate choice of agent architecture
CO2: Analyse and solve problems for goal based agent architecture (searching and planning algorithms).
CO3: Represent and formulate the knowledge to solve the problems using various reasoning techniques
CO4: Analyse applications of AI and understand planning & learning processes in advanced AI applications

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Artificial Intelligence**		3	CO1
	1.1	History of Artificial Intelligence, The AI problem*, The AI technique*, Foundations of AI		
	1.2	Categorization of Intelligent System, Components of AI Program,		
	1.3	Sub-areas of AI, Applications of AI, Current trends in AI.		
2	**Intelligent Agents**		5	CO1
	2..1	Agents and Environments, The concept of rationality, The Task environment and their properties, PEAS, The structure of Agents, Types of Agents, Learning Agent, function of agent program		
3	**Problem Solving**		15	CO2
	3.1	Solving problem by Searching : Problem Solving Agent, Formulating Problems, Example Problems.		
		*Defining problem as state space search, *production rules, *Problem characteristics, issues in design of search program,		
	3.2	Uninformed Search Methods: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening depth first search		
	3.3	Informed Search Methods: Heuristic, properties of good heuristic, Greedy best first Search, A* Search, AO* search.		
	3.4	**Local Search Algorithms and Optimization Problems:** Hill-climbing search: concept, algorithm, problems and solutions in hill climbing Constraint satisfaction- concept, inferences in CSP, CSP Backtracking algorithm* Genetic algorithms*: The genetic algorithm process, solving problems with GA for optimization and learning, significance of genetic operators		
		Adversarial Search: Games, Optimal strategies, The minimax algorithm , Alpha-Beta Pruning,		
		#Self Learning – Online search algorithms, partially observable/imperfect information games		
4	**Knowledge and Reasoning**		10	CO3
	4.1	Knowledge based Agents, The Wumpus World, inference procedures, First Order Logic: Syntax and Semantic, Inference in FOL, Unification and lifting, Forward chaining, backward Chaining,		

		Resolution, Answer set programming		
		#Self Learning : Knowledge Engineering process, Propositional Vs Predicate logic		
		Uncertain Knowledge and Reasoning: Uncertainty, acting under uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Inference in Bayesian network,		
5	**Planning and Learning**		12	CO4
	5.1	The planning problem, Planning Vs Searching, STRIPS and ADL, Planning with state space search, Partial order planning, Hierarchical planning, Contingent Planning		
		#Self learning : Multiagent planning		
	5.2	Learning: Forms of Learning, Inductive Learning, Learning Decision Tree, applications of learning		
		#Self learning : Practical machine learning		
	$ 5.3	**Applications of AI and Current State of research in AI:** Natural Language Processing(NLP):Language models, text classification, information retrieval, information extraction. **Expert Systems**: Components of expert systems, ES vs Traditional System. Characteristics of expert systems, roles in ES implementation, ES implementation process, applications, advantages and limitations of ES Live face de-identification in Video, ReAgent Serving Platform(RSP), AI habitat, Robust visual question answering		
		Total	45	

Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

$- Teachers can choose from any state of art AI application and research work; these are suggestive contents. Based on the latest developments, these topics(minimum 2) could be chosen.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Stuart J. Russell and Peter Norvig	Artificial Intelligence : A Modern Approach	Pearson Education.	Second Edition
2.	*Elaine Rich and Kevin Knight	Artificial Intelligence	The McGraw-Hill	Third Edition
3.	George F Luger	Artificial Intelligence	Pearson Education	Fourth Edition

Course Code	Course Title						
116U01L603	Artificial Intelligence Lab.						
	TH		P		TUT	Total	
Teaching Scheme(Hrs.)	-		02		-	02	
Credits Assigned	-		01		-	01	
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Artificial Intelligence". Students will be graded based on continuous assessment of their term work.

Departmental Elective - II

Course Code	Course Title							
116U01E621	Compiler Construction							
	TH			P		TUT		Total
Teaching Scheme(Hrs.)	03			2				05
Credits Assigned	03			01				04
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	25	25	--	--	150

***Term Work will consist of Practical covering entire syllabus of compiler construction. Students will be graded based on continuous assessment of their term work.**

Course prerequisites (if any):
Finite automata, pushdown automata etc. from Theory of Computer science.

Course Objectives
The course aims to give knowledge of the principal structure of a compiler and about the basic theories and methods used to implement the different phases of the compiler.

Course Outcomes
At the end of successful completion of the course the student will be able to

CO1	Study phases of compiler and illustrate different parsing techniques and semantic analysis.
CO2	Illustrate and analyze the different intermediate code generation techniques and run time storage allocation.
CO3	Apply optimization techniques
CO4	Analyze and interpret the different issues in code generation phase

