SOMAIYA VIDYAVIHAR UNIVERSITY

K J Somaiya College of Engineering

Syllabus

TY B.Tech Electronics and Computer Engineering

(Third Year: Semester V-VI)

From
Academic Year 2024-25
(Revision-1)

TY B.Tech /EXCP/Revision 1.0

K.J. Somaiya College of Engineering, Mumbai-77
(A Constituent College of Somaiya Vidyavihar University)

It is notified for information of all concerned that the Board of Studies at its meeting held on //20XX and the subsequent meeting of the Faculty of Engineering and Technology (FoET) on / /2023 and Academic Council held on 05/04/2023 amended the syllabus of T.Y. B. Tech EXCP. Same will be brought into force from Academic Year 2024-25 with immediate effect.

Preamble

The Department was established in 1983 and has been accredited thrice by the National Board of Accreditation in 1998, 2009, and 2013. The Department offers UG, PG, and Ph.D. programs. In the era of Industry 4.0, intelligent devices are an integral part of human life, This has resulted in the need for electronics engineers to acquire skill of hardware design and System Software so that they can effectively use their expertise in the domains which are combination of hardware - software; such as Embedded Systems, Robotics, IOT, Machine Vision, Data Analytics, and Artificial intelligence.

Due to the rapid evolution in all the above fields, engineers must possess proficiency in hardware and software. Electronics and Computer engineering aims to integrate two separate engineering domains, exposing the students to the needs of today's industry. It is necessary to map industry requirements into the educational system and develop a continuous knowledge cycle that gives exposure to new technologies. Industrial automation is an interdisciplinary topic covering areas ranging from algorithms to handling processes and system developments to digital manufacturing. By increasing automation through the use of sensors, IoT, and configurable robots on the assembly line, 'smart' factories will be able to mass-produce items satisfying individual customer orders and specifications. Efficiency in productivity and quality of the product can be improved through automation and Internet-of-Things (IoT). The Department strives to provide a conducive environment for the students to develop analytical and practical skills and apply them to real-world problems.
The major emphasis of the curriculum is:

- To prepare the Learner with a sound foundation in the mathematical, scientific, and engineering fundamentals.
- To motivate the Learner in the art of self-learning and to use modern tools for solving real-life problems.
- To equip the learners with the skill set of Laboratory tools by including various laboratory courses in the curriculum.
- To equip the Learner with state-of-the-art programming languages to make them ready for placements.
- Our core courses are designed in a manner to prepare the Learner to be equally competent for qualifying competitive technical examinations.
- To encourage, motivate, and prepare the Learner for Lifelong- learning.
- To ingrain in the learner's mind the values of professionalism, ethics, effective leadership, and social responsibility.

HOD ETRX

Somaiya Vidyavihar University
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Vision

To impart excellent quality-education by keeping pace with rapidly changing technologies and to create technical manpower of global standards with ethical and social values.

Mission

Efforts to impart quality and value-based education to:

- Raise satisfaction level of all stakeholders
- Create competent professionals
- Provide all possible support to promote research and development activities

Program Educational Objectives (PEOs)

A graduate of Electronics and Computer Engineering will:

PEO 1. Adapt to upcoming technologies to solve real-life problems of society
PEO 2. Pursue higher education or research, demonstrate entrepreneurial qualities
PEO 3. Emerge as a leader with a professional and ethical outlook, exhibit effective communication, teamwork and multidisciplinary approach

Program Outcomes (POs)

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

PO 1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2. **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.
PO 3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety and the cultural, societal, and environmental considerations.
PO 4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and inter-

pretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **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.

PO 6. **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.

PO 7. **Multidisciplinary competence:** Recognize/ study/analyze/provide solutions to real-life problems of multidisciplinary nature from diverse fields

PO 8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and teamwork:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.

PO 10. **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.

PO 11. **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.

PO 12. **Lifelong 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 (PSOs)

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

PSO 1. Design, construct and implement hardware and software ased modern Electronic systems with varying complexities specialization to the solution of complex engineering problems.

PSO 2. Demonstrate proficiency in use of software and hardware required in real-life applications.

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

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Semester V - Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH-P-TUT	Total Hrs.	Credits Assigned TH-P-TUT	Total Credits	Course Category
116U40C501	Theory of Automata	3-0-1	04	3-0-1	04	PC
116U40C502	Automation & Control System	3-0-0	03	3-0-0	03	PC
116U40C503	Computer Organization & Architecture	3-0-0	03	3-0-0	03	PC
116U40E51X	Department Elective – I	3-0-0	03	3-0-0	03	PE
116U06O5XX	Open Elective Technical – I	3-0-0	03	2-0-0	02	OE
116U06H5XX	Open Elective Humanities/ Management	2-0-0	02	2-0-0	02	HS
116U40L501	Web Programming Laboratory	0-2-2	04	0-2-0	02	PC
116U40L502	Automation & Control System Laboratory	0-2-0	02	0-1-0	01	PC
116U40P501	Mini Project - I	0-2-0	02	0-1-0	01	PR
116U40L51X	Department Elective – I Laboratory	0-2-0	02	0-1-0	01	PE
	TOTAL	**17-08-3**	**28**	**16-5-1**	**22**	

Semester V - Department Elective -I

Course Code	Elective Name
116U40E511	Hardware Description Language and FPGA
116U40E512	Electromagnetics Engineering
116U40E513	Sensors and Measuring Instruments
116U40E514	Information Theory and Coding Techniques
116U40E515	Analog Integrated Circuits and Applications
116U40E516	Software Engineering
116U40E517	#Advanced Python Programming and Applications

ESE based on PR exam

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Semester V - Examination Scheme

Course Category	Course Name	CA		ESE	TW	O	P&O	Total
		ISE	IA					
116U40C501	Theory of Automata	30	20	50	25	-	-	125
116U40C502	Automation & Control System	30	20	50	-	-	-	100
116U40C503	Computer Organization & Architecture	30	20	50	-	-	-	100
116U40E51X	Department Elective – I	30	20	50	-	-	-	100
116U06O5XX	Open Elective Technical – I	30	20	-	-	-	-	50
116U06H5XX	Open Elective Humanities/ Management	30	20	-	-	-	-	50
116U40L501	Web Programming Laboratory	-	-	-	50*	-	25	75
116U40L502	Automation & Control System Laboratory	-	-	-	25	-	25	50
116U40P501	Mini Project - I	-	-	-	25	25	-	50
116U40L51X	Department Elective – I Laboratory	-	-	-	25	25	-	50
TOTAL		**180**	**120**	**200**	**150**	**50**	**50**	**750**

***Term work based on laboratory performance of 25 marks and Mini Project of 25 marks**

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Semester VI Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH-P-TUT	Total Hrs.	Credits Assigned TH-P-TUT	Total Credits	Course Category
116U40C601	Digital Signal & Image Processing	3-0-0	03	3-0-0	03	PC
116U40C602	Computer Communication Networks	3-0-0	03	3-0-0	03	PC
116U40C603	Operating System and Compilers	3-0-0	03	3-0-0	03	PC
116U40E61X	Department Elective – II	3-0-0	03	3-0-0	03	PE
116U06O6XX	Open Elective Technical – II	3-0-0	03	2-0-0	02	OE
116U06H6XX	Open Elective Humanities/ Management	2-0-0	02	2-0-0	02	HS
116U40P601	Mini Project - II	1-2-0	03	0-2-0	02	PR
116U40L601	Digital Signal & Image Processing Laboratory	0-2-0	02	0-1-0	01	PC
116U40L602	Computer Communication Networks Laboratory	0-2-0	02	0-1-0	01	PC
116U40L603	Operating System and Compilers Laboratory	0-2-0	02	0-1-0	01	PC
116U40L61X	Department Elective – II Laboratory	0-2-0	02	0-1-0	01	PE
116U06-601	MNCC	2-0-0	02	-	-	
TOTAL		**20-10-0**	**30**	**16-6-0**	**22**	

Course Code	Elective Name
116U40E611	Power Electronics
116U40E612	Basics of VLSI
116U40E613	Computer Graphics
116U40E614	Applied Data Science
116U40E615	#Mobile App Development
116U40E616	Mobile Communication and Ad hoc Networks
116U40E617	Drone Technology

ESE based on PR exam

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Semester VI - Examination Scheme

Course Category	Course Name	CA		ESE	TW	O*	P&O	Total
		ISE	IA					
116U40C601	Digital Signal & Image Processing	30	20	50	-	-	-	100
116U40C602	Computer Communication Networks	30	20	50	-	-	-	100
116U40C603	Operating System and Compilers	30	20	50	-	-	-	100
116U40E61X	Department Elective – II	30	20	50	-	-	-	100
116U06O6XX	Open Elective Technical – II	30	20	-	-	-	-	50
116U06H6XX	Open Elective Humanities/ Management	30	20	-	-	-	-	50
116U40P601	Mini Project - II	-	-	-	50*	25	-	75
116U40L601	Digital Signal & Image Processing Laboratory	-	-	-	25	25	-	50
116U40L602	Computer Communication Networks Laboratory	-	-	-	25	25	-	50
116U40L603	Operating System and Compilers Laboratory	-	-	-	25	25	-	50
116U40L61X	Department Elective – II Laboratory	-	-	-	25	25	-	50
TOTAL		**180**	**120**	**200**	**150**	**125**	**-**	**775**

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Course Code	Course Title							
116U40C501	Theory of Automata							
	TH		P			TUT		Total
Teaching Scheme (Hrs.)	03		–			01		04
Credits Assigned	03		–			01		04
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	30	20	50	25	–	–	–	125

* Batch wise Tutorial

Course prerequisites:

Python Programming

Course Objectives:

The course helps build concepts regarding the fundamental principles of Grammars, Automata Theory, Turing Machines, Push Down Automata, Un-decidability and Intractable Problems. It aims to understand the design of computing machines that can perform complex computation.

Course Outcomes:

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

CO 1. Understand Finite Automata, Non-deterministic Finite Automata, Mealy Machines, Moore Machines and its applications
CO 2. Describe regular languages using Regular Expressions
CO 3. Simplify and normalize grammars
CO 4. Implement context free languages using context free grammar and push down automata
CO 5. Design Turing Machines for various problems and its applications

Module No.	Unit No.	Details	Hrs.	CO
1	**Finite Automata**		**10**	**CO1**
	1.1	**Introduction:** Alphabets, String, Language, Basic Operations on language, Concatenation, Kleene Star.		
	1.2	**Finite Automata (FA):** Its behavior; DFA - Formal definition, State transition diagram, transition table, Language of a DFA. NFA - Formal definition, state transition diagram, transition table Language of an NFA. FA with epsilon-transitions, Eliminating epsilon-transitions, Equivalence of DFAs and NFAs, Conversion from NFA to DFA. Moore machine and Mealy Machine- Formal definition, state transition diagram, transition table, Conversion from Mealy to Moore machine and Moore to Mealy machine. Application of Finite Automata for Lexical Analysis and Lex tools		
2	**Regular Languages**		**09**	**CO2**
	2.1	Chomsky hierarchy, Regular sets, Regular Expression, Some closure properties of Regular languages -Closure under Boolean operations, reversal, homomorphism, inverse homomorphism, etc.		
	2.2	FA and Regular Expressions, equivalence between FA and regular expressions		
	2.3	Pumping lemma for Regular languages, Equivalence and minimization of Finite Automata, Myhill-Nerode Theorem		
	2.4	Application of finite automata and regular expression in lexical analysis		

Module No.	Unit No.	Details	Hrs.	CO
3	**Context free Grammars**		**08**	**CO3**
	3.1	Context-free Grammars (CFGs) -Formal definition, sentential forms, leftmost and rightmost derivations, the language of a CFG. Derivation tree or Parse tree-Definition, Simplification of CFGs -Removing useless symbols, epsilon-Productions, and unit productions.		
	3.2	Relationship between parse trees and derivations. Parsing and ambiguity, Application of CFGs, Ambiguity in grammars and Languages.		
	3.3	Normal forms -CNF and GNF. Proving that some languages are not context free -Pumping lemma for CFL's, applications. Some closure properties of CFL's -Closure under union, concatenation, Kleene closure, substitution, Inverse homomorphism, reversal, intersection with regular set, etc. Some more decision properties of CFL's.		
4	**Push Down Automata**		**08**	**CO4**
	4.1	Pushdown Automata (PDA) -Formal definition, behavior and graphical notation, Instantaneous descriptions (Id's).		
	4.2	The language of PDA (acceptance by final state and empty stack). Equivalence of acceptance by final state and empty stack, Equivalence of PDAs and CFGs.		
	4.3	Conversion: CFG to PDA, PDA to CFG		
	4.4	DPDAs -Definition, DPDAs, Multi-stack DPDAs & NPDAs and CFLs, Languages of DPDAs, NPDAs.		
5	**Turing Machine**		**10**	**CO5**
	5.1	Turing Machines TM -Formal definition and behavior, Transition diagrams, Language of a TM, TM as accepters deciders and generators. TM as a computer of integer functions, Design of TMs, Programming techniques for TMs - Storage in state, multiple tracks, subroutines, etc.		
	5.2	Universal TMs, Variants of TMs –Multi-tape TMs, Nondeterministic TMs. TMs with semi-infinite tapes, Multistack machines, Simulating TM by computer, Simulating a Computer by a TM.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman	*Introduction to Automata Theory, Languages and Computations*	Pearson Education, India	3^{rd} Edition, 2020
2.	John C. Martin	*Introduction to Languages and the Theory of Computation*	McGraw-Hill Education, India	4th Edition, 2010
3.	Michael Sipser	*Introduction to the Theory of Computation*	Cengage Learning, India	3^{rd} Edition, 2014
4.	O.G. Kakde	*Theory of Computation*	Laxmi Publication, India	1^{st} Edition, 2008

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Course Code	Course Title						
116U40C502	Automation & Control 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:

Networks, Signals and Systems

Course Objectives:

This course offers a comprehensive overview of Industrial Automation and Control technology, commonly observed in various types of factories, serving both discrete and continuous manufacturing processes. The course covers an extensive array of related subjects, encompassing the benefits and architecture of automation systems, measurement systems featuring sensors and signal conditioning, control systems for discrete and continuous variables, as well as hydraulic, pneumatic, and electric actuators, in addition to industrial communication and embedded computing.

