SOMAIYA VIDYAVIHAR UNIVERSITY

K J Somaiya College of Engineering

Syllabus

B. Tech Computer Engineering

(Third Year Semester V and VI)

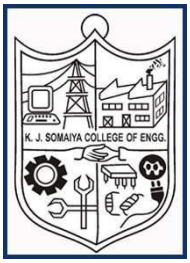
From

Academic Year 2022-23

(Revision-1)

Approved by FOET 08/05/2022 and AC 06/07/2022

TY B. Tech / COMP / Revision 1.0



K J Somaiya College of Engineering, Mumbai-77

(A Constituent College of Somaiya Vidyavihar University)

Preamble

KJSCE as a constituent college of Somaiya Vidyavihar University has the academic flexibility to develop and implement its own curriculum *KJSCE-SVU-2020* with features such as inclusion of choice based Open Elective Courses, Add on Credit / Audit Courses, Exposure Courses, etc. Distinct assessment and evaluation methods are also designed based on focus of individual courses. The outcome of this entire exercises; either by way of student placements or the feedback received from all stakeholders is quite encouraging.

At present, Industry is moving towards Industrial revolution 4.0. Knowing very well that every country's education system forms the basis of its progress and the groundwork for its future, we need to be making engineering graduates equipped to take industrial challenges. A common feature in successful education systems is the balance between tradition and the capacity to be flexible and able to adapt to current social trends. To achieve this, Somaiya Vidyavihar University allows for the undergraduate courses to have a focus on the changing industrial scenario.

Our new revision in syllabus *KJSCE-SVU-2020,* introduced from the academic year 2020-21, has been designed based on the revised guidelines from various accrediting bodies.

The said syllabus is a result of expert advice from members of Board of Studies, Faculty of Engineering & Technology and Academic Council; both having due representation from academia as well as appropriate industries. Subsequently faculty members of the college have put in efforts to document it in the form which has been presented here.

Some of the highlights of the *KJSCE-SVU-2020* syllabus are: Introduction of wide choice for branch specific electives, more number of open or interdisciplinary electives, opportunity for internships, etc. Courses like Object Oriented Programming Methodology, Full Stack Development and Digital Design are designed as laboratory oriented courses and pay more attention to hands-on learning. There is also an emphasis on project based learning (PBL) through courses like Mini-projects and PBL is also encouraged through projects as part of various courses.

Focus of academic processes in KJSCE is such that, by the time student completes the requirements of the degree, he/ she will be able to acquire attributes required for profession as an engineer. Outcomes are defined to acquire these attributes which lead to development of curriculum, pedagogy and assessment tools. These tools need to be updated based on experiences of teacher and learner. Hence teaching -learning -evaluation paradigm is going to be a mix of traditional as well as use of ICT tools. Role of the faculty member changes from tutor to trainer / instructor/ facilitator / mentor based on the outcomes targeted.

For measuring learning outcomes of students, traditional methods like tests, laboratory work and End Semester Examinations (ESE) are implemented. Continuous Assessment (CA) is carried out through tests and internal assessment (IA) like quizzes, case studies, mini projects etc. These IA tools enable the students to develop competencies through solutions discussed, improvisations suggested, feedbacks given by faculty members. Through these assessment methods students get opportunity for reading research papers, presenting ideas and working in a team.

Since the assessments are distributed throughout the term the learning process is continuously monitored and graded.

The Department of Computer Engineering courses focus on thrust areas of Department. These areas are Intelligent System and Data Processing, Network System and Security, Image Analysis and Interpretation and System & Software Engineering.

College promotes co-curricular, extra-curricular activities as well as sports; making life outside classroom exciting and rewarding. What makes these activities very effective is the fact that these do not focus only on winning trophies but try to nurture generic skills such as leadership, effective communication, teamwork etc. which are essential skills for a bright professional career.

Along with my colleagues, I welcome you to Department of Computer Engineering and look forward to lead you towards professional career.

Dr. Deepak Sharma
Head
Department of Computer Engineering

Dr. Shubha Pandit
Principal and Dean
Faculty of Engineering and Technology

Vision

To become a center of excellence in discipline of Computer Engineering for developing technically adept professionals with ethical and leadership qualities in service of society.

Mission

- Provide sound technical foundation in Computer Engineering through comprehensive curriculum and application oriented learning.
- Provide ambience for professional growth and lifelong learning for adapting to challenges in rapidly changing technology
- Inculcate social and ethical values and leadership qualities

Program Educational Outcomes (PEO)

A graduate of Computer Engineering will

PEO1. Solve problems in diverse fields using knowledge of Computer Engineering.

PEO2. Excel in professional career, exhibit leadership qualities with ethics &soft skills.

PEO3. Pursue higher education, research or entrepreneurship, engage in professional development, adapt to emerging technologies.

Program Outcomes (PO)

After successful completion of the program Computer Engineering Graduate will be able to:

PO1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities

with an understanding of the limitations.

PO6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, cultural, environmental, health, safety and legal issues relevant to the professional engineering practice; understanding the need of sustainable development

PO7. **Multidisciplinary Competence:** Recognize/ study/ analyze/ provide solutions to real-life problems of multidisciplinary nature from diverse fields

PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO1: Design, construct and implement hardware and software based modern Computing / Information systems with varying complexities

PSO2: Demonstrate competence in designing, implementation and maintenance of computer based applications, computer-controlled equipment and networks of intelligent devices.

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Acronym for category of courses		Acronyms used in syllabus document	
Acronym	**Definition**	**Acronym**	**Definition**
BS	Basic Science Courses	**CA**	Continuous Assessment
ES	Engineering Science	**ESE**	End Semester Exam
HS	Humanities and Social Sciences including Management Courses	**IA**	Internal Assessment
PC	Professional Core Courses	**O**	Oral
PE	Professional Elective courses	**P**	Practical
OE	Open Elective Courses	**P&O**	Practical and Oral
LC	Laboratory Courses	**TH**	Theory
PR	Project	**TUT**	Tutorial
AC	Audit Course	**TW**	Term work
AOCC	Add on Credit Course	**ISE**	In- Semester Examination
AOAC	Add on Audit Course	**CO**	Course Outcome
AVAC	Add on Value Audit Course	**PO**	Program Outcome
EX	Exposure Course	**PSO**	Program specific Outcome
I	Interdisciplinary courses		

Acronyms used for type of Course

Acronym used	Definition
C	Core Course
E	Elective Course
O	Open Elective Technical
H	Open Elective Humanities/Management/SWAYAM-NPTEL
P	Project
L	Laboratory Course
T	Tutorial
X	Exposure course
A	Audit course