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Compiler**		**5**	**CO1**
	1.1 1.2 1.3 1.4	Compilers: Introduction to Compilers, Phases of a compiler, Comparison of compilers and interpreters. Compiler-compilers : JAVA compiler environment, YACC compiler-compiler		
2	**Lexical Analysis**		**3**	**CO1**
	2.1 2.2 2.3 2.4 2.5 2.6	Role of a Lexical analyzer, input buffering, specification and recognition of tokens, Finite Automata, Designing a lexical analyzer generator, Pattern matching based on NFA's.		
3	**Syntax Analysis**		**8**	**CO1**
	3.1 3.2 3.3	Role of Parser, Top-down parsing: Recursive descent and predictive parsers (LL), Bottom-Up parsing: Operator precedence parsing, LR, SLR and LALR parsers.		
4	**Syntax Directed Translation**		**5**	**CO1**
	4.1 4.2 4.3 4.4 4.5	Syntax directed definitions, construction of syntax tree, Type checking Top-down translation and Bottom-up evaluation of inherited attributes, analysis of syntax directed definitions		
5	**Run Time storage**		**6**	**CO2**
	5.1 5.2 5.3 5.4 5.5	Activation record, handling recursive calls, management of variable length blocks, garbage collection and compaction, storage allocation strategies.		
6	**Intermediate Code Generation**		**4**	**CO2**

	6.1 6.2 6.3 6.4	Intermediate languages: graphical representations, DAGs, Three address code, Types of three address statements, Syntax directed translation into three address code, implementation of three address statements		
7	**Code Generation**		**8**	**CO4**
	7.1 7.2	Semantic stacks, attributed translations, evaluation of expressions, control structures, and procedure calls		
8	**Code Optimization.**		**6**	**CO3**
	8.1 8.2 8.3 8.4 8.5 8.6 8.7 8.8 8.9 8.10	Machine dependent and machine independent code optimization Sources of optimization Data flow analysis Tail call optimization and Tail Recursion Elimination, Procedure Integration, Inline Expansion Leaf Routine optimization and shrink wrapping Register allocation and assignment, Graph coloring, Unreachable Code Elimination, Straightening If simplifications, Loop Simplifications, Loop inversion, Un switching, Branch optimizations, Tail merging or cross jumping, Conditional moves, Dead code Elimination, Branch Prediction, Machine Idioms and Instruction combining		
Self Learning Component: Compilation of object-oriented languages				
		Total	**45**	

 # Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

Recommended books

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	A.V. Aho, and J.D.Ullman	Principles of compiler construction	Pearson Education	Second Edition, 2007
2.	Kenneth C. Louden	Compiler Construction, Principles and Practice	Cengage Learning	Fourth Edition, 2006
3.	Dick Grune, Koen G.L, Henri Bal	Modern Compiler Design	Wiley Publications	Second Edition, 2006
4.	D M Dhamdhere	System Programming	Tata McGraw Hill publication	First Edition, 2011

Course Code	Course Title						
116U01L621	Compiler Construction Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Compiler Construction". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01E622	Data Mining and Business Intelligence							
	TH		P			TUT		Total
Teaching Scheme(Hrs.)	03		--			--		03
Credits Assigned	03		--			--		03
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	--	--	--	--	100

Course prerequisites (if any): Understanding of basic concepts of Database Management System and algorithms and Data structures**.**

Course Objectives:

1. To introduce the concept of data mining as an important tool for enterprise data management.
2. To enable students to effectively identify sources of data and process it for data mining.
3. To make students well versed in all data mining algorithms like classification clustering and association rule mining and their method of evaluation.
4. To approach business problems analytically by identifying opportunities to derive business values from data.

Course Outcomes:

At the end of successful completion of the course the student will be able to

CO1: To understand the concepts of data mining and its applications in business intelligence.
CO2: Preprocess and analyze data needed for data mining using different preprocessing techniques.
CO3: Apply & implement appropriate data mining algorithms like classification, clustering on larger data sets.
CO4: Discover interesting patterns from large amounts of data to analyse and extract patterns to solve problems.
CO5: Apply and analyze data mining for Business Intelligence Application.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to data mining (DM)**			
	1.1	What is Data Mining; Knowledge Discovery in Database (KDD), What can be Data to be Mined, Related Concept to Data Mining, Data Mining Technique, Application and Issues in Data Mining	**05**	**CO1**
2	**Data Exploration and Data Preprocessing**			
	2.1	Types of Attributes; Statistical Description of Data; Data Visualization; Measuring similarity and dissimilarity.		
	2.2	Why Preprocessing? Data Cleaning; Data Integration; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Normalization, Binning, Histogram Analysis and Concept hierarchy generation.	**10**	**CO2**
3	**Classification and Prediction**			
	3.1	Basic concepts, what is supervised and unsupervised methods, difference between classification and prediction tasks. Decision Tree Induction: Attribute Selection Measures, Naïve Bayes' Classifier, Linear and nonlinear regression, Logistic Regression.		
	3.2	Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation.	**10**	**CO3**
	3.3	Cluster Analysis: Basic Concepts, Partitioning Methods: K-Means, KMediods and hierarchical methods: Agglomerative. #Self-Learning: Divisive, BIRCH; Density-Based Methods: DBSCAN		
4	**Frequent pattern mining**			
	4.1	Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and Association Rules; Frequent Pattern Mining, The Apriori Algorithm for finding Frequent Itemsets, pattern growth approach for mining Frequent Itemsets;	**10**	**CO4**
	4.2	Mining Frequent Itemsets using vertical data formats; Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules, Correlation Analysis, lift.		
5	**Business Intelligence**		**10**	**CO5**

	5.1	What is Business intelligence? Business intelligence architectures; Definition of decision support system; Development of a business intelligence system using Data Mining Applications like Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance CRM etc.		
		#Self-learning: Data warehouse concepts & business intelligence tools.		
			Total	**45**

 # Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Galit Shmueli, Nitin Patel, Peter Bruce	Data mining For Business intelligence	Wiley Student Edition	
2.	Han, Kamber	Data Mining Concepts and Techniques	Elsevier	2nd edition
3.	Alex berson & Stephen J Smith	Data Warehousing, Data Mining & OLAP	Tata McGraw Hill	
4.	M.H. Dunham	Data Mining Introductory and Advanced Topics	Pearson Education	
5.	Rajiv Sabherwal, Irma Becerra-Fernandez	Business Intelligence: Practices, Technologies and Management	Wiley	1 edition

Course Code	Course Title						
116U01L622	Data Mining and Business Intelligence Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course “Data Mining and Business Intelligence”. Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01E623	Software Testing & Quality Assurance							
	TH			P		TUT		Total
Teaching Scheme(Hrs.)	03			-		-		03
Credits Assigned	03			-		-		03
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50					100

Course prerequisites (if any):
Software Engineering, Programming Concepts & Algorithms.

Course Objectives
The objective of this course is to impart understanding of techniques for software testing and quality assurance. To help students to develop skills that will enable them to construct software of high quality - software that is reliable, and that is reasonably easy to understand, modify and maintain.

Course Outcomes
At the end of successful completion of the course the student will be able to

CO1	Explore the fundamentals of testing.
CO2	Describe the various levels of testing and their use in designing of various test cases.
CO3	Model various test cases for real life applications.
CO4	Outline software quality concepts
CO5	Identify software quality assurance goals and standards.

Module No.	Unit No.	Details	Hrs.	CO
1		**Fundamentals of Testing**	6	CO 1
	1.1	Human and errors, Testing and Debugging, Software Quality, Requirement Behavior and Correctness, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, The Tester's Role in a Software Development Organization, Origins of Defects, Defect Classes, The Defect Repository and Test Design.		
		# Self Learning - Defect Examples		
2		**Levels of Testing**	10	CO 2
	2.1	The Need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests. The Class as a Testable Unit, The Test Harness, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, System Test – The Different Types, Regression Testing, Alpha, Beta and Acceptance Tests.		
		#Self-Learning -Junit Tool		
3		**Test Case Design and Implementation:**	10	CO 3
	3.1	Introduction to Testing Design Strategies, Test Case Design Strategies, Using Black Box Approach to Test Case Design, Random Testing, Equivalence Class Partitioning, Boundary Value Analysis, , Using White-Box Approach to Test design, Coverage and Control Flow Graphs, Covering Code Logic,Additional White Box Test Design		
		#Self Learning – Other Black box & Whitebox Test Design Approaches		
4		**Quality Assurance**	8	CO 4
	4.1	Introduction The Software Quality Challenge. What is Software Quality? Software Quality Factors The Components of the Software Quality Assurance System - Overview.		
	4.2	Pre-Project Software Quality Components Contract Review Development and Quality Plans		
	4.3	SQA Components in the Project Life Cycle Integrating Quality Activities in the Project Life Cycle Reviews. Software Testing – Strategies Software Testing – Implementation		

		Assuring The Quality of Software Maintenance. Assuring The Quality of External Participants Parts Case Tools and their Effect on Software Quality.		
5	**Software Quality Assurance**		**9**	**CO 5**
	5.1	Software Quality Infrastructure Components Procedures and Work Instructions. Supporting Quality Devices Staff Training, Instructing and Certification. Preventive and Corrective Actions. Configuration Management Documentation and Quality Records Controls.		
	5.2	Software Quality Management Components Project Progress Control Software Quality Metrics Software Quality Costs		
	5.3	Standards, Certification and Assessment SQA Standards ISO 9001 Certification Software Process Assessment		
		Total	**48**	

Recommended books

Sr. No	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1	Kshirsagar Naik, Priyadarshi Tripathy	Software Testing & Quality Assurance	Wiley , India	1st Edition 2016
2	Naresh Chauhan	Software Testing Principles& Practices	Oxford University Press	2nd Edition,2016
3	Daniel Galin	Software Quality Assurance: From Theory to Implementation	Pearson Publishers	1e Paperback,1 January 2008

Course Code	Course Title						
116U01L623	Software Testing & Quality Assurance Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Software Testing & Quality Assurance". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01E624	Wireless sensor networks and IOT							
	TH			P		TUT		Total
Teaching Scheme(Hrs.)	03			--		--		03
Credits Assigned	03			--		--		03
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	--	--	--	--	100

Course prerequisites (if any):Embedded system, Data networks and Adhoc networks

Course Objectives

To learn basic architecture of Wireless sensor networks and Internet of Things and understand WSN routing protocols and evaluate software ,hardware platforms for IoT technology. Also create applications using IOT analytics.

Course Outcomes

At the end of successful completion of the course the student will be able to

CO1	Explain the basic architecture and working principle of wireless sensor networks and Internet of Things
CO2	Identify challenges and issues in WSN routing and suggest solutions.
CO3	To use different Operating system for Wirelese sensor networks and IoT
CO4	Evaluate the software and hardware platforms for IoT Technologies and design small IoT application.
CO5	Create IoT application data using IoT Analytics.