Course Outcomes:

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

CO 1. Understand the basic concepts of control systems
CO 2. Describe and design control systems
CO 3. Explain automation fundamentals and PLC architecture
CO 4. Explain various actuators used in control systems
CO 5. Analyze Industrial standard protocols and their real life applications

Module No.	Unit No.	Details	Hrs.	CO
1	Introduction to Control Systems		08	CO1
	1.1	Introduction to Control System, Types of control systems (open-loop vs. closed-loop), Control system components and terminology.		
	1.2	Mathematical Modeling of Systems: Transfer functions and block diagrams, Block Diagram Reduction (BDR) technique and Signal Flow Graph (SFG), Mason's Gain Formula, Conversion of BDR to SFG and vice versa.		
2	Analysis of Control Systems		11	CO2
	2.1	Concept of Stability of LTI System, Routh-Hurwitz criterion for Stability analysis.		
	2.2	Time domain analysis - Transient response analysis- First order systems, Impulse, Step and Ramp response, Transient response specifications, Steady state error and error constants.		
	2.3	Frequency Domain Analysis: Bode Plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Gain margin and phase margin via Nyquist diagram and Bode plots, Polar Plot.		
3	**Introduction to Industrial Automation**		10	CO3
	3.1	Architecture of Industrial Automation Systems, Functional Elements, Industrial Control Systems.		
	3.2	PLC Architecture and different components, Fundamentals of Programming, Ladder Logic, Interfacing sensors with PLC, Sensor Wiring, Sinking and Sourcing concepts.		
	3.3	Feedback Control Systems: General form of feedback control, ON/OFF control, P, PI, PID control, Control of Process elements (Level, Temperature, Pressure, Flow)		

Module No.	Unit No.	Details	Hrs.	CO
4	**Industrial controls & Automation**		**10**	**CO4**
	4.1	Pneumatic Control Systems, ISO Symbols for pneumatic and hydraulic, Pneumatic valves.		
	4.2	Electrical actuation system: Solid state switches – Solenoids, Solenoid valves, PLC controlled Actuators		
	4.3	Role of IoT in Automation, Introduction to Industrial IoT (IIOT), Smart sensors, Interfacing of smart sensors with PLC.		
5	**Industrial standard Protocols and Case study**		**06**	**CO5**
	5.1	Communication Protocols, Fieldbus, HART, Modbus, Fieldbus, RS-485 Transmission technology, SCADA Protocols		
	5.2	Role of SCADA In Industrial Automation , Human Machine Interface		
	5.3	Case study of control and automation systems applications		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	A Nagoor Kani	*Control Systems*	CBS Publishers & Distributors Pvt Ltd	5^{th} Edition, 2020
2.	I.J. Nagrath and M Gopal	*Control Systems*	New Age International Publications, India	6^{th} Edition, 2019
3.	Norman S. Nise	*Control Systems Engineering*	Wiley, USA	7^{th} Edition, 2015
4.	Curtis D. Johnson	*Process Control Instrumentation Technology*	Pearson, USA	8^{th} Edition, 2005
5.	Frank D. Petruzella	*Programmable Logic Controllers*	McGraw-Hill Education, USA	5^{th} Edition, 2016
6.	Krzystof Iniewski	*Smart Sensors for Industrial Applications*	CRC Press, UK	1^{st} Edition, 2013

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Course Code	Course Title							
116U40C503	Computer Organization & Architecture							
	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:

Digital Electronics , Microprocessors and Microcontrollers

Course Objectives:

This course will introduce students to the fundamental concepts underlying modern computer organization and architecture. Main objective of the course is to familiarize students about hardware design including logic design, basic structure and behavior of the various functional modules of the computer and how they interact to provide the processing needs of the user. It will cover machine level representation of data, instruction sets, computer arithmetic, CPU structure and functions, memory system organization and architecture, system input/output, multiprocessors, and digital logic. The emphasis is on studying and analyzing fundamental issues in architecture design and their impact on performance.

Course Outcomes:

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

CO 1. Define the performance metrics of a Computer and working of the arithmetic logic unit(ALU) and its sub modules.
CO 2. Describe the purpose and function of Control unit and Processor organization and its data path.
CO 3. Identify different types of memories with cache and virtual memory concepts.
CO 4. Summarize input output techniques in computer systems.
CO 5. Explain the advantages and limitations of Parallelism in system.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Computer Organization**		**09**	**CO1**
	1.1	Fundamental Units of a Computer, evolution of computers, Von Neumann model, Introduction to buses, Basic Measures of Computer Performance - Clock Speed, CPI,MIPS		
	1.2	Introduction to number representation methods, integer data computation, and multiplication and division algorithms for signed numbers, floating point arithmetic, IEEE standards for Floating point representations :Single Precision and Double precision Format		
2	**Processor Organization and Architecture**		**12**	**CO2**
	2.1	CPU Architecture , Register Organization, Instruction cycle, Instruction Formats, , basic instruction cycle, instruction interpretation and sequencing		
	2.2	Control Unit Design- Hardwired and Micro-programmed Control: Vertical and Horizontal Micro-Instructions, Microinstruction sequencing and execution, micro operations, concepts of Nano programming, Comparison between CISC and RISC architectures.		
	2.3	Pipeline: An Overview of Pipelining, Pipelined Data path and Control, Data Hazards, Control Hazards		
3	**Memory Subsystem**		**12**	**CO5**
	3.1	Cache memory concept, architecture (L1, L2, L3), mapping techniques, Write Policies, cache coherency, MESI protocol (* Numerical Problems expected)		
	3.2	Interleaved and associative memory, Memory Hierarchy		
	3.3	Virtual Memory Management-Concept, Segmentation, Paging, Page Replacement policies, Secondary storage, RAID levels.		
		#Self Learning Topic: Classification of Memories-Primary and Secondary Memories, RAM (SRAM and DRAM) and ROM(EPROM, EEPROM)		

Module No.	Unit No.	Details	Hrs.	CO
4	**Input / Output Subsystem**		**09**	**CO4**
	4.1	Types of I/O devices and Access methods, Types of Buses , Bus Arbitration Expansion Bus Concept, PCI Bus		
	4.2	Types of data transfer techniques, programmed I/O, interrupt driven I/O and DMA		
5	**Introduction To Parallel Processing System**		**03**	**CO5**
	5.1	Introduction to Parallel Processing Concepts, Flynn's classification, Array and vector processors, shared memory multiprocessors (SMP)		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Carl Hamacher, Zvonko Vranesic and Safwat Zaky	*Computer Organisation*	McGraw-Hill Education, India	6^{th} Edition, 2022
2.	John P. Hayes	*Computer Architecture and Organization*	Pearson Education, Singapore	3^{rd} Edition, 2002
3.	William Stallings	*Computer Organization and Architecture - Designing for Performance*	Pearson Education, India	11^{th} Edition, 2022
4.	D. A. Patterson and J. L. Hennessy	*Computer Organization and Design - The Hardware/Software Interface*	Morgan Kaufmann, USA	4^{th} Edition, 2010
5.	Andrew S. Tanenbaum and Todd Austin	*Structured Computer Organization*	Pearson Education, India	6^{th} Edition, 2016

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Course Code	Course Title						
116U40E511	Hardware Description Language and FPGA						
	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:

Digital Electronics

Course Objectives:

The objective of this course is to introduce a hardware description language (HDL) for the specification, simulation, synthesis and implementation of digital logic systems. The students are exposed to hardware description language namely Verilog in this course. The students are expected to write Verilog codes using different features and implement designs on FPGA / CPLD. The students will have design practice sessions and implement digital logic systems with commercial Electronic design automation (EDA) tools.

Course Outcomes:

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

CO 1. Understand the basic constructs and programming fundamentals of Verilog
CO 2. Write codes for simple applications using basic Concurrent and Sequential statements in Verilog
CO 3. Test a Verilog code and verify the circuit model
CO 4. Synthesize and Implement the simple circuits on CPLD / FPGA
CO 5. Design a medium scale application using various peripheral interfaces with FPGA

Module No.	Unit No.	Details	Hrs.	CO
1	**Digital circuit design with programmable Logic : Overview**		**08**	**CO1**
	1.1	Overview of Programmable Logic Architectures and Hardware Description Language Features		
	1.2	Fundamental Concepts, Designing with programmable logic, Design Flow.		
	1.3	Verilog variables, data types, operators, Registers, Nets, Modules, Ports declaration and connection rules, always and Initial blocks		
2	**Modeling Combinational circuits in Verilog**		**12**	**CO2**
	2.1	Behavioral modeling, structural modeling, Gate level primitives, User defined primitives. Description styles in Verilog- continuous assignment, procedural assignment, blocking and non blocking		
	2.2	Modeling combinational circuits using Verilog like Decoders and encoders, Multiplexers and Demultiplexers, Priority encoder, Priority decoder, Comparators, Adders, subtractors etc.		
3	**Testing Combinational circuits using Verilog**		**04**	**CO2**
	3.1	Test Bench: need and examples of TestBench, Features of Verilog useful for testbench like *display*monitor etc.		
4	**Modeling Sequential circuits using Verilog**		**12**	**CO2 CO3**
	4.1	Sequential Statements, If Statements, Case Statements,Loop Statements, Tasks and functions		
	4.2	Design of sequential circuits, flip flops, counters memories, shift registers etc.		
	4.3	Design of FSM using Verilog, (Mealy and Moore type) Introduction to datapath and controller design with simple examples		

Module No.	Unit No.	Details	Hrs.	CO
5	**Design for Synthesis and Implementation**		**09**	**CO4 CO5**
	5.1	Simple applications like interfacing of LEDs, Keypad, Sensors , Stepper Motor etc with FPGA and controlling using Verilog.		
	5.2	Applications from Computer Architecture like , Arithmetic Circuits, FPU, ALU control , Pipelined processor Applications like Signal Processing: Digital Filters and Codecs		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	J Bhasker	*A Verilog HDL Primer*	Taylor & Francis India Pvt Ltd, India	2^{nd} Edition, 2013
2.	Morris Mano, Michael D. Celetti	*Digital Design: With an Introduction to the Verilog HDL*	Pearson Education, India	6^{th} Edition, 2018
3.	Zainalabedin Navabi	*Verilog Digital System Design RT Level synthesis TestBench and verification*	McGraw-Hill Education, India	2^{nd} Edition, 2008
4.	Michael D. Celetti	*Advanced Digital Design with the Verilog HDL*	Pearson Education, India	2^{nd} Edition, 2017

Somaiya Vidyavihar University
K.J. Somaiya College of Engineering
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Course Code	Course Title						
116U40E512	Electromagnetics 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:

Vector Calculus, Applied Physics and Coordinate Systems

Course Objectives:

Electromagnetic Engineering is the study of the underlying laws that governs the manipulation of electricity and magnetism, and how we use these laws to our advantage. This course covers the application of electrostatics, steady magnetic field and time varying fields using Maxwell's equations for different media, wave equation, electromagnetic problems using different numerical methods, use of transmission lines and waveguides in wave propagation.

Course Outcomes:

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

CO 1. Understand Fundamental of Electromagnetics Laws.
CO 2. Derive Maxwell's Equations and Boundary Condition.
CO 3. Derive and Analyze the electromagnetic wave equation in different mediums.
CO 4. Analyze EM power transmission through guided structures.
CO 5. Understand Computational Electromagnetics.