Acronyms used in Eight Digit Course code e.g. 116U06C101

Acronym Serially as per code	Definition
1	SVU 2000 First revision
16	College code
U	Alphabet code for type of programme
06	Programme code
C	Type of course
1	Semester I – semester number
01	First course of semester – course serial number It will be XX for the elective/choice based courses

SVU_TY_2020
Semester V – Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)			Total (Hrs.)	Credits Assigned			Total credits	Course Category
		TH	P	TUT		TH	P	TUT		
116U01C501	Software Engineering	3	0	0	3	3	0	0	3	PC
116U01C502	Computer Networks	3	0	0	3	3	0	0	3	PC
116U01C503	Operating System	3	0	0	3	3	0	0	3	PC
116U06O5xx	OE Technical – I / NPTEL /SWAYAM/ Coursera	3	0	0	3	2	0	0	2	OE
116U06G/Y5xx	OE HM	2	0	0	2	2	0	0	2	HS
116U01E51x	Departmental Elective-I	3	0	0	3	3	0	0	3	PE
116U01L501	Software Engineering Lab.	0	2	0	2	0	1	0	1	PC
116U01L502	Computer Networks Lab.	0	2	0	2	0	1	0	1	PC
116U01L503	Operating System Lab.	0	2	0	2	0	1	0	1	PC
116U01L51x	Departmental Elective-I Lab	0	2	0	2	0	1	0	1	PE
116U01L504	Full Stack Development Lab.	1	2	0	3	1	1	0	2	PC
	Total	**18**	**10**	**0**	**28**	**17**	**5**	**0**	**22**	

SVU_TY_2020
Semester V-Examination Scheme

Course Code	Course Name	Examination Scheme							
		Theory Marks				TW	Oral	/Pract and Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		ISE	IA	Total					
116U01C501	Software Engineering	30	20	50	50	--	--	--	100
116U01C502	Computer Networks	30	20	50	50	--	--	--	100
116U01C503	Operating System	30	20	50	50	--	--	--	100
116U06O5xx	OE Technical – I / NPTEL /SWAYAM/ Coursera	30	20	50	--	--	--	--	50
116U06G/Y5xx	Open Elective HM	30	20	50	--	--	--	--	50
116U01E51x	Departmental Elective-I	30	20	50	50	--	--	--	100
116U01L501	Software Engineering Lab	--	--	--	--	25	25	--	50
116U01L502	Computer Networks Lab	--	--	--	--	25	25	--	50
116U01L503	Operating System Lab	--	--	--	--	25	25	--	50
116U01L51x	Departmental Elective-I Lab	--	--	--	--	25	25	--	50
116U01L504	Full Stack Development Lab	--	--	--	--	50*		--	50
Total		**180**	**120**	**300**	**200**	**150**	**100**	**--**	**750**

***Term work based on laboratory performance**

List of Departmental Elective-I for V Semester
(Offered by Department of Computer Engg.)

Sr. No.	Course Code	Course Name
1	116U01E511	Computer Graphics
2	116U01E512	Advanced Databases and Data Warehousing
3	116U01E513	Microprocessors
4	116U01E514	Soft Computing

List of Open Electives for V Semester

Sr. No.	Course Code	Course Name
1	116U06O511	Mobile application Development – Flutter
2	116U06O512	Virtual Reality & Augmented Reality Engine Development
3	116U06O513	Data Base Management System
4	116U06O514	Web Application Development using FLASK

SVU_TY_2020
Semester VI - Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH			Total (Hrs.)	Credits Assigned			Total credits	Course Category
		TH	P	TUT		TH	P	TUT		
116U01C601	Digital Signal & Image Processing	3	0	0	3	3	0	0	3	PC
116U01C602	Information Security	3	0	0	3	3	0	0	3	PC
116U01C603	Artificial Intelligence	3	0	0	3	3	0	0	3	PC
116U01E62x	Departmental Elective-II	3	0	0	3	3	0	0	3	PE
116U06O6xx	OE Technical – II / NPTEL /SWAYAM/ Coursera	3	0	0	3	2	0	0	2	OE
116U06G/Y5xx	OEHM	2	0	0	2	2	0	0	2	HS
116U01L601	Digital Signal & Image Processing Lab.	0	2	0	2	0	1	0	1	PC
116U01L602	Information Security Lab.	0	2	0	2	0	1	0	1	PC
116U01L603	Artificial Intelligence Lab.	0	2	0	2	0	1	0	1	PC
116U01L62x	Departmental Elective-II Lab.	0	2	0	2	0	1	0	1	PE
116U01P601	Mini Project	1	2	0	3	0	3	0	3	PR
	Total	**18**	**10**	**0**	**28**	**17**	**6**	**0**	**23**	
116U06N5xx	MNCC	1	0	0	1	0	0	0	0	MNCC

SVU_TY_2020
Semester VI-Examination Scheme

Course Code	Course Name	Examination Scheme							
		Theory Marks				TW	Oral	/Pract. and Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		ISE	IA	Total					
116U01C601	Digital Signal & Image Processing	30	20	50	50	--	--	--	100
116U01C602	Information Security	30	20	50	50	--	--	--	100
116U01C603	Artificial Intelligence	30	20	50	50	--	--	--	100
116U06O6xx	OE Technical – II / NPTEL /SWAYAM/ Coursera	30	20	50	--	--	--	--	50
116U06G/Y5xx	OEHM	30	20	50	--	--	--	--	50
116U01E62x	Departmental Elective-II	30	20	50	50	--	--	--	100
116U01L601	Digital Signal & Image Processing Lab	--	--	--	--	25	25	--	50
116U01L602	Information Security Lab	--	--	--	--	25	25	--	50
116U01L603	Artificial Intelligence Lab	--	--	--	--	25	25	--	50
116U01L62x	Departmental Elective-II Lab	--	--	--	--	25	25	--	50
116U01P601	Mini project	--	--	--	--	50	--	25^	75
Total		**180**	**120**	**300**	**200**	**150**	**100**	**25**	**775**

^Presentation and Demo based on mini project and viva based on implementation

List of Departmental Elective - II for VI Semester

Sr. No.	Course Code	Course Name	Remarks
1	116U01E621	Compiler Construction	
2	116U01E622	Data Mining and Business Intelligence	
3	116U01E623	Software Testing and Quality Assurance	
4	116U01E624	Wireless Sensor Networks and IOT	
5	116U01E625	Mobile Communication and Adhoc Networks	
6	116U01E626	Machine Learning	
7	116U01E627	Micro Services and Dev OPS	
8	116U01E628	Applied Cryptography	Not available to students with Honours in CSF
9	116U01E629	Cloud Computing	

List of Open Elective Technical - II for VI Semester
(Offered by Department of Computer Engg.)