Module No.	Unit No.	Details	Hrs.	CO
1		**Introduction to Wireless Sensor networks and IOT**	**12**	**CO1**
	1.1 1.2 1.3. 1.4	**Characteristic requirements for WSN** - Challenges for WSNs – WSN vs Adhoc Networks **Sensor network architecture** Commercially available sensor nodes –Imote, **IRIS, Mica Mote, EYES nodes, BTnodes, TelosB–** **IoT ARCHITECTURE:** Various architectures of the IoT middleware such as distributed, services oriented, centralized, M2M Domain model, Information model, functional model, communication model, IoT reference architecture **Self learning : Scenarios for WSN and IOT**- Home Control - Building Automation - Industrial Automation - Medical Applications, Environmental Monitoring		
2		**Medium Access Control and Routing Protocols**	**12**	**CO2**
	2.1 2.2	**Medium Access Control Protocols:** Fundamentals of wireless MAC protocols, Contention-based protocols - Schedule-based protocols ; SMAC-BMAC - The IEEE 802.15.4 MAC protocol. **Routing Protocols :** Routing Challenges and Design Issues in Wireless Sensor Networks, Classification of Adhoc Routing protocols, Flooding and gossiping - Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing — Hierarchical Routing — Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols ..		
3		**Operating system and Sensors in WSN and IOT**	**08**	**CO3**
	3.1 3.2	TinyOS, Raspbian ,Debian Perception layer of the IoT: Various sensors such as light sensors, accelerometer, gyroscope, magnetometer, camera microphone, GPS, proximity sensors. Etc		
4		**IoT Physical Devices**	**08**	**CO4**
	4.1 4.2 4.3	IoT Prototype design using microcontroller boards: Arduino, Raspberry PI, Beagalbone, Introduction to Actuators in IoT applications. Case study: Home Automation,Industrial Automation		
5		**IoT Analytics**	**05**	**CO5**
	6.1 6.2 6.3	Business Process in IoT IoT Analytics with cloud Edge analytics		
		Total	**45**	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Carlos De Morais Cordeiro, Dharma Prakash Agarwal	Adhoc and sensor networks:Theory and Applications	World Scientific Publishing	1st edition ,2006
2.	C.Siva Ram murthy,B.S.Manoj	Adhoc wireless networks	Pearson	1st edition,2006
3.	Arshdeep Bhaga and Vijay Madisetti	"Internet of Things (A Hands-on-Approach)",University Press	Tata McGraw-Hill ,India	4th edition ,2015
4.	Hakima Chaouchi	"The Internet of Things (Connecting objects to the web)"	Wiley publication	1st edition,2014
5.	Hakim Cassimally and Adrian McEwen	" Designing the Internet of things"	Wiley publication	1st edition,2013

Course Code	Course Title					
116U01L624	Wireless sensor networks and IOT Lab.					
	TH		P		TUT	Total
Teaching Scheme(Hrs.)	-		02		-	02
Credits Assigned	-		01		-	01
Examination Scheme	Marks					
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Wireless sensor networks and IOT". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01E625	**Mobile Communication and Ad-Hoc Networks**							
	TH		**P**		**TUT**			**Total**
Teaching Scheme(Hrs.)	**03**		**--**		**--**			**03**
Credits Assigned	**03**		**--**		**--**			**03**
Examination Scheme	**Marks**							
	CA		**ESE**	**TW**	**O**	**P**	**P&O**	**Total**
	ISE	**IA**						
	30	**20**	**50**	**--**	**--**	**--**	**--**	**100**

Course prerequisites (if any):

Basic Knowledge of Computer Networks, Layered Architecture, Structure and working related Protocols**.**

Course Objectives

1. To provide an overview of Mobile & Cellular Communication networks area and its applications in communication engineering.
2. To understand the various terminology, principles, concepts, Standards, algorithms and different methodologies used in Wireless Communication Networks specifically for Wireless Ad-Hoc Networks.

Course Outcomes

At the end of successful completion of the course the student will be able to

CO1: Explain the basic concepts of various wireless networks and their working characteristics with respect to mobile network generations such as 2G, 3G and beyond.

CO2 Compare infrastructure based and Ad hoc networks, elaborating characteristics and

	features of Ad hoc Networks
CO3	Inspect designing of Wireless MAC protocols for Ad hoc networks; and the working principle of different WLAN IEEE standards.
CO4	Describe various Network Layer & Transport layer mechanisms and Routing Protocols for Wireless networks.
CO5	Explain various features and operations of Application Protocols of wireless Ad-hoc and Mesh Networks like sensor networks, VANETs etc.

Module No.	Unit No.	Details	Hrs.	CO
1	**Cellular Mobile Networks**		**10**	**CO 1**
	1.1	Cellular networks: Basic cellular system, Frequency allocation, Frequency re-use		
	1.2	GSM System Architecture: GSM Radio subsystem, Interfaces, Network and switching subsystem, Operation subsystem		
	1.3	GSM channels: Traffic Channel multiframe, Control (Signaling) Channel Multiframe, Frames, Multi-frames, Super-frames and Hyper-frames		
	1.4	GSM Call Set up Procedure		
	1.5	CDMA Networks		
	1.6	Handoff: Hard and soft		
		#Self Learning-VoIP		
2	**2.5 G, 3 G Networks and beyond**		**09**	**CO1**
	2.1	2.5G Networks: GPRS Architecture, GPRS Network Nodes: Mobile Station, Base Station System, GPRS Support Node, HLR and VLR, GPRS Interfaces		
	2.2	3G Networks: The Universal Mobile Telecommunication System (UMTS) - UMTS Network Architecture, UMTS FDD and TDD		
	2.3	Next generation networks; 3GPP LTE and beyond		
		#Self Learning - VoLTE		
3	**Wireless LAN**		**09**	**CO2 CO3**
	3.1	Infrastructure & Ad hoc Networks; Introduction to ad hoc networks – definition, characteristics features.		