Module No.	Unit No.	Details	Hrs.	CO
1	**Fundamental of Electromagnetics**		**10**	**CO1**
	1.1	Vector Calculus: Vector Algebra, Dot Product, Cross Product, Unit Vector, Coordinate system and Transformation: Cartesian, Cylindrical and Spherical.		
	1.2	Electrostatic: Coulomb's Law, Electric field due to a point charge, line charge, surface charge, and volume charge. Gauss' law, Divergence Theorem.		
	1.3	Magneto static: Bio-Savart's law, Ampere's law, Stokes' Theorem		
2	**Maxwell's Equations and Boundary Conditions**		**08**	**CO2**
	2.1	Electric Potential, Poisson's and Laplace equations. Maxwell's Equations: Integral and differential form in free space, static, time varying fields, harmonically time varying fields, Good Conductors and dielectric media with their interpretations. Continuity Equation.		
	2.2	Boundary Conditions for static electric and magnetic fields and flux densities.		
3	**Electromagnetic Wave Propagation**		**10**	**CO3**
	3.1	Wave equation and its solution. Wave propagation in lossy dielectrics, lossless dielectrics, free space, and good conductors. Concept of skin depth.		
	3.2	Poynting Vector and power flow in free space and in dielectric, conducting media. Polarization of wave: Linear, Circular and Elliptical.		

Module No.	Unit No.	Details	Hrs.	CO
1	**Transmission Lines**		**12**	**CO4**
	4.1	Transmission line parameters, Transmission line Equations, Characteristic impedance, Input Impedance, Standing Wave Ratio and Power.		
	4.2	Smith Chart: Reflection Coefficient, Standing Wave Ratio.Scattering Parameters (S-Parameters) and its properties.		
	4.3	Rectangular Waveguide: Basic Parameters, TE, TM, TEM modes		
5	**Computational Electromagnetics**		**05**	**CO5**
	5.1	Finite Difference Method (FDM), Finite Element Method (FEM), Method of Moment (MoM).		
	5.2	Case studies in recent developments in FDM, FEM, MoM.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Matthew N. O Sadiku	*Principles of Electromagnetics*	Oxford University Press, India	6^{th} Edition, 2015
2.	T.V.S. Arun Murthy	*Electromagnetic Fields (Theory and Problems)*	S.Chand Company Pvt Ltd, India	3^{rd} Edition, 2014
3.	William Hayt, John Buck	*Problems and Solutions Electromagnetics*	McGraw-Hill Education, India	1^{st} Edition, 2011
4.	Joseph A Administer	*Schaum's Outline Series Theory and Problems of Electromagnetics*	McGraw-Hill Education, India	5^{th} Edition, 2018

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Course Code	Course Title						
116U40E513	Sensors and Measuring Instruments						
	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:

Elements of Electrical and Electronics Engineering

Course Objectives:

The main objective of this course is to discuss the basic Characteristics of measurement systems working with various electronics instruments. Students will be able to understand the working of different types of Sensors, Transducers and Signal Conditioning Circuits, modern measuring instruments and their applications in industry.

Course Outcomes:

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

CO 1. Understand the knowledge of electronics measuring instruments and their characteristics.
CO 2. Demonstrate different types of Transducers/Sensors and selection for given applications.
CO 3. Apply the concept of Data Acquisition Systems for measurement of various sensor parameters.
CO 4. Analyze signal conditioning circuits for measurement of various parameters.
CO 5. Use Modern Measuring Instruments

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Measuring Instruments**		**10**	**CO1**
	1.1	Basic characteristics of Instruments: static and dynamic, · Classification of Instruments, Response for standard inputs: Unit step, Ramp and sinusoidal signals, Performance characteristics and types of errors, Errors in measurements and error analysis		
	1.2	Function Generator and Signal Generator: Introduction, Sine Wave Generator, Pulse And Square Wave Generator. Oscilloscope Block Diagram, Cathode Ray Tube , Block Diagram Of Digital Signal Oscilloscope, Its Principle and Working. Digital Multimeters.		
2	**Transducers**		**12**	**CO2**
	2.1	Requirement of Transducers, · Classification of transducers, Advantages of Electrical Transducers.		
	2.2	Transducer used for measurement of physical parameters such as : Temperature (RTD, Thermistor, Thermocouple), Pressure (Force and Torque):Electrical Pressure Measurement, Differential Pressure Transmitter and its application. Level Measurement Transducer: Capacitive, Orifice plate, Ultrasonic, and its application. Sensors used in biomedical application, IR sensors, PIR sensors, Sensors interfacing with Aurdino.		
	2.3	Displacement: Principle of Transduction, LVDT, RVDT, Strain gauge. Flow: Head type, Electromagnetic Flow meter, Rotameter, Ultrasonic Flow meter, Vortex Flow meter.		
		#Self learning Topic: Application of Data logger to cloud.		
3	**Data acquisition systems**		**08**	**CO3**
	3.1	Single channel data acquisition, Multi-channel data acquisition systems. SCADA Systems.		
	3.2	PC-based Instrumentation System, Data Loggers. Virtual Instrumentation and Data acquisition software (LabVIEW).		

Module No.	Unit No.	Details	Hrs.	CO
4	**Signal Conditioning Circuits**		**09**	**CO4**
	4.1	Principles of Analog signal conditioning, analog filters, Op Amp circuits in instrumentation, Design guidelines for analog signal conditioning, Design of signal conditioning circuits for temperature measurement.		
	4.2	Principles of digital signal conditioning, converters design, Various signal generators and its implementation, Switch capacitor filter, Logarithmic amplifier, Frequency to voltage and voltage to frequency, converters, Current to voltage and voltage to current converters. Design with DAC and ADCs.		
5	**Modern Measuring Instruments**		**06**	**CO5**
	5.1	Measurement of frequency and time. Spectrum analyzer and network analyzer, measurement of temperature pressure and humidity, Bio-informatics sensors, Nano sensors.		
	5.2	Instrumentation for automation and control, Emerging trends in electronic measurement and instrumentation		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Albert D. Helfrick, William D. Cooper	*Modern electronics Instrumentation and measurement techniques*	Prentice-Hall of India, India	5^{th} Edition, 2015
2.	David Bell	*Electronic Instruments and Measurements*	Oxford University Press, India	3^{rd} Edition, 2013
3.	H.S. Kalsi	*Electronic instrumentation*	McGraw-Hill Education, India	2^{nd} Edition, 2019
4.	A K Sawhney	*Electrical and Electronic Measurement and Instrumentation*	Dhanpat Rai &Co.,India	2^{nd} Edition, 2015
5.	C S Rangan, G R Sarma, V S V Mani	*Instrumentation Devices and Systems*	McGraw-Hill Education, India	2^{nd} Edition, 2001
6.	Curtis D. Johnson	*Process Control Instrumentation Technology*	Pearson Education, India	8^{th} Edition, 2014

Somaiya Vidyavihar University
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Course Code	Course Title						
116U40E514	Information Theory and Coding Techniques						
	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:

Analog and Digital Communication, Probability theory, Matrices.

Course Objectives:

The objective of the course is to introduce the concept of information theory and various coding techniques. The course includes different source coding methods useful in data compression. The course also introduces channel coding methods like block codes and convolutional code for error detection and correction.

Course Outcomes:

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

CO 1. Apply concepts of Information Theory.
CO 2. Learn different source coding techniques.
CO 3. Identify and explain error detection and correction using appropriate techniques.
CO 4. Know basic operations used by common encryption techniques

Module No.	Unit No.	Details	Hrs.	CO
1	**Information Theory and Channel Capacity**		**07**	**CO1**
	1.1	Introduction to Information Theory, Measure of Information, Entropy, Information rate		
	1.2	Information Capacity Theorem, Capacity of a Gaussian channel, bandwidth, S/N trade-off, central limit theorem.		
	1.3	Shannon's source coding theorem.		
2	**Source Coding**		**12**	**CO2**
	2.1	Huffman coding, Shannon-Fano coding, Lempel Ziv coding, examples and applications of source coding.		
	2.2	Introduction to image compression, The JPEG Standard for Lossless Compression, The JPEG Standard for Lossy Compression		
3	**Error Correcting Codes: Block codes**		**13**	**CO3**
	3.1	Need for channel encoding, redundancy, code rate, code efficiency and hamming bound, bit error rate.		
	3.2	Linear block code for error correction, Matrix description of a linear block code, Parity Check Matrix, Decoding of a linear block code, Syndrome decoding.		
	3.3	Cyclic code, Polynomials, Method for generating Cyclic code, Matrix description of Cyclic codes, Syndrome computation and error detection, Decoding of Cyclic code.		
4	**Convolutional Codes**		**08**	**CO4**
	4.1	Introduction to Convolutional Codes, Convolutional Encoder Representation, Tree, Trellis and State diagrams, Polynomial description of Convolutional Codes, Generating Function, Matrix description of Convolutional Codes.		
	4.2	Decoding of Convolutional Codes: Viterbi decoding.		

Module No.	Unit No.	Details	Hrs.	CO
5	**Coding for Secure Communications**		**05**	**CO5**
	5.1	Introduction to Cryptography, An overview of Encryption Techniques, Operations used by Encryption Algorithms.		
	5.2	Symmetric (Secret Key) Cryptography, Data Encryption Standard (DES), Asymmetric (Public-Key) Algorithms, The RSA algorithm.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Ranjan Bose	*Information Theory Coding and Cryptography*	McGraw-Hill Education, India	3^{rd} Edition, 2016
2.	Thomas M. Cover, Joy A. Thomas	*Elements of Information Theory*	Wiley, India	2^{nd} Edition, 2006
3.	Wade Trappe, Lawrence C. Washington	*Introduction to Cryptography with Coding Theory*	Pearson Education, India	2^{nd} Edition, 2011
4.	Herbert Taub, Donald Schilling, Goutam Saha	*Principles of Communication Systems*	McGraw-Hill Education,India	4^{th} Edition, 2017
5.	Shu Lin, Daniel J Costello	*Error control coding Fundamental and applications*	Pearson Education, India	2^{nd} Edition, 2010

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Course Code	Course Title							
116U40E515	Analog Integrated Circuits and Applications							
	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:

Elements of Electrical and Electronics Engineering, Analog Electronics Circuits

Course Objectives:

The objective of the course is to learn basic concepts in the design of analog integrated circuits using linear and nonlinear circuits using Op-amp. Students will also be able to design various applications of special function integrated circuits such as timer IC, Voltage Regulators ICs and Instrumentation Amplifier.

Course Outcomes:

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

CO 1. Understand the characteristics, ratings, parameters of Operational amplifier.
CO 2. Design circuits using op-amps for linear applications.
CO 3. Design circuits using op-amps for nonlinear applications.
CO 4. Study internal functional blocks and design applications using Timers, regulator circuits, and ADCs

Module No.	Unit No.	Details	Hrs.	CO
1	**Operational Amplifier Fundamentals**		**07**	**CO1**
	1.1	Basic Op Amp Configurations, Ideal Op Amp parameters and Circuits Analysis, Simplified Op Amp Circuits Diagram, Frequency response for open loop and closed loop configuration.		
	1.2	Understanding op-amp datasheet for design purpose. Numerical based on op-amp parameters.		
2	**Linear Applications of OP-AMP**		**08**	**CO2**
	2.1	Shunt-Shunt feedback (Inverting Amplifier), Series shunt feedback (Non-Inverting Amplifier) Summing Amplifier, Averaging Amplifier, Difference Amplifier, Instrumentation Amplifier, Instrumentation Amplifier (IC AD620)		
	2.2	Integrator/Differentiator using OP-AMP Current-to-Voltage Converters, Voltage-to-Currents Converters, Grounded load V/I Converter, Sample-and-Hold circuit.		
3	**Active Filter**		**06**	**CO2**
	3.1	The Transfer function, First-Order Active Filters.		
	3.2	Standard Second- Order Responses, KRC Filters.		
4	**Non Linear Applications of OP-AMP**		**08**	**CO3**
	4.1	Voltage Comparators, Comparator Application, Schmitt Triggers, Precision Rectifier, Peak Detectors.		
	4.2	Mono-shot Multi-vibrator, Astable Multi-vibrator Triangular waveform Generator		
5	**Regulators and Data Converters**		**08**	**CO4**
	5.1	Functional block diagram of Voltage Regulators, Fixed voltage Regulators (78XX and 79XX). Variable Voltage Regulators (LM317)		
	5.2	ADC 0808 and DAC 0809		
6	**Waveform Generators and special ICs**		**08**	**CO4**
	6.1	Oscillators using OP-AMP (RC –Phase shift and Wien Bridge oscillators).		
	6.2	Monolithic Timer – NE555		
		Total	**45**	

Recommended Books:

S.No.	**Name/s of Author/s**	**Title of Book**	**Name of Publisher with country**	**Edition and Year of publication**
1.	Sergio Franco	*Design with operational amplifiers and analog integrated circuits*	McGraw-Hill Education, India	4^{th} Edition, 2016
2.	Ramakant A. Gayakwad	*OP-AMP and Linear ICs*	Pearson Education, India	6^{th} Edition, 2015
3.	D. Roy Choudhary, Shail Bala Jain	*Linear Integrated Circuits*	New Age International, India	5^{th} Edition, 2010
4.	S Salivahanan, V. S. Kanchana Bhaaskaran	*Linear Integrated Circuits*	McGraw-Hill Education,India	3^{rd} Edition, 2019

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Course Code	Course Title							
116U40E516	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:

Object Oriented Programming

Course Objectives:

The course aims to provide students with a comprehensive understanding of software engineering, covering software development methodologies, requirements analysis, design principles, programming skills, quality assurance, project management, version control, maintenance, ethics, and effective communication. By the end of the course, students should be well-equipped to participate in software development projects and collaborate effectively in real-world settings.