Sr. No.	Course Code	Course Name	Remarks
1	116U06O601	Social Mobile Analytics and Cloud	
2	116U06O602	Audio Signal Processing	
3	116U06O603	Applied Machine Learning using Tensor flow	Not available to students with Honours in Data Science and Analytics
4	116U06O604	Quantum Computing	
5		Digital Accessibility	

Semester - V

Course Code	Course Title						
116U01C501	**Software Engineering**						
	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):

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Course Objectives:

The Course focusses at developing an understanding of software process models such as the waterfall and evolutionary models. It Further provides, an understanding of software requirements and the SRS documents. The course aims at enabling the students to prepare the system design and test cases for proper testing of the software.

Course Outcomes:

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

CO1 : Understand the software development process and Estimate different types of resources for the given project.
CO2 Analyze the software requirements and Model the defined problem with the help of UML diagram.
CO3 Prepare the System Design and Model
CO4 Identify and manage configuration items and risks for the software
CO5 Test the given software for different test cases with proper test planning.

Module No.	Unit No.	Details	Hrs.	CO
1	**The Product and the Process:**		**08**	**CO 1**
	1.1	Software life cycle models: Waterfall, RAD, Spiral, Agile process.		
	1.2	Understanding software process, Process metric, CMM Levels		
	1.3	Planning & Estimation: Product metrics Estimation- LOC, FP, COCOMO models.		
	1.4	Project Management activities : Planning, Scheduling and Tracking		
2	**Requirement Engineering**		**08**	**CO 2**
	2.1	Introduction to OO Methodologies :Booch,Rambaug and Jacobson		
	2.2	Requirements Engineering Tasks, Requirement Elicitation Techniques, Software Requirements: Functional, Non- Functional		
	2.3	Requirements Characteristics, Requirement qualities, Requirement Specification, Requirement Traceability, System Analysis Model Generation, Documentation : Use Case Diagram, Acitvity Diagram		
	2.4	Categorizing classes: entity, boundary and control ,Modeling associations and collections-Class Diagram		
	2.5	Dynamic Analysis - Identifying Interaction – Sequence and Collaboration diagrams, State chart diagram		
3	**System Design Engineering**		**7**	**CO 3**
	3.1	Design quality, Classification of Design Activities, Design Concepts: Modularity and Layering, Introduction to Pattern-Based Software Design,		
	3.2	Software Architecture, Data Design, Object-Oriented versus Function-Oriented Design, Design of Software Objects, Methods, Cohesion and Coupling between Objects,		
	3.3	User Interface Design: Rules, User Interface Analysis and Steps in Interface Design, Design Evaluation		
	3.5	Software Reuse, Component-Based Software Engineering		
4	**System Implementation, Configuration Management & Risk Management**		**14**	**CO 4**

	4.1	Packages and interfaces: Distinguishing between classes/interfaces, Exposing class and package interfaces		
	4.2	Mapping model to code , Mapping Object Model to Database Schema		
	4.3	Component and deployment diagrams: Describing Dependencies		
	4.4	Managing and controlling Changes, Managing and controlling version		
	4.5	Categories of Risks, Nature Of Risk, Types of Risk, Risk Identification, Risk Assessment, Risk planning and control, Risk management, Evaluating risk to schedule, PERT technique.		
5	**Testing and Maintenance**		**8**	**CO 5**
	5.1	Testing Concepts: Purpose of Software Testing, Testing Principles, Goals of Testing, Testing aspects: Requirements, Test Scenarios, Test cases, Test scripts/procedures,		
	5.2	Strategies for Software Testing, Testing Activities: Planning Verification and Validation, Software Inspections,FTR		
	5.3	Levels of Testing : unit testing, integration testing, regression testing, product testing, acceptance testing and White-Box Testing		
	5.4	Black-Box Testing: Test Case Design Criteria, Requirement Based Testing, Boundary Value Analysis, Equivalence Partitioning		
	5.5	Object Oriented Testing: Review of OOA and OOD models, class testing, integration testing, validation testing		
	5.6	Reverse and re-engineering, types of maintenance		
	#Self-Learning : Testing 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	Roger Pressman	Software Engineering	Tata McGraw Hill.	Sixth edition, 2010
2	Bernd Bruegge	Object oriented software engineering	Pearson Education.	Third Edition, 2009
3	Ian Sommerville	Software Engineering	Pearson Education	Sixth edition, 2001
4	John Nicholas, Herman Steyn	Project Management for Business Engineering and Technology	Routledge	5th Edition, 2017
5	Bob Hughes, Mike cotterell, Rajib Mall	Software Project Management	Tata McGraw Hill	fifth Edition, 2012

Course Code	Course Title						
116U01L501	Software Engineering 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 Engineering". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01C502	**Computer 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): NA

Course Objectives:

1. To introduce concepts and fundamentals of data communication and computer networks.
2. To explore the inter-working of various layers of OSI.
3. To understand and apply IP addressing concepts in network design.
4. To assess the strengths and weaknesses of various routing algorithms.
5. To understand the transport layer and various application layer protocols.

Course Outcomes:

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

CO1 :	Explain the fundamentals of the data communication networks, reference models, topologies, physical media, devices, simulators and identify their use in day to day networks.
CO2	Demonstrate Data Link Layer, MAC layer technologies & protocols and implement the functionalities like error control, flow control.
CO3	Demonstrate various network layer protocols and network design using IP addressing, forwarding, routing concepts.
CO4	Demonstrate Transport layer concepts like socket, flow control, error control, congestion control, QoS.
CO5	Describe various features and operations of application layer protocols such as Telnet, HTTP, DNS, SMTP.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to networking**		**06**	**CO1**
	1.1	Types of Networks: LAN, WAN, MAN. Network Topology (types)		
	1.2	Network Software: Protocol hierarchy, Design Issues for layers, Connection oriented and connectionless services, Reliable and Un-reliable services		
	1.3	OSI and TCP/IP reference model, Comparison of OSI and TCP/IP reference model		
	1.4	Overview of connecting devices, NIC, Repeater, Hub, Bridge, Router, Gateway		
		# Self-Learning: Guided and Un-guided transmission media		
2	**Data Link and MAC Layer**		**12**	**CO2**
	2.1	Error Control: Types of Errors; Redundancy, Checksum, Hamming Code and CRC.		
	2.2	Framing, and Flow Control; Flow control Protocols: Stop-and-wait, Go-Back-N, Selective-Repeat, Piggybacking		
	2.3	MAC address; Random Access: ALOHA, slotted ALOHA, Efficiency; CSMA, CSMA/CD, CSMA/CA.		
	2.4	Controlled Access, Channelization, IEEE standards, different Ethernets		
		# Self-Learning: Modular Arithmetic		
3	**Network Layer**		**10**	**CO3**
	3.1	Network layer services, IPv4, strategies to bridge the limitations (IP sub netting, CIDR, NAT, Addressing, Options, Extension headers, Packet forwarding, Congestion Control)		
	3.2	ARP, RARP, DHCP and ICMP		
	3.3	IPV6 Addressing		