	3.2	MAC Protocols for Ad hoc wireless Networks: Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals and Classification of MAC protocols, Contention based protocols with reservation mechanisms.		
	3.3	IEEE standards: 802.11a, 802.11b, 802.11g, 802.11e, 802.11n;IEEE 802.16.		
		#Self Learning – HIPERLAN, Bluetooth, WLAN Security- WEP, WPA, WPA2		
4	**Mobile Network and Transport layer**		**12**	**CO4**
	4.1	Introduction to Mobile IP: Requirements, IP packet delivery, agent discovery, registration, tunneling and encapsulation.		
	4.2	Routing protocols for Ad hoc wireless Networks: Introduction, Issues in designing a routing protocol for Ad-hoc wireless Networks, Classification of routing protocols, Proactive Vs reactive routing protocols, Hybrid routing Algorithm		
	4.3	Unicast routing algorithms and Hierarchical Routing : DSR, AODV, OLSR, ZRP		
		#Self Learning-Energy Efficient Routing in Wireless Networks		
	4.4	Classical TCP improvements – methods of mobile TCP: Indirect TCP, snooping TCP, mobile TCP		
		#Self Learning –Fast Retransmit/Fast Recovery		
5	**Mobile Application layer & Application domains of Ad hoc Networks**		**05**	**CO5**
	5.1	Wireless Application Protocol (WAP)		
		#Self Learning:- WML		
	5.2	Vehicular Ad hoc networks (VANETs)		
	5.3	Sensor Networks		

Total	**45**	

 # Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	J. Schiller	Mobile Communications	Pearson Education	2nd Edition
2.	KavehPahlavan, Prashant Krishnamurthy	Principles of Wireless Networks	Pearson Education	2003
3.	DipankarRaychaudhuri, Mario Gerla	Emerging Wireless Technologies and the Future Mobile Internet	Cambridge University Press	1st Edition, 2011
4.	MustafeErgen	Mobile Broadband Including Wi Max and LTE	Springer	2009
5.	Savoy G.Glisic	Advanced Wireless Comm& Internet	Wiley Publication	3rd Edition

Course Code	Course Title						
116U01L625	Mobile Communication and Ad-Hoc Networks Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Mobile Communication and Ad-Hoc Networks". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01E626	Machine Learning							
	TH		P			TUT		Total
Teaching Scheme(Hrs.)	03		-			--		03
Credits Assigned	03		-			--		03
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	-		--	-	100

Course prerequisites (if any):
Linear algebra
Probability and statistics
Multivariate calculus
Algorithms and complexity
Programming language such as C++, Java, Python

Course Objectives:
1. Introduction to fundamentals of Machine Learning
2. Study of application of various ML algorithms
3. Analysis Machine Learning algorithms
4. ML Algorithm based application development

Course Outcomes
At the end of successful completion of the course the student will be able to

CO1: Comprehend the basics of Machine Learning.
CO2: Apply and implement machine learning methods
CO3: Analyze machine learning algorithms
CO4: Design Dimensionality reduction techniques
CO5: Develop Applications using Machine Learning methodologies

Module No.	Unit No.	Details	Hrs.	CO
1	**Machine Learning Basics**		**05**	**CO**
	1.1	Introduction to Machine Learning, Key Terminology, Types, Introduction to applications of Machine Learning, Steps to choose the right ML algorithm, Steps in developing a Machine Learning Application.		**1**
	1.2	**Feature Engineering**: Data Collection, Data Exploration and Profiling, data cleaning for consistent data, Introduction to data preprocessing methods for improving data quality, Data Splitting for training and evaluation sets		
2	**Supervise Learning with Regression and Classification :**		**12**	**CO**
	2.1	Linear Regression, Logistic Regression, Advanced Regression Techniques		**2, 3, 5**
	2.2	Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART), Random Forest		
		Self-Learning – Ensemble Learning		
	2.3	Support Vector Machines: Maximum Margin Linear Separators, Quadratic Programming solution, Kernels for learning non-linear functions		
	2.4	Bayesian Belief networks, Hidden Markov Models. KNN supervised learning Applications of Bayesian Belief networks		
		Self-Learning: Applications of HMM		
3	**Dimensionality Reduction :**		**07**	**CO**
	3.1	Dimensionality Reduction Techniques: Principal Component Analysis, Independent Component Analysis.		3, 4
		Backward feature elimination and forward feature construction		
4	**Unsupervised Learning :**		**08**	**CO**
	4.1	K-means clustering, Hierarchical clustering, Expectation Maximization Algorithm, Supervised learning after clustering, Radial Basis functions		2, 3
5	**Neural Network with Supervised and Unsupervised Learning**		**08**	CO

	5.1	Introduction to Neural Network, Learning Parameters, Activation functions Supervised and unsupervised Neural Networks, Feed-Forward network and Back-Propagation Algorithms, Applications of Neural networks		3, 5
		# Self-Learning: Deep Belief Nets.		
6	**6.1**	**Introduction to Reinforcement Learning:**	**04**	**CO**
		Elements of Reinforcement Learning, Model based learning, Temporal Difference Learning.		**1**
		Total	**45**	