Course Outcomes:

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

CO 1. Understand the software development process and Estimation of the project.
CO 2. Design UML Model as per the software requirements.
CO 3. Describe System Design and Model.
CO 4. Identify configuration management tool for software development.
CO 5. Apply software testing for software quality assurance.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction of Software Engineering**		**08**	**CO1**
	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 Analysis**		**08**	**CO2**
	2.1	Requirements Engineering Tasks, Requirement Elicitation Techniques, and Software Requirements: Functional, Non- Functional.		
	2.2	Requirements Characteristics, Requirement qualities, Requirement Specification, Requirement Traceability, System Analysis Model Generation, Documentation :Use Case Diagram, Activity Diagram.		
	2.3	Categorizing classes: entity, boundary and control, Modeling associations and collections-Class Diagram.		
	2.4	Dynamic Analysis - Identifying Interaction – Sequence and Collaboration diagrams, State chart diagram.		
3	**System Design Engineering**		**07**	**CO3**
	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.		
		#Self learning Topic: Software Reuse, Component-Based Software Engineering		

Module No.	Unit No.	Details	Hrs.	CO
4	**System Implementation, Configuration Management & Risk Management**		**14**	**CO4**
	4.1	Mapping model to code, Mapping Object Model to Database Schema.		
	4.2	Component and deployment diagrams: Describing Dependencies.		
	4.3	Managing and controlling Changes, Managing and controlling version.		
		#Self learning Topic: 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**		**08**	**CO5**
	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	Case Study: Test case for library management system.		
		#Self learning Topic: Testing tools		
		Total	**45**	

Recommended Books:

S.No.	**Name/s of Author/s**	**Title of Book**	**Name of Publisher with country**	**Edition and Year of publication**
1.	Roger Pressman	*Software Engineering*	McGraw-Hill Education, India	9^{th} Edition, 2020
2.	Bernd Bruegge	*Object Oriented Software Engineering*	Pearson Education, India	3^{rd} Edition, 2009
3.	Ian Sommerville	*Software Engineering*	Pearson Education, India	10^{th} Edition, 2015
4.	John Nicholas, Herman Steyn	*Project Management for Business Engineering and Technology*	Routledge, UK	5^{th} Edition, 2017

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Course Code	Course Title							
116U40E517	Advanced Python Programming and Applications							
	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:
Python Programming

Course Objectives:
The primary course objective is to empower students with proficiency in image processing, network programming, Raspberry Pi application development, and game development. By gaining expertise in these diverse domains, students are well-equipped to embark on technology-related projects and pursue dynamic career opportunities in an ever-evolving digital landscape.

Course Outcomes:
At the end of successful completion of the course the student will be able to
CO 1. Explore OpenCV and its graphical user interface (GUI) features for image processing.
CO 2. Understand the fundamentals of network programming, including the role of sockets and web services.
CO 3. Applied knowledge of Raspberry Pi for various applications.
CO 4. Develop a brief understanding of game development, game frameworks, and Python's role

Module No.	Unit No.	Details	Hrs.	CO
1	**Python tool for Image Processing**		**12**	**CO1**
	1.1	Introduction to OpenCV, GUI features in OpenCV		
	1.2	Basic operations on Images, Arithmetic Operations on Images, Mathematical tool in OpenCV		
	1.3	Changing Colorspaces, Geometric Transformation of Images, Image thresholding, Smoothing Images, Image Gradient, Contours in OpenCV, Edge detection, Histograms		
2	**Network Programming**		**12**	**CO2**
	2.1	Introduction to Sockets and Web Services		
	2.2	Sockets in Python: Socket to Socket Communication, Setting Up a Connection, An Example Client Server Application, Socket Types and Domains, Implementing the Client Application, The Socketserver Module		
	2.3	Web Services in Python: RESTful Services, A RESTful API, Python Web Frameworks, Flask, Hello World in Flask		
3	**Raspberry Pi with Python**		**09**	**CO3**
	3.1	Setup and Management		
	3.2	Software for Raspberry pi		
	3.3	Computer Vision: Introduction, Installing, Simple CV, Setting up a USB Camera for Computer vision, Using a R-pi Camera Module for Computer vision, Counting Coins, Face Detection and Motion Detection, Optical Character Recognition		
	3.4	Controlling Hardware: Connecting an LED, Making a Buzzing Sound, Making a User interface to control PWM for LEDs and Motors, Interface IR and Ultrasonic Sensors		
	3.5	Applications: Controlling Servo Motors, Controlling Speed and direction of DC motor, Toggling with PUSH Switch, Using a , Measuring temperature with an ADC		

Module No.	Unit No.	Details	Hrs.	CO
4	**Game Programming**		**12**	**CO4**
	4.1	Introduction to Pygame Library: Games Framework and libraries, Python Games Development, Building Games with pygame, Display Surface, Events, Sprites and Images, Input handling, Sound and Music		
	4.2	A First Pygame Application		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Dr. R. Nageswara Rao	*Core Python Programming*	Wiley, India	2^{nd} Edition, 2018
2.	Sheetal Taneja, Naveen Kumar	*Python Programing: A Modular Approach*	Pearson Education, India	2^{nd} Edition, 2018
3.	Alexander Mordvintsev, Abid K	*OpenCV-Python Tutorials Documentation*	e-book	Release 1
4.	John Hunt	*Advanced Guide To Python3 Programming*	Springer, India	1^{st} Edition, 2019
5.	Simon Monk	*Raspberry Pi Cookbook*	O'Reilly Media, USA	2^{nd} Edition, 2019
6.	Swaroop C.H	*Byte of Python*	e-book	Kindle Edition, 2013

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Course Code	Course Title							
116U40L501	Web Programming Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			04		–		04
Credits Assigned	–			02		–		02
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	50*	–	–	25	75

*Term work based on laboratory performance of 25 marks and Mini Project of 25 marks

Course prerequisites:

Basic understanding of programming concepts (e.g., variables, control structures), Familiarity with HTML and CSS.

Course Objectives:

This full-stack development course provides students with a strong foundation in web development. By course completion, students will be proficient in creating responsive web pages using HTML, CSS, and Bootstrap. They will also excel in building interactive web applications with JavaScript, utilizing modern frameworks like React, and mastering server-side development with Node.js. Additionally, students will learn to integrate databases, implement user authentication, security measures, and deploy applications to diverse hosting environments, equipping them for successful careers in web development.

Course Outcomes:

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

CO 1. Understand the fundamentals of web development technologies, including HTML, CSS, and Bootstrap.

CO 2. Design responsive web pages using HTML, CSS, and Bootstrap, improving user interfaces.

CO 3. Create interactive web content with JavaScript, including form validation and event handling.

CO 4. Apply master front-end frameworks like React, building modern web applications.

CO 5. Develop back-end applications with Node.js, integrate databases, implement security, and deploy web projects.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Web Development, HTML and CSS**		**12**	**CO1, CO2**
	1.1	Introduction to the course overview of web development technologies Setting up development environments		
	1.2	HTML structure and tags CSS styling and layout, building a static webpage		
	1.3	Bootstrap grids, layouts, bootstrap components like iconography, dropdowns, input groups, navigation, alerts. and plugins.		
		#Self learning Topic: CSS Preprocessors, Responsive Web Design		
2	**Front-end Development with JavaScript**		**16**	**CO3**
	2.1	Introduction to JavaScript: Functions, Asynchronous Programming, Regular Expressions Callback and Promises DOM manipulation		
	2.2	Event handling, Building interactive web pages		
	2.3	Enhancing and Validating Forms		
3	**Front-end Frameworks**		**12**	**CO4**
	3.1	Introduction to front-end frameworks (e.g., React, Angular, or Vue) Building a front-end project using a framework		
	3.2	React Introduction:. Understanding basics of react app Understanding JSX, React Lifecycle, Class components vs functions components		
	3.3	Modules, States and Hooks, Event handling.,Props Building a basic Forms using React		
4	**Back-end Development with Node.js**		**10**	**CO5**
	4.1	Introduction to Node.js and server-side JavaScript setting up a Node.js server, Asynchronous and synchronous		
	4.2	Modules, Routing, Handling HTTP requests and response, Middleware, Caching		

Module No.	Unit No.	Details	Hrs.	CO
5	**Databases and Back-end Development**		**10**	**CO5**
	5.1	Introduction to databases (SQL and NoSQL) Integrating databases with Node.js, building a RESTful API, ORMs (Object-Relational Mapping)		
	5.2	User authentication and authorization Implementing security features, session management		
	5.3	Deploying web applications to servers Hosting options (e.g., AWS, Heroku) Domain registration and DNS configuration		
		#Self learning Topic: Continuous Integration/Continuous Deployment (CI/CD), Load Balancing and Scalability		
		Total	**60**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Terry Ann Felke-Morris, Ed.D.	*Web Development and Design Foundations with HTML5*	McGraw Hill Education, India	9^{th} Edition, 2019
2.	Kyle Simpson	*Up & Going*	O'Reilly,USA	1^{st} Edition, 2014
3.	Marijn Haverbeke	*Eloquent JavaScript*	No Starch Press,USA	3^{rd} Edition, 2018
4.	Anthony Accomazzo, Ari Lerner, Nate Murray, Clay Allsopp, David Gutman, Tyler McGinnis	*Fullstack React: The Complete Guide to ReactJS and Friends*	Fullstack.io, India	1^{st} Edition, 2017
5.	Mario Casciaro	*Node.js Design Patterns*	Packt Publishing Ltd.,UK	1^{st} Edition, 2014
6.	Kristina Chodorow	*MongoDB: The Definitive Guide*	O'Reilly, USA	3^{rd} Edition, 2020

Course Code	Course Title							
116U40L502	Automation & Control System Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	–	–	25	50

Term work will consist of experiments covering entire syllabus of "Automation & Control System" (116U40C502). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Level control by a 2-step controller using FluidLab
2. Continuous level control using FluidLab
3. Continuous flow control using FluidLab
4. Continuous pressure control using FluidLab
5. Study of Programmable Logic Controllers and implementation of Logic gates
6. Implementation of Timers and counters in Programmable Logic Controller
7. Study of operation of Single acting cylinder in Pneumatic system
8. Study of operation of Double acting cylinder in Pneumatic system
9. Study of operation of single & Double acting cylinder in Electro-Pneumatic system
10. Interfacing of Analog sensor to PLC and display the real time analog values in HMI
11. Demonstration of Industrial Internet of Things

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Course Code	Course Title							
116U40P501	Mini Project - I							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	–	–	25	50

Course prerequisites:
C Programming

Course Objectives:
This course aims to equip students with the ability to select suitable hardware projects and optimize the selected projected area for design and development of the final prototype. Students will understand project management fundamentals, explore microcontrollers and programming languages, also learn PCB development and debugging techniques, and develop proficiency in hardware based projects.

Course Outcomes:
At the end of successful completion of the course the student will be able to
CO 1. Identify topics based on hardware design and microcontroller programming.
CO 2. Design and fabricate printed circuit boards (PCBs).
CO 3. Develop interpersonal skills to work as a member of a group or leader.
CO 4. Analyze the impact of solutions in societal and environmental context for sustainable development.