	3.4	Shortest Path routing, DV, Link state Routing. Unicast protocols:, OSPF, BGP.		
	3.5	Multicast routing protocols: IGMP; Hierarchical Routing , DVMRP		
		# Self Learning: RIP, MOSPF		
4	**Transport Layer: Protocols**		**08**	**CO4**
	4.1	Services, Transport layer protocols, UDP, TCP: State Transition diagram, flow control, error control, TCP Timers, Queuing disciplines		
	4.2	TCP Congestion control, SCTP		
	4.3	Quality of Service		
5	**Application Protocols**		**09**	**CO5**
	5.1	HTTP, WWW		
	5.2	DNS		
	5.3	FTP, Telnet		
	5.4	SMTP		
		# Self Learning: POP and IMAP		
		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.	B.A.Forouzan	Data Communication and Networking	Tata McGraw Hill edition	Third Edition
2.	A.S.Tanenbaum	Computer Networks	Pearson Education	Fourth Edition
3.	B. A. Forouzan	TCP/IP Protocol Suite	Tata McGraw Hill edition	Third Edition
4.	J. Schiller	Mobile Communications	Pearson Education	Second Edition

Course Code	Course Title						
116U01L502	Computer Network 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 "Computer Netwrok". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01C503	Operating System							
	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 Computer Organization and architecture

Course Objectives:
1. To introduce basic concepts and functions of operating systems.
2. To understand the concept of process, thread and resource management.
3. To understand the concepts of process synchronization and deadlock.
4. To understand various Memory, I/O and File management techniques.
5. To understand the designing and implementation of system software like Assembler. Macro preprocessor and linker loader**.**

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

CO1: Identify the different system programs and their utility and Explain the fundamental concepts of operating system with extension to Unix and Mobile OS
CO2: Illustrate and analyze the Process, threads, process scheduling and thread scheduling
CO3: Describe the problems related to process concurrency and the different synchronization mechanisms available to solve them.
CO4: Explain disk organization and file system structure with illustration of disk scheduling algorithms
CO5: Understand Storage management with allocation, segmentation & virtual memory concepts

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to System software**		**7**	
	1.1	Concept, introduction to various system programs such as assemblers, loaders, linkers, macro processors, compilers, interpreters, operating systems, device drivers		**CO1**
		Operating System Objectives and Functions,		
	1.2	The Evolution of Operating Systems		
	1.3	OS Design Considerations for Multiprocessor and Multicore architectures		
	1.4	Operating system structures,		
	1.5	System Calls		
	1.5	Linux Kernel and Shell		
	1.7	System boot		
2	**Process Concept and scheduling**		**8**	
	2..1	Process: Concept of a Process, Process States, Process Description, Process Control Block, Operations on Processes.		**CO2**
		Threads: Definition and Types, Concept of Multithreading		
	2.2	Multicore processors and threads.		
		Scheduling: Uniprocessor Scheduling - Types of Scheduling: Preemptive and, Non-preemptive, Scheduling Algorithms: FCFS, SJF, SRTN, Priority based, Round Robin, Multilevel Queue scheduling.		
	2.3	Introduction to Thread Scheduling		
	2.4	Linux Scheduling.		
3	**Process Concurrency**		**10**	
	3.1	Concurrency: Principles of Concurrency, InterProcess Communication, Process/Thread Synchronization.		**CO3**
	3.2	Mutual Exclusion: Requirements, Hardware Support, Operating System Support (Semaphores and Mutex), Programming Language Support (Monitors)		
	3.3	Classical synchronization problems: Readers/Writers Problem, Producer and Consumer problem.		
	3.4	Principles of Deadlock: Conditions and Resource Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker‟s Algorithm for Single & Multiple Resources, Deadlock Detection and Recovery. Dining Philosophers Problem		
4	**Input output and file management**		**8**	
	4.1	File Management: Overview, File Organization and Access, File Directories, File Sharing, Secondary Storage Management, Linux Virtual File System.		**CO4**
	4.2	I/O Management and Disk Scheduling: I/O Devices, Organization of the I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, CLOOK. Disk Management, Linux		

		I/O.		
5	**Storage management**		**12**	
	5.1 5.2	Main Memory: Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples Virtual Memory: Background, Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		**CO5**
Self Learning Component: Androind OS, Cloud OS				
		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.	William Stallings	Operating System: Internals and Design Principles	Prentice Hall	8th Edition, 2014
2.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne	Operating System Concepts	John Wiley & Sons , Inc.	9th Edition, 2016
3.	Andrew Tannenbaum	Operating System Design and Implementation	Pearson	3rd Edition
4.	D.M Dhamdhere	Systems programming	Tata Mc-Graw Hill	2nd Edition
5.	Maurice J. Bach	Design of UNIX Operating System	PHI	2nd Edition
6.	J.J Donovan	Systems Programming	Tata McGraw Hill Publishing Company	--
7.	William Stallings	Computer organization and Architecture	Pearson Education	10th edition

Course Code	Course Title					
116U01L503	Operating System 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 "Operating System". Students will be graded based on continuous assessment of their term work.