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Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Peter Harrington	Machine Learning In Action	DreamTech Press	1st , 2012
2.	Ethem Alpaydın	Introduction to Machine Learning	MIT Pres	3rd, 2014
3.	Tom M.Mitchell	Machine Learning	McGraw Hill	1st, 2017
4.	Stephen Marsland	Machine Learning An Algorithmic Perspective	CRC Press	1st, 2011
5	M Gopal	*Applied Machine Learning*	Mc-Graw Hill Education India Pvt. Ltd.	Print edition: ISBN-13: 978-93-5316-025-8,

Term-Work will consist of practical experiments covering entire syllabus. Students will be graded based on continuous assessment of their term work

Course Code	Course Title						
116U01L626	Machine Learning Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Machine Learning". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title						
116U01E627	Microservices and DevOps						
	TH		P		TUT		Total
Teaching Scheme(Hrs.)	03		--		--		03
Credits Assigned	03		--		--		03
Examination Scheme	Marks						
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	--	--	--	--	--	50

Course prerequisites (if any):
Practical knowledge of Java

Course Objectives:
DevOps and Microservices are the most important topics being used in IT industry. The main objective of this course is to provide in depth understanding of DevOps and Microservices concepts, frameworks, tools and technology. It also help students to practically build DevOps pipeline using Jenkins and build microservice based applications using Java , Spring Framework using best practices. This course shall make student ready to build modern applications as a part of their academic course curriculum and make them ready to get more opportunities in IT industry
.

Course Outcomes:
At the end of successful completion of the course the student will be able to

CO1 Explain concept, importance and usage of DevOps and Microservices

CO2 Apply DevOps best practices which include Continuous Development, Continuous Testing, Configuration Management, Continuous Integration, Continuous Delivery, Continuous Deployment and Continuous Monitoring

CO3 To set up a basic DevOps pipeline

CO4 Differentiate between traditional monolithic and microservice based applications

CO5 Apply the Microservices patterns & principles for building microservice based applications

CO6 Implement microservices using Spring Boot Framework and Java

Module No.	Unit No.	Details	Hrs.	CO
1	**DevOps: What and why**		03	CO1
	1.1	o The History of Devops o What is DevOps o Linkage of Agile and DevOps o DevOps Benefits o DevOps Focus Areas o DevOps people, processes and tools o Understanding of How DevOps Works		
		#Self-Study: Understand Agile and Scrum Framework		
2	**DevOps Principles, practices and tools**		12	CO2
	2.1	○ DevOps Principles ○ DevOps Practices ▪ Configuration Management ▪ Version Control ▪ Infrastructure Automation ▪ System Provisioning ▪ Continuous Integration ▪ Test and Build Automation ▪ Continuous Delivery ▪ Continuous Deployment ▪ Metrics ▪ Logging ▪ Continuous Monitoring ▪ Alerting		
3	**Building DevOps Pipeline**		10	CO3
	3.1	o What is pipeline o What are different tools to build pipeline o How to start building pipeline o Create pipeline o How to use the pipeline o How to optimize the pipeline		
		#Self Learning –Understand Jenkins tool		
4	**Microservices: What and why**		12	CO4, CO5
	4.1	o What is monolithic architecture? o Benefits of monolithic application o drawbacks of monolithic application o What is Service? o History of Microservices		

		o What are microservices? o Principles of Microservices o Characteristics of Microservices o Industry adoption of microservices o Benefits of Microservices o Drawback of microservices o Monolithic Vs Microservices		
	4.2	**Microservices Pattern** o Core microservice development pattern o Microservice routing patterns o Microservice client resiliency patterns o Microservice security patterns o Microservice logging and tracing patterns o Microservice build/deployment patterns		
5	**Building Microservices using Spring Boot and Java**		**8**	**CO 6**
	5.1	o What is Spring Framework o What is Spring Boot o What is Spring Cloud o Setting up a development environment o Developing a RESTful service – the legacy approach o Moving from traditional web applications to microservices o Using Spring Boot to build RESTful microservices o Getting started with Spring Boot o Developing the Spring Boot microservice using the CLI o Developing the Spring Boot Java microservice using STS o Examining the POM file o Examining Application.java o Examining application properties o Examining ApplicationTests.java o Testing the Spring Boot microservice o Microservices using Spring Cloud		
		Total	**45**	

 # Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
6.	Aniket Mhala	*Fundamentals of Microservices*	Emotive Publications	October 2021
7.	Jennifer Davis and Katherine Daniels	*Effective DevOps*	O'Relly Publications	February 2016
8.	Sanjay Sharma and Bernie Coyne	*DevOps For Dummies*	2nd IBM limited edition	2015
9.	Rajesh V	*Spring Microservices*	Packt Publication	June 2016
10.	Cloves Carneiro Jr. ,Tim Schmelmer	*Microservices from Day One*	APress Publication	2016
11.	Sam Newman	Building Microservices: Designing Fine-Grained Systems	O'Reilly Media	Feb 2015

Course Code	Course Title						
116U01L627	Microservices and DevOps Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Microservices and DevOps". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title						
116U01E628	Applied Cryptography						
	TH		P	TUT	Total		
Teaching Scheme(Hrs.)	03		--	--	03		
Credits Assigned	03		--	--	03		
Examination Scheme	Marks						
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	--	--	--	--	100