Module No.	Unit No.	Details	Hrs.	CO
1	**Project Selection**		**10**	**CO1**
	1.1	Project Idea based on hardware design and microcontroller applications, Title Selection and Component List, Fundamentals of project management		
	1.2	Abstract Development, Summary paragraph		
2	**Literature review**		**06**	**CO1**
	2.1	Literature Review, Author Biographies, Scopus & SCI indexing, Google Scholar profile, GitHub, Research gap analysis. Activities related to Topic Chosen		
3	**Project Simulation, PCB design and Prototyping**		**10**	**CO2, CO3**
	3.1	Writing code for Microcontroller used, Simulation Results		
	3.2	Circuit Diagram Simulation and PCB Layout, PCB Design, Manual PCB Fabrication, PCB Assembly and Soldering.PowerPoint Presentation, User Manual Development, Working Circuit Video.Prototyping		
4	**Project Documentation**		**04**	**CO4**
	4.1	Standard publisher paper format, Paper Submission with Methodology, Professional Video Presentation, Overleaf Paper Draft, Graphical Abstract, Standard publisher paper format, Paper Submission with Methodology, Professional Video Presentation, Overleaf Paper Draft, Graphical Abstract		
	4.2	Technical Paper and Project Report		
		Total	**30**	

(*Project Idea can be such that, it can be extended as Software part in Mini Project-II)

Recommended Books:

S.No.	**Name/s of Author/s**	**Title of Book**	**Name of Publisher with country**	**Edition and Year of publication**
1.	Jack Meredith, Samuel Mantel	*Project Management, A Managerial Approach*	Wiley, India	7^{th} Edition, 2010
2.	Dennis Lock	*Project Management*	Gower Publishing, UK	9^{th} Edition, 2013
3.	Tim Williams	*The Circuit Designer Companion*	Newnes,Oxford and Boston, India	2^{nd} Edition, 2004
4.	Paul Scherz, Simon Monk	*Practical Electronics for Inventors*	McGraw-Hill Education, USA	4^{th} Edition, 2016

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Course Code	Course Title							
116U40L511	Hardware Description Language and FPGA Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Hardware Description Language and FPGA" (116U40E511). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Implement half adder , full adder , multibit adder, Full subtractor etc.
2. Implement Multiplexer behavior and structural modeling
3. Implement a 3:8 decoder with active low enable
4. Implement JK FF with Synchronous reset, Asynchronous reset
5. Implement 74163 like counter considering all the features of the IC
6. Universal 4 bit shift register with selection of functions
7. FSM Implementation : Word Problem
8. Asynchronous Counter
9. Applications like
   (a) Interfacing of LEDs, Keypad, Sensors , Stepper Motor
   (b) Interfacing VGA Monitor
   (c) Arithmetic Circuits, FPU, ALU control , Pipelined processor
   (d) Digital Filters and Codecs

Course Code	Course Title							
116U40L512	Electromagnetics Engineering Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Electromagnetics Engineering" (116U40E512). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Simulate and visualize electric field lines around point charges or conductive objects and Simulate and visualize magnetic field lines around magnets or current-carrying wires. using octave
2. Solve the Electric Field of a Line Charge Density and Surface Charge Density using Octave
3. Octave simulation of an Electromagnetic Wave Equation
4. Octave simulation of wave equation
5. Octave simulation of Transmission lines with losses
6. Octave simulation of Telegrapher's equation
7. Octave Simulation of different types of Polarisation
8. Octave simulation of modes of a Rectangular Waveguide

Course Code	Course Title							
116U40L513	Sensor Technology and Measurements							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Sensors and Measuring Instruments" (116U40E513). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Study the response of first order system
2. Study of Sensors(Temperature, LVDT) in hardware
3. Study of basic Industrial Sensors (Temperature Sensor, Strain gauge, Level sensor, LVDT) (Virtual Lab)
4. Design an amplifier and Filter
5. Data Acquisition in LabVIEW
6. Study of IR and PIR sensors
7. Tank level detection using LabVIEW

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Course Code	Course Title							
116U40L514	Information Theory and Coding Techniques Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Information Theory and Coding Techniques" (116U40E514). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. To implement Channel Capacity Analysis with different communication channels (e.g., wireless, optical fiber) and measure their capacity in terms of data rate and error rates using Matlab/python/C++
2. To implement various error-correcting codes e.g., Hamming codes, experiment with encoding and decoding processes. Measure the error correction capability under different noise conditions using Matlab/python/C++
3. Implement entropy and compression techniques like Huffman coding or arithmetic coding. Evaluate compression ratios and reconstruction quality using MATLAB/Python/C++
4. Investigate encryption algorithms like AES or RSA. Analyze the impact of encryption on data security and communication throughput
5. Implement various channel coding techniques such as convolutional codes and turbo codes. Evaluate their performance in noisy communication channels using MATLAB/PYTHON/C++
6. Define and implement appropriate metrics for evaluating the performance of your coding techniques, such as bit error rate (BER), signal-to-noise ratio (SNR), or throughput using MATLAB/Python/C++

7. Develop experiments to measure the loss of information in different data transformation and transmission processes using Python/MATLAB

8. Apply coding techniques to real-world scenarios, such as data transmission in wireless networks, satellite communications, or data storage systems

Course Code	Course Title							
116U40L515	Analog Integrated Circuits and Applications Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Analog Integrated Circuits and Applications" (116U40E515). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. To measure the parameters of Opamp 741
2. To study Inverting Non Inverting Amplifier and Subtractor using IC741
3. To implement Practical Differentiator first order active low pass filter
4. To implement three Op Amp Instrumentation Amplifier
5. To design and implement Inverting Schmitt Trigger for given UTP and LTP value
6. To implement triangular and square wave generator using IC741
7. Study of R-2R Ladder type DAC
8. To design and implement Astable Multivibrator using IC 555 timer
9. To implement Precision Full wave rectifier using IC741 (Simulation based)
10. To implement Sample and Hold Circuit (Simulation based)
11. To implement Instrumentation amplifier (3 opamp based and using IC AD620) (Simulation based)

12. To implement various precision rectifier using Opamp IC
13. To implement practical peak detector circuit using Opamp IC
14. Mini Project based on real life Applications using opamp IC, IC 555, and Regulator IC (use standard datasets available on web)

Course Code	Course Title							
116U40L516	Software Engineering Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Software Engineering" (116U40E516). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Requirement specification document for mini project
2. Estimation of project for mini project
3. Study of Umbrello Unified Modelling Language tool Or Lucid chart: flowcharts and diagram drawing tool
4. Modeling UML Use Case, Activity diagram, Class diagram, Sequence Diagram
5. User interface design using UI tools for a project
6. Study of Configuration Management tool
7. Designing Test plan using various testing methodologies for a project
8. Test software application using Selenium Java tool

Course Code	Course Title							
116U40L517	Advanced Python Programming and Applications Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Advanced Python Programming and Applications" (116U40E517). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:
Image Processing with OpenCV:

1. Introduction to OpenCV and Basic Image Operations
   - Display an image using OpenCV.
   - Perform basic operations like resizing, cropping, and rotating images
2. Arithmetic Operations and Colorspaces in OpenCV
   - Perform arithmetic operations on two images.
   - Convert images between different colorspaces (RGB, HSV, Grayscale).
3. Geometric Transformations and Image Thresholding
   - Apply geometric transformations such as translation, rotation, and scaling.
   - Implement image thresholding techniques.
4. Smoothing, Image Gradient, and Contours
   - Apply smoothing techniques like blurring and sharpening.
   - Calculate image gradients and identify contours in an image.

5. Edge Detection and Histograms
    - Implement edge detection algorithms (e.g., Canny).
    - Generate and analyze histograms of images.

Network Programming with Python:

6. Introduction to Sockets and Socket Communication
    - Create a basic socket server and client for communication.
7. Implementing a Client-Server Application
    - Develop a more advanced client-server application with socket communication.
8. Web Services with Flask
    - Create a simple RESTful web service using Flask.
    - Implement CRUD operations (GET, POST, PUT, DELETE) for a Bookshop service.

Raspberry Pi with Python:

9. Setting Up Raspberry Pi and SimpleCV
    - Install and configure the necessary software on a Raspberry Pi.
    - Set up SimpleCV for image processing.
10. Computer Vision with Raspberry Pi
    - Use a USB camera and R-pi Camera Module for basic computer vision tasks.
    - Implement face detection and motion detection.
11. Controlling Hardware on Raspberry Pi
    - Connect and control an LED using GPIO.
    - Generate a buzzing sound with a buzzer.
12. Interfacing with Sensors on Raspberry Pi
    - Interface with IR and Ultrasonic sensors.

- Develop a user interface to control PWM for LEDs and Motors.

Game Programming with Pygame

13. Introduction to Pygame Library
    - Set up Pygame for game development.
    - Understand the basic structure of a Pygame application.
14. Building a Simple Pygame Application
    - Create a basic game using Pygame.
    - Incorporate graphics, sprites, and handle user input.

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Course Code	Course Title							
116U40C601	Digital Signal & 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:

Networks, Signals & Systems

Course Objectives:

The goal of this course is to provide students a broad perspective in the field of signal processing in digital domain and image processing. The course will cover different signal processing concepts and time frequency domain and their applications in designing different filters. Additionally, the course introduces the fundamentals of image processing, segmentation, and their applications.

Course Outcomes:

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

CO 1. Apply the concept of DT domain in analyzing the discrete time systems.
CO 2. Design different filters in digital domain.
CO 3. Understand basics of image fundamentals.
CO 4. Utilize image processing in edge detection, image restoration and segmentation.
CO 5. Implement the morphological operations and image compression.

Module No.	Unit No.	Details	Hrs.	CO
1	**Discrete-Time Signals and Systems**		**07**	**CO1**
	1.1	Introduction to Discrete-Time signals and its type and properties, Signal manipulations (shifting, reversal, scaling, addition, multiplication), Classification of discrete systems.		
	1.2	Linear time invariant (LTI) systems, Concept of impulse response, Convolution in time domain		
2	**Introduction to Transforms and Filters**		**10**	**CO2**
	2.1	Introduction to Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT), Relation between DFT and DTFT, Z-Transform, Need of Fast Fourier Transform (FFT), FFT algorithm		
	2.2	Finite impulse response (FIR) filters, Infinite impulse response (IIR) filters		
3	**Digital Image Fundamentals**		**12**	**CO3**
	3.1	Introduction to digital image and its representation, Sampling and Quantization, Basic relationship between pixels, Connectivity, Image file formats: BMP, TIFF and JPEG.		
	3.2	Basic intensity transformation functions, Histogram processing, Histogram equalization		
	3.3	Fundamental of spatial filtering, Smoothening spatial filters, Sharpening spatial filters, Filtering in the frequency domain, Two dimensional Discrete Fourier Transform		
4	**Edge Detection, Image Restoration and Segmentation**		**08**	**CO4**
	4.1	Image Edge detection using Robert, Sobel, Previtt masks, Image Edge detection using Laplacian Mask.		
	4.2	Fundamentals of Image Degradation/Restoration Process, Restoration in the Presence of Noise		
	4.3	Image segmentation based on discontinuities: point, line and edge detection (Laplacian, Canny), Thresholding (Global, local, optimum), Region based segmentation, Hough Transform.		

Module No.	Unit No.	Details	Hrs.	CO
5	**Introduction to Morphological Operations, Image Compression and Applications**		**08**	**CO5**
	5.1	Morphological operations: Dilation, Erosion, Opening,Closing, Hit or Miss Transform, Boundary extraction		
	5.2	Image Compression Fundamentals, Basic Compression Techniques.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	S. Haykin	*Signals and Systems*	Wiley, India	2^{nd} Edition, 2007
2.	J.G. Proakis, D.G.Manolakis	*Digital Signal Processing: Principles, Algorithms and Applications*	Pearson Education, India	4th Edition, 2010
3.	Gonzalez & Woods	*Digital Image Processing*	Pearson Education, India	2^{nd} Edition, 2016
4.	W. Pratt	*Digital Image Processing*	Wiley, India	3^{rd} Edition, 2002

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Course Code	Course Title							
116U40C602	Computer Communication 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:

Analog and Digital communication

Course Objectives:

The objective of this course is to introduce computer communication and networking concepts. The students will understand the basic computer network architecture, protocol layers and service models.This course will help to enhance students' understanding, analyzing and implementation capability such as interconnecting network devices, network configuration and client-server programs that communicate over the internet.

Course Outcomes:

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

CO 1. Understand concept of computer communication & Network models.
CO 2. Describe different data link and transmission protocols for transmission and control.
CO 3. Discuss IP addressing and Routing algorithms.
CO 4. Explain Transport layer protocols.
CO 5. Analyze network protocols and current trends of computer communication and Network security concept.

Module No.	Unit No.	Details	Hrs.	CO
1	Introduction to Network Architectures		08	CO1
	1.1	Network Topologies, LAN, MAN, WAN, Connecting devices:NIC, Hubs, Repeaters, Bridges, Switches, Router, Gateway. Internetworks, Virtual LANs.		
	1.2	Protocol Hierarchies, Design Issues for the layers. Reference Models: Layers details of OSI, TCP/IP Models,Protocol Layers and their service models.		
	1.3	Introduction to physical media, Coax, fiber, twisted pair, Transmission Impairments.		
		#Self learning topic: Home networks, Internetworks		
2	Data link control		12	CO2
	2.1	Function of data link layer, MAC address, HDLC frame format, Flow and error control concepts and protocols, Noiseless and noisy channels.Piggybacking		
	2.2	Multiple Access: Random Access, control Access,Channelization.		
	2.3	Wired LANs: IEEE standards , Standard Ethernet, Fast Ethernet, Gigabit Ethernet Wired LANs: IEEE standards , Standard Ethernet, Fast Ethernet, Gigabit Ethernet		
3	**Network Layer Services and Protocols**		10	CO3
	3.1	Introduction to classful and classless IPv4 addressing subnetting and supernetting, IPv6 addressing. Compatibility with IPV4, Tunneling, Dual stack, Encapsulation, NAT.		
	3.2	Concept of Link State Routing and Distance Vector Routing, Bellman ford algorithm and Disjktra Algorithm, Routing in the Internet, Introduction to RIP, OSPF and BGP.		
		#Self-learning topic: Concepts of embedded networking environment.		