Department Elective - I

Course Code	Course Title							
116U01E511	**Computer Graphics**							
	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 familiarity with fundamental algorithms and data structures, Good programming skills, Basics of linear algebra and geometry

Course Objectives:

1. Explain hardware, software and OpenGL Graphics Primitives.
2. Illustrate interactive computer graphic using the OpenGL.
3. Design and implementation of algorithms for 2D graphics Primitives and attributes.
4. Demonstrate Geometric transformations, viewing on both 2D and 3D objects.
5. Infer the representation of curves, surfaces, Color and Illumination models

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

CO1: Understand the basic concepts of computer graphics and OpenGL
CO2: Implement Fill area Primitives, 2D Geometric Transformations and 2D viewing
CO3: Implement Clipping,3D Geometric Transformations and 3D viewing
CO4: Understand the computer Input& interaction, Curves and Computer Animation

Module No.	Unit No.	Details	Hrs.	CO
1	Introduction to Computer Graphics		7	
	1.1	Basics of computer graphics, Application of Computer Graphics, Video Display Devices: Random Scan and Raster Scan displays		CO1
	1.2	Introduction to Graphics software OpenGL ,coordinate reference frames, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms(DDA, Bresenham's), circle generation algorithms (Bresenham's).		
2	Fill area Primitives, 2D Geometric Transformations and 2D viewing:		10	
	2..1	Fill area Primitives: Polygon fill-areas, OpenGL polygon fill area functions, fill area attributes, general scan line polygon fill algorithm, OpenGL fill-area attribute functions		CO2
	2.2	2DGeometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates. Inverse transformations, 2DComposite transformations, other 2D transformations, raster methods for geometric transformations, OpenGL raster transformations, OpenGL geometric transformations function		
	2.3	2D viewing: 2D viewing pipeline, OpenGL 2D viewing functions		
3	Clipping,3D Geometric Transformations, Color and Illumination Models:		12	
	3.1	Clipping: clipping window, normalization and viewport transformations, clipping algorithms,2D point clipping, 2D line clipping algorithms: cohen-sutherland line clipping only - polygon fill area clipping: Sutherland-Hodgeman polygon clipping algorithm only.		CO3
	3.2	3DGeometric Transformations: 3D translation, rotation, scaling, composite 3D transformations, other 3D transformations, affine transformations, OpenGL geometric transformations functions.		

	3.3	Color Models: Properties of light, color models, RGB and CMY color models. Illumination Models: Light sources, basic illumination models-Ambient light, diffuse reflection, specular and phong model, Corresponding openGL functions.		
4	3D Viewing and Visible Surface Detection:		8	
	4.1	3DViewing:3D viewing concepts, 3D viewing pipeline, 3D viewing coordinate parameters , Transformation from world to viewing coordinates, Projection transformation, orthogonal projections, perspective projections, The viewport transformation and 3D screen coordinates. OpenGL 3D viewing functions.		CO3
	4.2	Visible Surface Detection Methods: Classification of visible surface Detection algorithms, depth buffer method only and OpenGL visibility detection functions.		
5	Input& interaction, Curves and Computer Animation:		8	
	5.1	Input and Interaction: Input devices, clients and servers, Display Lists, Display Lists and Modeling, Programming Event Driven Input, Menus Picking, Building Interactive Models, Animating Interactive programs, Design of Interactive programs, Logic operations.		CO4
	5.2	Curved surfaces, quadric surfaces, OpenGL Quadric-Surface and Cubic-Surface Functions, Bezier Spline Curves, Bezier surfaces, OpenGL curve functions. Corresponding openGL functions.		
Self Learning Component: Vulkan API by the Khronos group (known for OpenGL)				
		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.	Donald Hearn & Pauline Baker	Computer Graphics with OpenGL	Pearson Education	3rd / 4th Edition, 2011
2.	Edward S. Angel.	Interactive Computer Graphics, A top-down approach with shader-based OpenGL	Pearson Education	6th Edition, 2011.
3.	Dave Shreiner, Graham Sellers, John Kessenich, and Bill Licea-Kane	OpenGL Programming Guide: The Official Guide to Learning OpenGL	Addison-Wesley	8th Edition, 2013.

Course Code	Course Title						
116U01L511	Computer Graphics 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 "Computer Graphics". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title						
116U01E512	**Advance Database And Data Warehousing**						
	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):
Database systems

Course Objectives:
The objectives of this course is to understand, design, manage data in Distributed, Parallel systems. Object Relational Databases ,Active, temporal, spatial, multimedia and deductive databases for managing different types of data . NOSQL system types to manage big data. Building and using data warehouse for Online Analytical Processing .

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

CO1: Understand, design, analyze and process data in distributed, parallel, databases understand design.
CO2 Understand the concepts and design of Active, temporal, spatial, multimedia and deductive databases.
CO3 Understand and use NOSQL system types.
CO4 Model and Build multidimensional data warehouse and apply ETL process to populate data to data warehouse.
CO5 Perform Online Analytical Processing on the warehouse data.

Module No.	Unit No.	Details	Hrs.	CO
1	**Parallel and Distributed Databases**		**10**	**CO1**
	1.1 **1.2** **1.3**	Database system architectures- centralized, client server ,server system, parallel system, distributed system, network types. Parallel databases – introduction, I/O parallelism, query parallelism, Design of parallel systems, parallelism on multicore processor. Distributed databases – types,distibuted transactions commit protocls, concurrency control , query processing Cloud based databases, directory systems		
2	**Object based , Active, temporal, spatial, multimedia and deductive databases**		**10**	**CO2**
	2.1	Object based Databases –overview complex data types, inheritance, object identity, reference types, object oriented versus object relational, implementing		
	2.2	Active , temporal, spatial, multimedia and deductive databases concepts		
3	**NoSQL databases and Big data storage system**		**10**	**CO3**
		Introduction to NOSQL systems, CAP theorm, NOSQL systems- document basedand mongoDB, Key-value Stores, Column based, Graph databases and Neo4j,		
4	**Data ware house Modeling and ETL**		**10**	**CO4**
	4.1	Data Warehouse: The Building Blocks Defining Features, characteristics of DWH Data Warehouses and Data Marts , Top-Down Versus Bottom-Up Approach, A Practical Approach ,DWH architecture , Types of Metadata Principles of Dimensional Modeling Dimensional Modeling Basics ,ER Modeling Versus Dimensional Modeling, STAR Schema , snow flake schema, The Fact less Fact Table ,Schema Keys ETL Overview , ETL Requirements and Steps Data Extraction Techniques, Data Transformation and Data Loading		
5	**OLAP**		**05**	CO5
		Demand for Online Analytical Processing Major Features and Functions, OLAP Models, OLAP Implementation Considerations		
		#Self-Learning: Study of any one OLAP Tool		
		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	Elmasri and Navathe	"Fundamentals of Database Systems", ,2015	Pearson Education	7th **S**Edition,2015
2	Paulraj Ponniah	" Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals",	Wiley India,	2nd Edition, 2017
3	Raghu Ramakrishnan and Johannes Gehrke	"Database Management Systems"	McGraw Hill,	3rd Edition,2018
4	Korth,Silberchatz,Sudarshan	"Database System Concepts".,	McGraw Hill,	6th Edition 2013
5	Reema Thareja	Data warehousing	Oxford	1 Edition, 2009

Course Code	Course Title					
116U01L512	Advance Database And Data Warehousing 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 "Advance Database And Data Warehousing". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title						
116U01E513	**Microprocessors**						
	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):
Digital Design, Basics of Computer Organization and Architecture

Course Objectives:
1.To explore internal architecture of microprocessor, interface with memory and I/O devices.
2.To build microprocessor-based systems.
3.To study the concept of multicore processors.