Course prerequisites (if any):

Some mathematical maturity, in terms of understanding and working with mathematical definitions, concepts, and proofs, and elementary notions of logic, set theory, number theory,probability and statistics;

Course Objectives

In the era of Digital Computers and internet ensuring confidentiality, authentication, integrity of data during communication is very critical. This course impart students the knowledge of cryptographic algorithms and techniques to achieve same. It also introduces students to the advances in the area of cryptography

Course Outcomes

At the end of successful completion of the course the student will be able to

CO1	Explain fundamentals of Information Security and cryptography
CO2	Demonstrate various Cryptographic Algorithms for securing systems
CO3	Comprehend cryptographic hash functions, Message Authentication Codes and Digital Signatures for Authentication
CO4	Realize advances in the field of cryptography

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Information Security & Cryptography**		06	CO 1
	1.1	Information Security and its goals, Vulnerability Threats and Attacks		
	1.2	Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Stream and Block Cipher, Cryptanalysis, Brute Force Attack		
	1.3	Mathematics of Cryptography: Integer Arithmetic, The Extended Euclidean Algorithm, Modular Arithmetic, Matrices, Linear Congruence		
	1.4	Classical Cryptrography: Substitution and Transposition Techniques: Any two from each		
2	**Symmetric Key Cryptography**		09	CO2
	2.1	**Mathematics of Symmetric Key Cryptography:** Algebraic Structures, Group, Ring, Field, GF Fields		
	2.2	**Modern Block Ciphers**: Components of Modern Block Cipher, Product Ciphers, Diffusion and Confusion, Classes of Product Cipher **DES**: DES Structure, DES Analysis: Properties, Design Criteria, DES Strength and Weaknesses, DES Security, Multiple DES, 3DES		
	2.3	**AES**: AES Structure, Transformations, Key Expansion in AES-128, Key Expansion in AES-192 and AES-256, Key-Expansion Analysis, Analysis of AES: Security, Implementation, Simplicity and Cost		
		#Self Learning – Stream Cipher, RC5, Block Cipher Modes		
3	**Asymmetric Key Cryptography**		10	CO3
	3.1	**Mathematics of Asymmetric Key Cryptography:** Primes, Primality Testing, Factorization, Quadratic Congruence, Exponentiation and Logarithm		
	3.2	**Public key cryptography:** Principles of public key cryptosystems, The RSA algorithm, attacks on RSA		
	3.3	**Key management:** Diffie Hellman Key exchange, Man-in Middle attack		
		#Self Learning : Rabin Cryptosystem		
4	**Message Authentication and Digital Signatures**		11	CO3
	4.1	Message Authentication Approaches, Hash Function, Cryptographic Hash Function Requirements, Cryptographic Hash Function Security, Cryptographic Hash Function Structure, SHA, HMAC, MD5.		

	4.2	Using Symmetric Encryption for Message Authentication, Message Authentication Code (MAC), Digital Authentication Algorithm (DAA)		
	4.3	Using Public Key for Authentication, Digital Signatures, Properties of Digital Signatures beyond Message Authentication, DSS, Authentication Applications: Kerberos, X.509 Authentication Service		
		#Self Learning : RSA and Schnorr Digital Signature		
5	**Introduction to Advances in Cryptography**		**09**	**CO4**
	5.1	Quantum Cryptography, Quantum key distribution-QKD		
	5.2	Homomorphic Encryption		
	5.3	Secure Multi-Party Computation (MPC) In particular, Zero-Knowledge Proofs		
	5.4	Cryptographic Obfuscation		
		Total	**45**	

Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Behrouz A. Forouzan	Cryptography and Network Security	Mc Graw Hill	3rd Edition, 2017
2.	William Stallings	Computer Security Principles and Practice	Pearson Education	2016. 5th Edition
3.	Mark stamp	Information Security Principal and Practice	Wiley	2008, 3rd Edition
4.	Bruce Schneier	Applied Cryptography	Wiley	2015, Second Edition
5.	Jaydip Sen	Theory and practice of cryptography and network security protocols and technologies	Intech Publishers, Croatia, Europe	2013. First Edition
6.	Oded Goldreich	Foundations of Cryptography – A Primer	Foundations and Trends® in Theoretical Computer Science: Vol. 1: No. 1, pp 1-116	2005

Course Code	Course Title						
116U01L628	Applied Cryptography Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Applied Cryptography". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01E629	Cloud Computing							
	TH		P		TUT		Total	
Teaching Scheme(Hrs.)	03		--		--		03	
Credits Assigned	03		--		--		03	
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	--	--	--	--	100

Course Prerequisites (if any):

1. Fundamental knowledge on Operating system and Computer Networks
2. Basics of client/server programming and network protocols

Course Objectives:

Cloud computing has evolved as a very important computing model, which enables information, software, and other shared resources to be provisioned over the network as services in an on-demand manner. Students will be exposed to the current practices in cloud computing. Topics may include distributed computing models and technologies, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), virtualization, performance and systems issues, capacity planning, federated clouds, challenges in implementing clouds, data centers, hypervisor CPU and memory management, cloud hosted applications, and other advanced and research topics in cloud computing.