Module No.	Unit No.	Details	Hrs.	CO
4	**Transport-layer Protocols**		**09**	**CO4**
	4.1	Services, Transport layer protocols, UDP, TCP , State Transition diagram, TCP Timers, flow and error control.		
	4.2	Network performance parameters:-Fairness, Delay, jitter, and loss in packet switched networks, Bandwidth, throughput, congestion control and quality-of-service, Socket programming.		
		#Self-learning topic: QUIC.		
5	**Application layer and Network security**		**07**	**CO5**
	5.1	Application layer protocols such as HTTP, HTTPS WWW, FTP, FTPS, SMTP, DHCP, DNS, DNSSEC, Remote Login.		
	5.2	Network security: Key security concepts, threats, vulnerabilities, exploits, and mitigation techniques.		
		#Self-learning topic: Concept of Internet of Things, Architecture and Communication model.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	B. A. Forouzan	*Data Communications and Networking*	McGraw-Hill Education, India	4^{th} Edition, 2017
2.	William Stallings	*Data Computer Communication*	Pearson Education, India	10^{th} Edition, 2013
3.	A. S. Tanenbaum	*Computer Networks*	Pearson Education, India	5^{th} Edition, 2013
4.	B. A. Forouzan	*TCP/IP protocol suite*	McGraw-Hill Education, India	4^{th} Edition, 2016

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Course Code	Course Title							
116U40C603	Operating System and Compilers							
	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:

Python Programming, Data Structures, Computer Organization and architecture.

Course Objectives:

The course aims to introduce basic concepts and functions of operating systems, process, thread and resource management.Process synchronization and deadlock which are major parameters in system performance are also covered up in the course.

Course Outcomes:

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

CO 1. Explain the fundamental concepts of operating system Illustrate and analyse the Process, threads, process scheduling and thread scheduling

CO 2. Describe the problems related to process concurrency and the different synchronization mechanisms available to solve them

CO 3. Explain disk organization and file system structure with illustration of disk scheduling algorithms

CO 4. Understand Storage management with allocation, segmentation & virtual memory concepts

CO 5. Understand compiler construction tools and describes the functionality of each stage of compilation process

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Operating Systems and Process Concepts**		**07**	**CO1**
	1.1	Concept, introduction to various system programs such as assemblers, loaders, linkers, macro processors, compilers, interpreters, operating systems, device drivers Operating System Objectives and Functions.		
	1.2	Operating system structures, System Calls Linux Kernel and Shell System boot.		
	1.3	Process: Concept of a Process, Process States, Process Control Block. Threads: Definition and Types, Concept of Multithreading, Introduction to Thread Scheduling		
2	**Process Concurrency**		**10**	**CO2**
	2.1	Concurrency: Principles of Concurrency, Inter-Process Communication, Process/Thread Synchronization.		
	2.2	Mutual Exclusion: Requirements, Hardware Support, Operating System Support (Semaphores and Mutex), Programming Language Support (Monitors)		
	2.3	Classical synchronization problems: Readers/Writers Problem, Producer and Consumer problem.		
	2.3	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		
3	**Input output and file management**		**12**	**CO3**
	3.1	File Management: Overview, File Organization and Access, File Directories, File Sharing, Secondary Storage Management.		
	3.2	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.		

Module No.	Unit No.	Details	Hrs.	CO
4	**Storage management**		**08**	**CO4**
	4.1	Main Memory: Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples		
	4.2	Virtual Memory: Background, Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples		
5	**Compiler**		**08**	**CO4**
	5.1	Definition of compiler, interpreter and its differences, the phases of a compiler, role of lexical analyzer, regular expressions, finite automata, from regular expressions to finite automata, pass and phases of translation, bootstrapping, LEX-lexical analyzer generator.		
	5.2	PARSING: Parsing, role of parser, context free grammar, derivations, parse trees, ambiguity, elimination of left recursion, left factoring, eliminating ambiguity from dangling-else grammar, classes of parsing, top down parsing - backtracking, recursive descent parsing, predictive parsers, LL(1) grammars.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	William Stallings	*Operating System: Internal and Design Principles*	Prentice Hall, India	8^{th} Edition, 2014
2.	Abraham Silberschatz, Peter Baer Galvin,Greg Gagne	*Operating System Concepts*	Wiley, India	9^{th} Edition, 2016
3.	Andrew Tannenbaum	*Operating System Design and Implementation*	Pearson Education, India	3^{rd} Edition, 2015
4.	D.M Dhamdhere	*Systems Programming*	McGraw-Hill Education, India	3^{rd} Edition, 2001
5.	Alfred V. Aho, Jeffrey D. Ullman	*Principles of Compiler Design*	Pearson Education, India	1^{st} Edition, 2001

Somaiya Vidyavihar University
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Course Code	Course Title						
116U40E611	Power Electronics						
	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:

Analog Electronics Circuits, Electrical Networks.

Course Objectives:

This course introduces the basic concepts of switched-mode converter circuits for controlling and converting electrical power with high efficiency. Principles of converter circuit analysis are introduced and are developed for finding the steady state voltages, current, and efficiency of power converters. A basic understanding of electrical circuit analysis is an assumed prerequisite for this course.

Course Outcomes:

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

CO 1. Understand construction, principle of operation and V-I characteristics of various Power Electronics Devices.
CO 2. Analyze, compare and design power circuit of AC to DC converters.
CO 3. Design and analyze power circuit of DC to AC converters.
CO 4. Illustrate the analysis and comparison of various topologies of DC to DC converters.
CO 5. Distinguish the analysis of various topologies of AC to AC converters.

Module No.	Unit No.	Details	Hrs.	CO
1	**Power Electronics Devices**		**09**	**CO1**
	1.1	Principle of operation of SCR, static and dynamic characteristics, gate characteristics. Methods of turning on (type of gate signal), UJT triggering circuit, Commutation circuits.		
	1.2	Principle of operation, characteristics, rating and applications of: DIAC, TRIAC, MOSFET, IGBT and power BJT. Principle of operation, characteristics, rating and applications of: DIAC, TRIAC, MOSFET, IGBT and power BJT.		
		#Self learning topic: Study of turn on and driver ICs for various devices.		
2	**AC to DC Converters: Controlled Rectifiers**		**10**	**CO2**
	2.1	Single phase Half wave controlled rectifiers, Full wave controlled rectifiers, half controlled and fully controlled rectifiers with R, R-Land R-L-E load with and without feedback diodes. (effect of source inductance not to be considered). Dual converter. Performance Parameters.		
	2.2	Three phase half controlled and fully controlled rectifiers with R load only. Performance Parameters.		
3	**DC to AC Converters : Inverters**		**10**	**CO3**
	3.1	Principle of operation of Series and Parallel Inverters. Principles of operation of Single phase half / full bridge voltage source inverters with R and R-L load. Voltage control of single phase inverters using PWM techniques.		
	3.2	Three phase bridge inverters (120° and 180° conduction mode) with R and R-L load.		
4	**DC to DC Converters : Choppers**		**09**	**CO4**
	4.1	Basic principle of step up and step down choppers. Type-A, Type-B, Type-C, Type-D and Type-E choppers		
	4.2	Buck, Boost, Buck-Boost converters, Derivation of Vo, Io, Vc and Io under steady state condition.		

Module No.	Unit No.	Details	Hrs.	CO
5	**AC to AC Voltage Controllers and Cycloconverters**		**07**	**CO5**
	5.1	Principle of On-Off control, principle of phase control, single phase bidirectional control with R and RL load, TRIAC as light dimmer/ single-phase induction motor speed controller.		
	5.2	Principle of cycloconverter operation, single phase to single phase step-up and step-down cycloconverter. Introduction to three phase Cycloconverter. Applications of cycloconverter.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Dr. P.S. Bimbhra	*Power Electronics*	Khanna Publications, India, India	4^{th} Edition, 2008
2.	M.D. Singh, K.B. Khanchandani	*Power Electronics*	McGraw-Hill Education, India	2^{nd} Edition, 2013
3.	M. Rashid	*Power Electronics Circuits Devices and Applications*	Pearson Education, India	4^{th} Edition, 2013
4.	Ned Mohan	*Power Electronics: Converters, Applications and Design*	Wiley, India	3^{rd} Edition, 2002

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Course Code	Course Title						
116U40E612	Basics of VLSI						
	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:

Analog Electronics, Digital Electronics

Course Objectives:

The objective of the course is to familiarize the student with fundamental principles of VLSI Design. It provides coverage of classical VLSI Design for both combinational and sequential digital circuits. Various design styles used for design of such circuits have also been introduced.

Course Outcomes:

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

CO 1. Understand fundamentals of MOS physics and technology scaling
CO 2. Understand characteristics of different MOS inverters
CO 3. Implement MOS based circuits using different design styles
CO 4. Design and implement units of datapath
CO 5. Design and implement semiconductor memories

Module No.	Unit No.	Details	Hrs.	CO
1	**MOS Physics**		**12**	**CO1**
	1.1	**Introduction:** VLSI Design Flow, Y-Chart representation		
	1.2	**Physics of MOS:** MOS capacitor, energy band diagrams, band bending, flat band voltage, threshold voltage calculation, threshold adjustment, MOSFET linear and saturated operation (GCA), MOSFET capacitance, Channel length modulation.		
	1.3	**Technology Scaling:** Types of scaling, functional limitations of scaling, short channel, narrow channel effects, hot electron effects		
2	**MOS Inverters**		**12**	**CO2**
	2.1	**Circuit Analysis:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter, comparison of all types of MOS inverters, design of CMOS inverters.		
	2.2	**Logic Circuit Design:** Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter.		
3	**MOS Circuit Design Styles**		**08**	**CO3**
	3.1	**Design Styles:** Static CMOS, pass transistor logic, transmission gate, Pseudo NMOS, Domino, C2MOS		
	3.2	**Circuit Realization:** SR Latch, MUX, decoder using above design styles		
4	**Transmission Lines**		**04**	**CO4**
	4.1	**Adder:** Bit adder circuits, Ripple carry adder, CLA adder		
	4.2	**Multipliers and shifter:** Partial-product generation, partial-product accumulation, final addition, barrel shifter.		
5	**Semiconductor Memories**		**09**	**CO5**
	5.1	**SRAM:** ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits), DRAM (Operation 3T, 1T, operation modes, leakage currents, refresh operation, Input-Output circuits)		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim	*CMOS Digital Integrated Circuits – Analysis and Design*	McGraw-Hill Education, India	4^{th} Edition, 2016
2.	Jan M Rabaey	*Digital Integrated Circuits – A Design Perspective*	Pearson Education, India	2^{nd} Edition, 2016
3.	John P. Uyemura	*Introduction to VLSI Circuits and Systems*	Wiley, India	1^{st} Edition, 2006
4.	Debaprasad Das	*VLSI Design*	Oxford Publication, India	2^{nd} Edition, 2015
5.	Neil Weste, David Harris	*CMOS VLSI Design: A Circuits and Systems Perspective*	Pearson Education, India	4^{th} Edition, 2010
6.	Pucknell, Douglas A.Eshraghian, Kamran	*Basic VLSI Design*	Prentice Hall, India	3^{rd} Edition, 1995

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Course Code	Course Title							
116U40E613	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:
Basic familiarity with fundamental algorithms and data structures, Good programming skills, Basics of linear algebra and geometry.

Course Objectives:
The goal of this course is to provide students a broad perspective in the field of Computer Graphics, to explain hardware, software and OpenGL Graphics Primitives. Illustrate interactive computer graphics using OpenGL. Design and implement algorithms for 2D graphics Primitives and attributes. Demonstrate Geometric transformations, viewing on both 2D and 3D objects. Infer the representation of curves, surfaces, colour and illumination models.