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

CO1: Explain the process of Compilation from Assembly language to machine language
CO2: Build Microprocessor based system using memory chips and peripheral chips
CO3: Analyze the techniques for faster execution of instructions and enhance performance of microprocessors.
CO4: Identify and describe multicore processors

Module No.	Unit No.	Details	Hrs.	CO
1	Intel 8086 Architecture		4	
	1.1	Introduction to 80x86 microprocessor, Internal Architecture, Generation of physical address, Minimum & Maximum Mode, Ready and Reset pin significance.		CO1
	1.2	Study of 8086 supporting chips 8282(Latch), 8284(Clock Generator), 8286(Transreceiver), 8288(Bus Controller).		
2	Assembly Language Programming		8	
	2..1 2.2	Instruction Set of 8086 microprocessor in details, Addressing modes of 8086/88, Programming the 8086 in assembly language, Far and Near procedures, Macros Mixed mode programming with C-language and assembly.		CO1
3	Interrupt Structure		3	
	3.1	Interrupt Structure , Interrupt service Routine, Interrupt Vector Table, Hardware and Software Interrupts, INTR ,NMI , Interrupt Response, Execution of an ISR, Priority of Interrupts.		CO3
4	Interfacing with 8086		12	
	4.1 4.2	Functional Block Diagram and description, Control Word Formats, Operating Modes and Applications of the Peripheral Controller namely 8255-PPI, 8253-PIT, 8259-PIC and 8237-DMAC. Interfacing of the above Peripheral Controllers. Study of Multiprocessor Configurations namely Tightly Coupled System (TCS) and Loosely Coupled System (LCS).		CO2
5	Protected Mode Architecture		9	
	5.1 5.2	Historical evolution of 80286, 386, 486 processor. Programming model and operating modes of 80386DX processor. Address translation mechanism in protected mode ,Memory Management, Protection Mechanism of 80386.		CO3

6	Introduction to Pentium microprocessor and ARM processor		9	
	6.1	Pentium RISC features, Pentium super-scalar architecture, Pipeline stages .Branch Prediction, Instruction and Data caches, read and write cycles. ARM processor : Instruction set, addressing modes, operating modes with ARM core.		CO4
	6.2	#Self learning : Comparison of Pentium 2, Pentium 3 and Pentium 4 Processors, Comparative study of Multicore Processors i3,i5 and i7 , Application of Qualcomm in various devices like smartphone, smartwatch etc		
Self Learning Component: Androind OS, Cloud OS				
		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.	John Uffenbeck	8086/8088 families: Design Programming and Interfacing	Pearson Education	2nd edition
2.	Tom shanley& Don Anderson	Pentium Processor System architecture	Addison-Wesley	2nd edition
3.	Daniel Tabak	Advanced Microprocessor	Tata McGraw Hill	2nd edition
4.	Barry B. Brey	Intel Microprocessors	Pearson Education India	8th edition
5.	Douglas Hall	Microprocessor and Interfacing	TMH Publication	3rd edition
6	Andrew N. Sloss, Dominic Sysmes and Chris Wright – Elsevier Inc.	ARM System Developer's Guide Designing and Optimizing System Software	Elsevier Inc.	1st edition

Course Code	Course Title						
116U01L513	Microprocessors 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 "Microprocessors". Students will be graded based on continuous assessment of their term work.

Course Code	Course Title						
116U01E514	**Soft 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):

Familiarity with linear algebra, multivariate calculus, and probability theory, Knowledge of a programming language

Course Objectives:

The main objectives of this course are:

- To learn the key aspects of Soft Computing and Neural Network.
- To understand the features of neural networks and different learning methods.
- To study Fuzzy Logic concepts.
- To gain insight into Neuro Fuzzy Modeling.

Course Outcomes:

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

CO1: Identify and describe soft computing techniques and their roles
CO2: Analyze various training algorithms of neural network and its architectures
CO3: Understand various special Neural Networks.
CO4: Design Fuzzy controller system.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to soft Computing and Neural Network**		05	CO1
	1.1	Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques.		
	1.2	Biological neurons and its working, ANN – Terminologies, Basic Models, Linearly and non-linearly separable classification, McCulloch Pitts Neuron Model		
2	**Training Techniques for ANNs**		10	CO2
	2.1	Introduction to supervised and unsupervised learning, Adaline and Madaline		
	2.2	Hebbian learning, Perceptron Learning, Delta learning rule, Widrow Hoff learning, Winner take all Learning Rule , Out star learning		
	2.3	Multilayer Feedforward Network, Error Back Propagation Training, Learning factors.		
3	**Different Neural Networks**		10	CO2, CO3
	3.1	Associative memory network – Basic Concepts, Types- Auto, Hetro, Bidirectional (Discrete and continuous), Testing		
	3.2	Hopfield – Discrete, continuous, Counter propagation network, ART, SOFM, Recurrent Network		
4	**Special Neural Networks**		08	CO3
	4.1	Cognitron, Neocognitron, Boltzman Machine, Gaussian Machine, Simulated Annealing, SVM		
		#Self-Learning: Benefits of Multi-layer Neural Network		
5	**Fuzzy logic and Fuzzy system**		12	CO4
	5.1	Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques,		
	5.2	Fuzzy logic controller design, Neuro Fuzzy system, Some applications of Fuzzy logic.		
		#Self-Learning: Application of Fuzzy system in various appliances.		
		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	S.N. Sivanandam, S. Sumathi, S. N. Deepa	Introduction to neural networks	Tata Mcgraw-Hill	3rd Edition, 2019
2	Jacek. N. Zurada	Introduction to Artificial Neural Network	Jaico Publishing House	13th Edition 2016
3	J.S.R, Jang, C.T.Sunand E. Mizutan	Neuro Fuzzy and Soft Computing	PHI Learning	--
4	Simon Haykin	Neural Networks and Learning Machines The	PHI Learning	3rd Edition, 2011
5	Timothy J. Ross	Fuzzy Logic with Engineering Applications	Willey	3rd Edition, 2000
6	F. Martin, , Mc neill, and Ellen Thro	Fuzzy Logic: A Pratical approach	AP Professional	2010

Course Code	Course Title						
116U01L514	Soft 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 “Soft Computing”. Students will be graded based on continuous assessment of their term work.