At the end of successful completion of the course the student will be able to

CO1: Comprehend the issues related to cloud computing and its application
CO2: Investigate the system virtualization and outline its role in enabling the cloud computing System model
CO3: Analyse and apply cloud programming models to solve problems
CO4: Build cloud services and applications
CO5: Configure and experiment with advanced cloud technologies

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction**		6	CO1
	1.1	Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies - Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka		
2	**Virtualization**		11	
	2.1	Introduction, Characteristics of Virtualized Environments , Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization		CO2
	2.2	Technology Examples: Xen: Para virtualization, VMware: Full Virtualization, Microsoft Hyper-V		
	2.3	Cloud Computing Architecture : Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges		
		#Self-Learning – Virtual Machine Provisioning and Migration services		
3	**Cloud Infrastructure and Platforms in Industry**		09	CO3
	3.1	Amazon Web Services – Compute Services, Storage Services, Communication Services, Additional Services		
	3.2	Google Cloud Platform, Google AppEngine: Architecture and Core concepts; Application Life Cycle		
4	**Cloud Applications**		09	CO4
	4.1	Scientific Applications – Healthcare: ECG analysis in Cloud, Biology: Protein Structure Prediction, Geoscience: Satellite Image Processing		
	4.2	Business and Consumer Applications – CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming		
		#Self-Learning – other Applications		
5	**Advanced Topics in Cloud Computing**		10	
	5.1	Energy Efficiency in Clouds, Market Based Management of Clouds, Federated Clouds / Inter Cloud, Third Party Cloud Services: MetaCDN, SpotCloud		CO5
	5.2	Dockers and Containers, Micro Services, Cloud automation tools and DevOps concepts		
		Total	45	

Students should prepare all Self Learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA and Laboratory Experiments.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi	Mastering Cloud Computing	McGraw Hill Education Private Limited	2nd , 2013
2.	J.Vette, Toby J. Vette, Robert Elsenpeter	Cloud Computing: A Practical Approach	McGraw Hill Education Private Limited	1st , 2009
3.	Rajkumar Buyya, James Broberg, Andrzej Goscinski	Cloud Computing, Principles and Paradigms	Wiley	1st ,2013
4.	Tim Mathar, S. Kumaraswammy, S.Latif	Cloud Security & Privacy	O'REILLY	1st , 2009
5.	George Reese	Cloud Application Architectures: Building Applications and Infrastructure in the Cloud	O'Reilly Publication	1st , 2009
6.	Aniket Mhala	Fundamentals of Microservices	Emotive Publications	October 2021

Course Code	Course Title						
116U01L629	Cloud Computing Lab.						
	TH			P		TUT	Total
Teaching Scheme(Hrs.)	-			02		-	02
Credits Assigned	-			01		-	01
Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	25	--	--	25

Term-Work:

Term work will consist of experiments/ tutorials covering entire syllabus of the course "Cloud Computing". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01P601	**Mini Project**							
	TH			**P**		**TUT**		**Total**
Teaching Scheme(Hrs.)	**01**			**02**		**--**		**03**
Credits Assigned	**01**			**02**		**--**		**03**
Examination Scheme	**Marks**							
	CA			**ESE**	**TW**	**O**	**P**	**P&O**	**Total**
	T-1	**T-2**	**IA**						
	--	**--**	**--**	**--**	**50**	**--**	**--**	**25^**	**75**

Course prerequisites: Fundamentals of software engineering.

Course Objectives: The objective of the Mini Project is to address the real-world problems, find, implement and demonstrate the solution for the same through the courses learned in earlier semesters. Identify various hardware and software requirements for problem solution. It will also inculcate qualities such as meeting deadlines, making and following work plan. The Mini Project may be beyond the scope of courses learnt and interdisciplinary in nature.

Course Outcomes:

At the end of successful completion of the course the student will be able to

CO1 Define the problem statement and scope of problem.
CO2 Identify various hardware and software requirements for problem solution.
CO3 Implement and test the hardware/ software algorithms to meet the desired Specifications.
CO4 Analyze, interpret results and correspondingly modify the designed system to get the desired results.
CO5 Prepare a technical report based on the project.
CO6 Present technical seminar based on the Mini Project work carried out.

Module No.	Unit No.	Details	Hrs.	CO
1	**SRS Document.**		**02**	**CO 1**
	Prepare the basic documents required to develop a product, a software system, a website or a mobile app to provide certain services or facilities. Objective, Scope of the project, Requirements gathering, Design, Testing etc.			
2	**Design document.**		**04**	**CO 2**
	Levels of designs: Frontend interface, Backend/ database design. Heuristic Design principles.			
3	**Implementation and Prototyping.**		**04**	**CO 3**
	Implementation Plan, Process Design, Solution Design, Modules Description, Integration, Prototyping.			
4	**Testing.**		**03**	**CO 4**
	Types of testing: Black-box – ECP, BVA, White-box-Cyclomatic complexity.			
5	**Report Writing**		**03**	**CO 5 CO 6**
	A detailed report covering introduction, problem definition, scope, hardware-software requirements, literature survey, project design, implementation, testing, conclusion, future work etc.			
			15	

Term Work and Practical / Oral:

The mini project is a group project. Interdisciplinary projects are also permitted. Each project will be assigned to one faculty member as a supervisor.

There will be continuous assessment and progress report of the project that needs to be maintained by student(s). The final oral / Demo will be a presentation based on a demonstration of the project in front of a committee of examiners.