Course Outcomes:
At the end of successful completion of the course the student will be able to
CO 1. Understand the basic concepts of computer graphics and OpenGL
CO 2. Implement Fill area Primitives, 2D Geometric Transformations and 2D viewing
CO 3. Implement Clipping,3D Geometric Transformations and 3D viewing
CO 4. Understand the computer Input interaction, Curves and Computer Animation

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Computer Graphics**		**07**	**CO1**
	1.1	Basics of computer graphics, Application of Computer Graphics, Video Display Devices: Random Scan and Raster Scan displays		
	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, Midpoint), circle generation algorithms (Bresenham's, Midpoint).		
2	**Fill area Primitives, 2D Geometric Transformations and 2D viewing**		**10**	**CO2**
	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		
	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		

Module No.	Unit No.	Details	Hrs.	CO
3	**Clipping,3D Geometric Transformations, Color and Illumination Models**		**12**	**CO3**
	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.		
	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**		**08**	**CO3**
	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.		
	4.2	Visible Surface Detection Methods: Classification of visible surface Detection algorithms, depth buffer method only and OpenGL visibility detection functions.		

Module No.	Unit No.	Details	Hrs.	CO
5	**Input & interaction, Curves and Computer Animation**		**08**	**CO4**
	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.		
	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 topic: Vulkan API by the Khronos group (known for OpenGL), Game development using Pygame**		
		Total	**45**	

Recommended Books:

S.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, India	4^{th} Edition, 2011
2.	Edward S. Angel	*Interactive Computer Graphics, A top-down approach with shader-based OpenGL*	Pearson Education, India	6^{th} Edition, 2011
3.	Dave Shreiner, Graham Sellers, John Kessenich, Bill Licea-Kane	*OpenGL Programming Guide: The Official Guide to Learning OpenGL*	Addison-Wesley, USA	8^{th} Edition, 2013
4.	Zhigang Xiang, Roy Plastock	*Computer Graphics*	McGraw-Hill Education,India	2^{nd} Edition, 2010
5.	Amrendra Sinha, Arun Udai	*Computer Graphics*	McGraw-Hill Education, India	1^{st} Edition, 2008

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Course Code	Course Title						
116U40E614	Applied Data Science						
	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:
Python Programming

Course Objectives:
The objective of this course is to impart knowledge of Data Interpretation and how to visualize the data. It also introduces how to handle data in Data Science like exploratory data analysis. It also covers Business intelligence Software like Tableau. It also includes various case studies of data visualization.

Course Outcomes:
At the end of successful completion of the course the student will be able to
CO 1. Understand the fundamental concepts of data science.
CO 2. Apply statistical techniques for data analysis.
CO 3. Perform exploratory data analysis on various datasets.
CO 4. Create effective data visualizations and visual data storytelling.

Module No.	Unit No.	Details	Hrs.	CO
1	**Data Science Overview**		**08**	**CO1**
	1.1	Introduction to Data Science, Different Sectors of Data Science		
	1.2	Types of data in Business contexts, Data Categorization.		
	1.3	Types of data Collection, Structured and Unstructured data.		
	1.4	Sources of data, Data Quality issues		
2	**v**		**12**	**CO2**
	2.1	Descriptive statistics		
	2.2	Distributions, mean, variance, covariance, covariance matrix		
	2.3	Understanding univariate and multivariate normal distributions		
	2.4	Introduction to hypothesis testing, confidence interval for estimates, Analysis of Variance, Correlation Analysis		
3	**Exploratory data analysis**		**10**	**CO3**
	3.1	Understanding Data, Basic Visualization: Matplotlib and seaborn libraries		
	3.2	Missing value analysis		
	3.3	Outlier detection analysis Outlier detection analysis		
	3.4	Data preparation and preprocessing, Data Standardization		
4	**Data Visualization**		**15**	**CO4**
	4.1	Need of Visualization, From Visualization To Visual Data Storytelling: An Evolution		
	4.2	Getting Started With Tableau, Connecting Data, Understanding Dimensions and Measures		
	4.3	Choosing the Right Visual, Colors, Formatting, Dashboard, Preparing Data for Storytelling, Advanced Chart		
	4.4	Case Study on following topics Healthcare, E-commerce, Finance, Social Media, Environmental Science		
		Total	**45**	

Recommended Books:

S.No.	**Name/s of Author/s**	**Title of Book**	**Name of Publisher with country**	**Edition and Year of publication**
1.	Joel Grus	*Data Science from Scratch: First Principles with Python*	O'Reilly, India	2^{dn} Edition, 2019
2.	Peter Bruce, Andrews Bruce	*Practical Statistics for Data Scientists*	O'Reilly, India	2^{nd} Edition, 2020
3.	Jake Vander-Plas	*Python Data Science Handbook*	O'Reilly, India	2^{nd} Edition, 2016
4.	Sharada Sringeswara	*Data Visualization: Storytelling Using Data*	Wiley,India	1^{st} Edition, 2022

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Course Code	Course Title						
116U40E615	Mobile App Development						
	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:

Fundamentals of Object Oriented Programming concepts

Course Objectives:

The objective of this course is to introduce students to the basics of mobile app development, including the different platforms, tools and technologies involved.The students will learn to design, develop, and test mobile apps and publish their mobile apps to the app store.

Course Outcomes:

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

CO 1. Understand the different mobile app platform and technologies.
CO 2. Design mobile apps using native and cross-platform development.
CO 3. Create mobile apps with rich functionality Using databases and other back-end service.
CO 4. Deploy their mobile app to the store.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Flutter**		**10**	**CO1**
	1.1	Introduction to Flutter Development Environment, Understanding the Flutter Architecture, Flutter macOS Setup, Flutter Windows Setup		
	1.2	Introduction to Dart Programming Language, Coding Style and Naming Convention, Declaring Variables, Numbers, Booleans, Constant and Final Keywords, Dart Types and Operators, Control Flow and Functions, Understanding Classes and Constructors, Data Structures.		
2	**Building user interface**		**10**	**CO2**
	2.1	Creating UI with Flutter, Basics and Understanding Widgets, Flutter Basic Layouts, Widgets in Flutter: Material App, Scaffold Widget, Different Button Widgets, Drawer and Navigation Bar, User Notification Widgets: Snack Bar, Toast, Alert, Handling User Input and Working with TextFields, Radios, Checkbox, Adding Custom Images and Fonts		
	2.2	Navigation and State Management, Navigation Types, Passing Data via the Constructor, Using Named Routes & Passing Data With Named Routes, Dart programming (Coding Style and Naming Convention, Declaring Variables, Numbers, Booleans, Constant and Final Keywords, Dart Types and Operators, Control Flow and Functions, Understanding Classes and Constructors, Data Structures), Flutter App Architecture Patterns, Provider Package.		
3	**Android Development**		**10**	**CO3**
	3.1	Android, The Android SDK and Android Studio, Creating your first Android app, Android app structure, Android app components, Android app lifecycle		
	3.2	User Interface Design, Views and layouts, Creating user interfaces with XML, Working with different types of views, Handling user input, Creating custom views.		

Module No.	Unit No.	Details	Hrs.	CO
4	**Mobile app development using Android Studio**		**10**	**CO3**
	4.1	Activities and Services, Activities, Services, Intents, Communicating between activities and services, Data Storage and Retrieval, Shared preferences, SQLite databases, Content providers.		
	4.2	Advanced Android Topics, Fragments, Networking, Background tasks, Testing and debugging, Publishing your app to the Google Play Store		
5	**App development**		**05**	**CO4**
	5.1	Designing considerations for building a simple game, Designing considerations for building a social media app, Designing considerations for building, Designing considerations for building a shopping app, Designing considerations for building a news app.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Eric Windmill	*Flutter in Action*	Manning Publications, USA	1^{st} Edition, 2019
2.	Marco L. Napoli	*Beginning Flutter: A Hands On Guide to App Development*	Wrox, England	1^{st} Edition, 2019
3.	Prajyot Mainkar, Salvatore Giordan	*Google Flutter Mobile Development Quick Start Guide: Get up and running with iOS and Android mobile app development*	Packt Publishing, India	1^{st} Edition, 2019
4.	Ivo Balbaert , Dzenan Ridjanovic	*Learning Dart*	Addison-Wesley, USA	1^{st} Edition, 2004
5.	Mark Clow	*Learn Google Flutter Fast: 65 Example Apps*	Independently published	1^{st} Edition, 2019
6.	Drawn Griffiths, David Griffiths	*Head First Android Development ,A Brain –Friendly guide*	O'Reilly,India	2^{nd} Edition, 2017
7.	Jerome DiMarzio	*Beginning Android Programming with Android StudioBeginning Android Programming with Android Studio*	Wrox, England	4^{th} Edition, 2016

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Course Code	Course Title						
116U40E616	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:

Basics of Analog and Digital Communication

Course Objectives:

This course aims to introduce the concept of cellular communication. The course offers various characteristic features of ad hoc wireless networks along with the understanding of the concepts such as functioning of different access and routing protocols that can be used for adhoc networks. It also discusses emerging technologies that derived from MANET, their challenges and current development.

Course Outcomes:

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

CO 1. Understand the cellular concept and multiple access techniques.
CO 2. Compare different types of wireless networks used in MANET.
CO 3. Understand the current topics in MANETs and WSNs, both from an industry and research point of views.
CO 4. Analyze how proactive routing protocols function and their implications on data transmission delay and bandwidth consumption.
CO 5. Discuss the applications and challenges in mobile ad hoc networks.

Module No.	Unit No.	Details	Hrs.	CO
1	**Principles of Cellular Communication and Access techniques**		**12**	**CO1**
	1.1	Cellular Terminology, Cell structure and Cluster, frequency reuse concept, Cluster size and system capacity, method of locating Co channel cells, frequency reuse distance, and Co channel interference.		
	1.2	Multiple access techniques: CDMA, TDMA, FDMA, SDMA, SSMA and hybrid multiple access techniques.		
2	**Wireless Networks and Internet**		**10**	**CO2**
	2.1	IEEE 802.11 WLAN, IEEE 802.15 WPAN, IEEE 802.16 WMAN		
	2.2	Wireless ATM, Wireless internet, Mobile IP, TCP in wireless domain, WAP, concept of web over wireless.		
	2.3	4G wireless standards, LTE.		
3	**Introduction To Ad-Hoc Networks**		**06**	**CO3**
	3.1	Introduction and Applications of Ad hoc networks MANET, Mobile Internet connectivity and Personal area Networks.		
	3.2	Characteristics and Issues in Ad Hoc wireless networks.		
4	**Routing Protocols**		**10**	**CO4**
	4.1	Routing, Destination sequence distance vector, Dynamic source routing, Alternative metrics, Overview ad-hoc routing protocols.		
	4.2	Design issues, Goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms.		
	4.3	Hybrid routing algorithm, Energy aware routing algorithm, Hierarchical routing, QoS aware routing.		
5	**Applications and Recent Developments**		**07**	**CO5**
	5.1	Academic Environment Applications, Defence Applications, Healthcare Applications, Vehicular Ad Hoc Networks, Search and Rescue.		
	5.2	Challenges: Security, Recent development in the field of sensors, Wireless Ad Hoc sensor networks.		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	C. Siva Ram Murthy and B.S.Manoj	*Ad hoc Wireless Networks Architectures and protocols*	Pearson Education, India	2^{nd} Edition, 2007
2.	F. Zhao, L. Guibas	*Wireless Sensor Networks: An Information Processing Approach*	Morgan Kaufmann, USA	1^{st} Edition, 2005
3.	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Sojmenovic	*Mobile Ad-hoc Networking*	Wiley , India	2^{nd} Edition, 2015
4.	Mohammad Ilyas	*The Handbook of Ad-hoc Wireless Networks*	CRC Press, USA	1^{st} Edition, 2002
5.	Subir Kumar Sarkar, T.G. Basavaraju, C. Puttamadappa	*Ad Hoc Mobile Wireless Network*	CRC Press, USA	2^{nd} Edition, 2013

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Course Code	Course Title							
116U40E617	Drone Technology							
	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:
Software programming

Course Objectives:
Provide students with a foundational understanding of drone technology, including the history, types of drones, and their applications in various industries.

Course Outcomes:
At the end of successful completion of the course the student will be able to
CO 1. Understand fundamentals of Drone Technology.
CO 2. Describe drone hardware and sensors.
CO 3. Develop drone software and simulation.
CO 4. Illustrate different drone application.
CO 5. Understand advanced drone technology.