Course Code	Course Title						
116U01L504	**Full Stack Development Lab. - MERN**						
	TH		**P**		**TUT**		**Total**
Teaching Scheme(Hrs.)	**01**		**02**		**-**		**03**
Credits Assigned	**01**		**01**		**-**		**02**
Examination Scheme	**Marks**						
	CA		**ESE**	**TW**	**O**	**P**	**P&O**	**Total**
	ISE	**IA**						
	----	**--**	**--**	**50***	**--**	**--**	**--**	**50**

***Term Work will consist of Practical covering entire syllabus of "MERN" -XXXXX. Students will be graded based on continuous assessment of their term work.**

Course prerequisites (if any):
Basics of HTML,CSS, JavaScript and Concept of Database.

Course Objectives
MERN Stack (Mongo DB, ExpressJs, Reactjs and Nodejs) is a very popular programming technology used for developing web apps as well as mobile Apps. MERN stack is many times faster than the traditional programming languages like PHP, ASP.NET, etc. Moreover, it can manage millions of users simultaneously without crashing the server.

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

CO1	Summarize the concepts of various front-end, backend web application development technologies & frameworks.
CO2	Illustrate the concepts of various front-end, back-end web application development technologies & frameworks using different web development tools.
CO3	Build a web app application, individually or in a team by combining various development technologies & frameworks for real-world problems.
CO4	Test the concepts and components of various front-end, back-end web app development technologies & frameworks using web development tools.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction To MERN**		08	1
	1.1	Introduction to MERN, Architecture of MERN, Benefits of MERN, Application of MERN Revision of JavaScript's		
2	**REACT Part-1**		10	1, 2
	2.1	i. React Introduction ii. Install node iii. Create an app using create-react-app iv. Understanding basics of react app v. Understanding JSX vi. Understanding virtual DOMS, Single page apps		
	2.2	i. React Lifecycle ii. States iii. Class components vs functions components iv. Event handling v. Props vi. Building a basic Forms using React		
3	**REACT Part-2**		10	2
	3.1	i. Routes ii. Conditional Rendering iii. Pure Components iv. High Order components v. Controlled vs Uncontrolled components		
	3.2	i. Redux ii. Babel, webpack iii. Add Redux in a Project and build using webpack		
	3.3	i. Creating a Mock API Server ii. Axios. iii. Server-Side Rendering		
4	**Nodejs and Express**		10	2,3
	4.1	i. Simple Server ii. Response Types – HTML, JSON iii. Routing iv. Express Intro v. Make a call from frontend to server.		
	4.2	i. Express Params and Query String ii. Express Middleware iii. API Authentication iv. JWT token, Passport.js v. Socket Programming		
5	**Database**		10	3,4
	5.1	i. SQL vs NO SQL		

		ii. MongoDB / DynamoDB overview iii. Installing MongoDB iv. Connecting and inserting data v. Deleting and updating data vi. CRUD		
	5.2	**CODE REVIEW + DEPLOYMENT** i. Tools for code review ii. Standard coding conventions iii. Firebase iv. Deploy using Netlify v. Deploy using AWS Ec2		
		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	Shelly Powers	Learning Node	O' Reilly	2 nd Edition, 2016
2	Azat Marden	Express .js Deep API reference	Apress	2 nd edition, 2015.
3	Krishna Chodorow	MongoDB The Definite Guide	O'Reilly	2 nd edition, 2014
4	Vasan Subramanian	Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node	Apress	2nd Edition, 2019

Course Code	Course Title						
116U01L504	Full Stack Development Lab- MEAN						
	TH		P		TUT		Total
Teaching Scheme(Hrs.)	01		02		-		03
Credits Assigned	01		01		-		02
Examination Scheme	Marks						
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	----	--	--	50*	--	--	--	50

Course Prerequisites:

Basics of HTML, CSS, JavaScript and Backend Technology, and familiar with new versions of Text Editor.

Course Objectives:

The overall aim of the course is to build Commercial Web Applications using the MEAN stack. This course is meant for anyone who wants to start building full stack JavaScript applications in Node.js, AngularJS, Express and MongoDB.

Course Outcomes:

On completion of the course students will be expected to:

CO1: Build full stack applications in JavaScript using the MEAN technologies.

CO2: Architect MEAN stack applications from scratch

CO3: Develop modular, maintainable Single Page Applications using Angular 2 technology.

Module No.	Unit No.	Details	Hrs.	Outcome
1.0		**Introduction to Mean stack**	05	
	1.1	Introduction to MEAN, Architecture of MEAN, Benefits of MEAN, Application of MEAN,		**CO1**
2.0		**Understanding of MongoDB and NoSQL**	05	
	2.1	Scope of NoSQL, MongoDB: Structure and Applications, Commands, Mongo DB and Its connections, Getting started with Mongoshell, Interacting with data from the command line.		**CO1**
3.0		**Nodejs and Express**	12	
	3.1	Simple Server ii. Response Types – HTML, JSON iii. Routing iv. Express Intro v. Make a call from frontend to server		**CO2,CO3**
	3.2	. Express Params and Query String ii. Express Middleware iii. API Authentication iv. JWT token, Passport.js v. Socket Programming		
4.0		**Mongoose, Schema and Validation**	10	
	4.1	Mongoose Definition, connect MongoDB using Mongoose, Schema, Importing and exporting data , Connecting to a Node.js application, Querying the database from Node.js		**CO3**
5.0		**Angular 2+ , MongoDB, Node.js**	13	
	5.1	Introduction, Introduction to typescript, Environment Setup, Modules, Component, Template, Directives, Custom Directives, Pipes, Custom Pipes, Services, Routing, Dependency Injection, Change Detection, Advanced Routing, Template Driven Form, Model Driven Form, Advanced HTTP, Animation, CRUD operations in MongoDB, REST API.		**CO3**

	5.2	**CODE REVIEW + DEPLOYMENT** i. Tools for code review ii. Standard coding conventions iii. Firebase iv. Deploy using Netlify v. Deploy using AWS Ec2		
		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.	Shelly Powers	Learning Node	O' Reilly	2nd Edition, 2016
2.	Azat Marden	Express .js Deep API reference	Apress	2nd edition, 2015.
3.	Krishna Chodorow	MongoDB The Definite Guide	O'Reilly	2nd Edition, 2014
4.	Matt Frisbie	Angular 2 Cookbook	Packt>	2nd Edition, 2017
5.	Shravan Kumar Kasagoni	Building Modern Web Applications Using Angular	Packt>	1st Edition, 2017

Course Code	Course Title							
116U01L504	Full Stack Development Lab. - Django							
	TH		P		TUT		Total	
Teaching Scheme(Hrs.)	01		02		--		03	
Credits Assigned	01		01		--		02	
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	--	--	--	50	--	--	--	50

* Batch wise Tutorial

Course prerequisites:

Basics of HTML,CSS, JavaScript and Concept of Database.