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Drone Technology**		**08**	**CO1**
	1.1	Introduction to drone, History of drone technology, , Introduction to different applications of drones , Benefits and challenges of drone technology		
	1.2	Different types of drones: Multi-rotor drones, Fixed-wing drones, Hybrid drones, Single-rotor drones, Single-rotor helicopters, Autonomous drones, MicrodronesM, Military drones		
2	**Drone Hardware**		**10**	**CO2**
	2.1	Basic components of a drone: Different types of drone motors, Drone propellers, Drone batteries, Flight controllers, Other drone hardware components		
	2.2	Pixhawk, Drone Parts Categories,Drone Kit, Drone Frame and Accessories, Flight Controller & Accessories, Drone Transmitter and Receiver, FPV Cameras, GPS Modules, Drone Motor, (ESC) Drone Speed Controller, Drone Accessories, Drone Propellers, FPV Antennas and Trans-Receivers, Drone Gimbal and Accessories		
3	**Drone Software**		**10**	**CO3**
	3.1	Types of drone software, Drone operating systems, Drone flight planning software, Mission control software, Drone image and video processing software		
	3.2	Flight Planning and Mission Control Software, Image and Video Processing Software, Simulation Software,Programming Software		
4	**Drone Applications**		**08**	**CO4**
	4.1	Drone photography and videography, Drone surveying and mapping, Drone inspection and maintenance		
	4.2	Drone delivery, Drone agriculture, Other drone applications		
5	**Drone Applications**		**09**	**CO5**
	5.1	Autonomous drones, Drone swarms, Drone artificial intelligence, Drone machine learning		
	.52	Drone computer vision,Other advanced drone technologies FPV drones,Programmable drones		
		Total	**45**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Simon Rose	*Agricultural Drones*	Raintree Publishers, UK	1^{st} Edition, 2017
2.	Terry Kilby, Belinda Kilby	*Make: Getting Started with Drones*	Maker Media, USA	1^{st} Edition, 2015
3.	Ian Cinnamon, Romi Kadri, Fitz Tepper	*DIY Drones for the Evil Genius: Design, Build, and Customize Your Own Drones*	McGraw-Hill Education	1^{st} Edition, 2016
4.	The Editors of Make	*Make: DIY Drone and Quadcopter Projects*	Maker Media, USA	1^{st} Edition, 2016
5.	Ronald Buchi	*How to buy and fly a Quadcopter Drone*	Herstellung and Verlag:BoD-Norderstedt, Germany	2^{nd} Edition, 2022

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Course Code	Course Title							
116U40P601	Mini Project - II							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	01			02		–		03
Credits Assigned	–			02		–		02
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	–	–	25	50

Course prerequisites:

Python, C Programming

Course Objectives:

This comprehensive course equips students with essential project management, full-stack software development, UI/UX design, database design, and software testing knowledge. It emphasizes the importance of project phases, stakeholder identification, and general management skills, allowing students to integrate frontend, backend, and database components for holistic software development.

Course Outcomes:

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

CO 1. Identify problems based on full-stack software development.
CO 2. Design and develop User Interfaces (UIs).
CO 3. Develop software programs to function effectively as part of a team or in a leadership role.
CO 4. Apply skills to solve the problems within societal and environmental frameworks, with a focus on promoting sustainable development.

Module No.	Unit No.	Details	Hrs.	CO
1	**Fundamentals of Project Management**		**01**	**CO1**
	1.1	Exploring the fundamentals and importance of Project Management, the essential task of identifying project stakeholders, the indispensable general management skills required for the successful project execution.		
2	**Full-Stack Software Development**		**03**	**CO2**
	2.1	Exploring Full-Stack Development, examine its components, including the front-end, back-end, and database layers , integration of different layers to achieve a comprehensive full-stack development solution.		
3	**UI/UX Design and Implementation**		**05**	**CO3**
	3.1	Fundamentals of UI/UX Design and Development, Core development principles for UI/UX designers, Utilizing CSS, HTML, and JavaScript programming languages for user interface design, Crafting an intuitive user experience through effective design.		
4	**Design and Development of Database**		**10**	**CO5**
	4.1	Understanding the basics of DBMS, Database design process and its significance in software development, Implementing robust and efficient databases for applications.s		
5	**Software Testing**		**04**	**CO4**
	5.1	Basics of Software Testing, Comprehensive overview of software testing, Introduction to software testing tools and their applications, Ensuring software quality through effective testing practices.		
		Total	**15**	

Module No.	Unit No.	Details	Hrs.	CO
1	**Project Idea Submission**		**10**	**CO1**
	1.1	Title Selection and Component List, Revised Title Submission, Project Foundation		
	1.2	Abstract Development		
2	**Literature review**		**06**	**CO2**
	2.1	Introduction to Project, Literature Review in software domain, Introduction to IPR.		
3	**Project Code & Simulation**		**10**	**CO4**
	3.1	Code Development and Simulation Results, software development process and simulation techniques, frontend and backend design, database integration, and the creation of a working project video.		
	3.2	Development of flowcharts, UML diagrams, simulations, PowerPoint presentations, and user manuals.		
4	**Final Project Report**		**04**	**CO4**
	4.1	Standard publisher paper format, Paper Submission with Methodology, Professional Video Presentation		
	4.2	Final Report Draft Submission, Final Project Report Submission		
		Total	**30**	

(Note: Project idea can be continuation of Mini Project 1)

Recommended Books:

S.No.	**Name/s of Author/s**	**Title of Book**	**Name of Publisher with country**	**Edition and Year of publication**
1.	Jack Meredith, Samuel Mantel	*Project Management, A managerial approach*	Wiley, India	7^{th} Edition, 2010
2.	Chris Northwood	*The Full Stack Developer*	APress, India	1^{st} Edition, 2018
3.	Elvis Canziba	*Hands-On UX Design for Developers*	Packt Publishing, India	1^{st} Edition, 2018
4.	Henry Lee	*Voice User Interface Projects*	Packt Publishing, India	1^{st} Edition, 2018

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Course Code	Course Title							
116U40L601	Digital Signal & Image Processing Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Digital Signal & Image Processing" (116U40C601). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. To find DFT / IDFT of given DT signal.
2. Program to obtain convolution & correlation of two finite length sequences
3. Implementation of FFT of given sequence
4. Implementation of FIR filter for a given sequences
5. Virtual Lab on study of Infinite Impulse Response (IIR) filters.
6. Simulation, display of an image and operations on an Image.
7. Transformation of an Image
8. Contrast Stretching of a Low Contrast Image.
9. Histogram and Histogram Equalization.
10. Image Smoothening & Sharpening Filters.
11. Implementation of Edge Detection Algorithms.

Course Code	Course Title							
116U40L602	Computer Communication Networks Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Computer Communication Networks" (116U40C602). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. To Study of Network Devices and connectors using Cisco packet tracer.
2. To implement local area Network (LAN) and study basic networking commands
3. To implement and study Virtual LAN using Cisco packet tracer
4. To make an Ethernet LAN cable for connecting networking devices
5. To implement a topology for a company using Cisco packet tracer.
6. To learn and implement IP V4 address and subnetting using cisco packet tracer.
7. To learn and configure static routing using Cisco packet tracer
8. To learn and configure dynamic routing using Cisco packet tracer.
9. To understand TCP/IP cell using Wireshark software
10. Configuration of DNS DHCP server using Packet Tracer.

Course Code	Course Title							
116U40L603	Operating System and Compilers Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Operating System and Compilers" (116U40C603). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Exploring basic Commands of DOS, UNIX and Windows Utilities
2. Shell Programming and System calls
3. Implementation of Basic Process Management Algorithms – Non Preemptive (FCFS , SJF, priority)
4. Implementation of Basic Process management algorithms - Preemptive (SRTN, RR, priority)
5. Implementation of Process synchronization algorithms using semaphore - producer consumer problem / reader-writers problem
6. Implementation of dining philosopher problem using threads
7. Implementation of Deadlock Avoidance Policy
8. Implementation of Disk scheduling algorithms - FCFS,SSTF,SCAN, CSCAN, LOOK
9. Implementation of Memory Allocation Algorithms

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Course Code	Course Title							
116U40L611	Power Electronics							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Power Electronics" (116U40E611). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Characteristics of Power Electronics Device
2. Half and Full wave CONTROLLED rectifier Simulation with R LOAD
3. Half and Full wave rectifier Simulation with RL LOAD
4. Simulation of single phase Semiconverter
5. Gate triggering circuit using UJT (Proteus software)
6. Class C Commutation of SCR
7. Class D Commutation of SCR
8. Simulation on Single Phase Inverter with RL load
9. Simulation on Three Phase Inverter with RL load (120 and 180 degree conduction mode)
10. Simulation of Buck Converter

Course Code	Course Title							
116U40L612	Basics of VLSI							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Basics of VLSI" (116U40E612). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:Implementation using LTSpice/ esim

1. V-I characteristics of MOSFET with parameter variation: a) Varying W/L ratio b) Varying lambda
2. Comparison of four inverters
3. Implementation of digital logic expression
4. Estimation of propagation delay of CMOS inverter
5. Implementation of NAND and NOR gates using Static CMOS design style
6. Implementation of XOR using Pass Transistors and Transmission Gates
7. Implementation of MUX and Decoder using Pass Transistors and Transmission Gates
8. Implementation of Clocked SR Flip Flop using CMOS (NOR) and CMOS (NAND)
9. Implementation of NOR and NAND based ROM array
10. Implementation of 1 bit Full adder using a) Static CMOS logic b) Mirror CMOS logic c) Transmission gate

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Course Code	Course Title							
116U40L613	Computer Graphics							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Computer Graphics" (116U40E613). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. a. Digital Differential Analyser (DDA) Line Drawing Algorithm b. Bresenham Line Drawing Algorithm
2. Draw the Following polygon/shape/curve. a. Bresenham Circle Drawing Algorithm. b. Other shapes
3. Write a program to demonstrate the LINE CLIPPING algorithm a. Cohen-sutherland-algorithm b. Mid-Point Subdivision Line Clipping Algorithm c. Liang-Barsky Line Clipping Algorithm
4. Write a program to perform 2D and 3D transformation a. Translation b. Scaling c. Rotation d. Shear e. Reflection
5. Write a program to demonstrate the Polygon CLIPPING algorithm
6. Write a program to implement Shadow Mapping
7. Write a program to implement transparency
8. Write a program to implement Simple Interaction with the mouse and keyboard
9. Write a program to draw "Bucky ball" using OpenGL library
10. Mini-Project using any open source not restricted to Pygame and OpenGL

Course Code	Course Title							
116U40L614	Applied Data Science							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Applied Data Science" (116U40E614). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Collect real-world data from different sources and Analyze and assess data quality issues.
2. Calculate descriptive statistics for a given dataset.
3. Perform hypothesis testing on sample data.
4. Explore and visualize a dataset using Matplotlib and Seaborn.
5. Detects and handles missing values and outliers.
6. Perform Data Preprocessing on given dataset
7. Create interactive data visualizations and Dashboard using Tableau
8. Design a compelling visual data storytelling presentation.
9. Mini Project

Course Code	Course Title							
116U40L615	Mobile App Development							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Mobile App Development" (116U40E615). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Create a simple Flutter app that displays "Hello World."
2. Create a Flutter app that uses various Dart operators and functions.
3. Create a Flutter app that showcases different basic layouts and widgets (e.g., Column, Row, Container).
4. Add custom images and fonts to your Flutter app.
5. Set up the Android development environment, including Android Studio and the Android SDK.
6. Explore the Android app structure and understand the component
7. Publish a simple Android app to the Google Play Store.
8. Choose one of the following app concepts (simple game, social media, shopping, news) and outline its design considerations.

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Course Code	Course Title							
116U40L616	Mobile Communication and Ad hoc Networks							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of “” (116U40E616). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. To demonstrate Frequency reuse concept
2. Estimation of received power to understand path loss in cellular communication system
3. Experiment based on Wi-Fi network using simulation tool
4. Experiment based on Bluetooth network using simulation tool
5. Create a mobile Ad-hoc network using a simulation Tool.
6. Implement an Ad-hoc On-demand Distance Vector protocol using simulation Tool.
7. Understand the OSPF routing using simulation tools.
8. Implement Energy aware routing algorithm

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Course Code	Course Title							
116U40L617	Drone Technology							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		–		02
Credits Assigned	–			01		–		01
Examination Scheme	Marks							
	CA		ESE	TW	O	P	P&O	Total
	ISE	IA						
	–	–	–	25	25	–	–	50

Term work will consist of experiments covering entire syllabus of "Drone Technology" (116U40E617). Students will be graded based on continuous assessment of their term work.

Practical and oral examination will be based on laboratory work and entire syllabus.

Tentative list of Experiments:

1. Assemble a simple drone kit and explain its various components.
2. Research and present on the historical development of drones and their evolution over time.
3. Showcase real-world applications of drones by conducting live drone demonstrations.
4. Study the benefits and challenges of drone technology, including safety, privacy, and regulations.
5. Disassemble and reassemble a drone, identifying and explaining the basic components.
6. Compare the performance of different types of drone motors and propellers in terms of thrust and efficiency.
7. Conduct battery life tests for various drone batteries and analyze their performance.
8. Demonstrate the working of a flight controller and its role in stabilizing a drone's flight.

9. Explore other drone hardware components like GPS modules, sensors
10. Install and configure different drone operating systems on a compatible drone platform.
11. Plan and execute a simulated drone mission using flight planning and mission control software.
12. Process drone-captured images and videos, applying filters and enhancements using drone image and video