Course Objectives

This course is intended to obtain proficiency in Python programming and development of real-world web applications using Django by learning the basics and the advanced concepts like writing Python scripts, working with Databases, creating Views, Templates, Forms, Models and REST APIs in Django.

Course Outcomes

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

CO1: Understand the JQuery language & the Document Object Model along with Ajax usage which simplify data transfer to server
CO2: Apply Django functionality and the Model-View-Template (MVT) paradigm for web development
CO3: Develop Admin panel of web application along with database connectivity
CO4: Discover advanced concepts such as REST API implementation and third-party module integration

Module No.	Unit No.	Details	Hrs.	CO
1	**jQuery**		10	CO1
	1.1	Selecting Elements - Understanding the DOM, Using the $() function, Selectors (CSS, Attribute, Custom), DOM Traversal methods		
	1.2	jQuery Web Page Manipulation - Handling Events and Styling Animating, Manipulating the DOM		
	1.3	Sending Data with Ajax		
2	Django – Part I		06	CO2
	2.1	Introduction to Django Creating a Django Project – Installing Django, Creating an application Configuring the application, Routing in Django, Regular Expressions		
	2.2	Working with Templates – Injecting the data from the view to template, creating dynamic templates, Integrating variables in templates, Using Filters		
3	Django - Part 2		10	CO2
	3.1	Models and Migrations - Databases, SQL CRUD operations (create, read, update, delete), Relationships		
	3.2	URL Mapping, Views, and Templates – Function-Based, Class-Based, URL Configuration, Django Template Language		
	3.3	Forms – Django Forms, Validating Forms & Retrieving Python Values		
4	Django - Part 3		12	CO3
	4.1	Introduction to Django Admin – Creating superuser account, CRUD operation using Django Admin App, Customizing the ModelAdmin Classes		
	4.2	Serving Files – Statics, Media and File Uploads		
	4.3	Sessions and Authentication, Customizing Admin Site, Adding Views to the Admin Site		
5	Building API & Testing		07	CO4
	5.1	REST API, Serializers, ViewSets, Routers and Authentication		
	5.2	Testing in Django – Testing Models and Views, Django Request Factory, Test Case Classes, Deployment using Heroku		
		Total	**45**	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
	Ben Shaw, Saurabh Badhwar, Andrew Bird, Bharath Chandra K S, Chris Guest	*Web Development with Django*	Packt Publishing	Released February 2021 ISBN: 9781839212505
2.	Jonathan Chaffer , Karl Swedberg	Learning jQuery - Fourth Edition	Packt Publishing	June 2013 ISBN 9781782163145
	Antonio Melé	Django 3 By Example	Packt Publishing	Published:31 March 2020 ISBN:9781838989323, 1838989323
	Ryan Benedetti, Ronan Cranley	*Head First jQuery*	O'Reilly Media, Inc.	Released September 2011 ISBN: 9781449393212

Term-Work consists of programming assignments covering entire syllabus. Students will be graded based on continuous assessment of their term work.

Course Code	Course Title							
116U01L504	**Full Stack Development - Flask**							
	TH		**P**		**TUT**		**Total**	
Teaching Scheme(Hrs.)	**01**		**02**		**--**		**03**	
Credits Assigned	**01**		**01**		**--**		**02**	
Examination Scheme	**Marks**							
	CA		**ESE**	**TW**	**O**	**P**	**P&O**	**Total**
	ISE	**IA**						
	--	**--**	**--**	**50**	**--**	**--**	**--**	**50**

Course Prerequisites (if any):
Basics fundamentals of HTML, CSS, Python programming

Course Objectives:
Flask is known for being simple, lightweight and having a small learning curve. Basically, Flask is an API of Python used for developing web based Application.

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

CO1: Understand basic Flask configuration along with routes and views for developing first web application
CO2: Apply Jinja Template Engine for rendering dynamic web content
CO3: Implement flask-wtf module for creating forms and SQLAlchemy toolkit for database connectivity
CO4: Build admin interface for Flask application and ensure security by implementing different authentication strategy
CO5: Discover advanced concepts such as REST API implementation and third-party module integration for testing and deployment of application

Module No.	Unit No.	Details	Hrs.	CO
1	Flask Configuration		05	CO1
	1.1	Introduction , Environment setup with virtualenv, Handling basic configurations and Initialization		
	1.2	Routes and View Functions, Server startup, Sample application		
	1.3	Request Response Cycle, Flask Extension		
2	Templates		05	CO1,CO2
	2.1	The Jinja2 Template Engine, Bootstrap layout		
	2.2	Block composition and Layout Inheritance, Creating Custom context processor, creating custom Jinja2 filter		
	2.3	Custom Error Pages, Links, Static Files		
	# Self-learning: Advanced Date and Time formatting			
3	Webforms with WTForms and Data Modeling in Flask		12	CO3
	3.1	SQLAlchemy model as data representation, Validation of fields on server, Common form set		
	3.2	Custom fields and validation, custom widgets, Uploading files, Cross-site Request Forgery Protection		
	3.3	Creating an SQL Alchemy DB instance, Create basic and relational database model, Database migration with Flask-Migrate		
	3.4	Model data indexing using Redis, Opting NoSQL database with MongoDB		
4	Admin Interface for Flask Apps and Authentication in Flask		10	CO4
	4.1	CRUD interface, Flask Admin extension, registering models with Flask Admin		
	4.2	Creating custom forms and actions, WYSIWYG for textarea integration, creating user roles		
	4.3	Session-based authentication, Flask-Login extension, Authentication with Google, Facebook, Twitter		
5	RESTful API building , Testing and Deployment		13	CO5
	5.1	Class-based and extension-based REST API		
	5.2	Code coverage reports, Flask Test Client, end-to-end testing with selenium		
	5.3	Deployment with Apache, Heroku		
Self Learning Component: SQLAlchemy REST API, S3 storage for file uploads				
		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.	Shalabh Aggarwal	*Flask Framework Cookbook*	Packt Publishing	2nd Edition, July 2019
2.	Miguel Grinberg	*Flask Web Development*	O'Rilley Media Inc.	2nd Edition March 2018
3.	Miguel Grinberg	*The New And Improved Flask Mega-Tutorial*	O'Rilley Media Inc.	February 2018
4.	Gareth Dwyer	*Flask By Example: Unleash the full potential of the Flask web framework by creating simple yet powerful web applications*	Packt Publishing	March 2016

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.	**10**	**CO3**
	3.2	Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation.		
	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**	

 # 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.	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.