SOMAIYA VIDYAVIHAR UNIVERSITY

K J Somaiya College of Engineering

Syllabus

SY B.Tech Electronics and Computer Engineering

(Second Year: Semester III-IV)

From

Academic Year 2023-24

(Revision-1)

Approved by FOET and AC

SY 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 24/03/2023 and the subsequent meeting of the Faculty of Engineering and Technology (FoET) on 10/01/2023 and Academic Council held on 05/04/2023 amended the syllabus of S.Y. B. Tech EXCP. Same will be brought into force from Academic Year 2023-24 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 III - Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH-P-TUT	Total Hrs.	Credits Assigned TH-P-TUT	Total Credits	Course Category
116U40C301	Integral Transform and Vector Calculus	3-0-1	04	3-0-1	04	BS
116U40C302	Analog Electronic Circuits	3-0-0	03	3-0-0	03	PC
116U40C303	Digital Electronics	3-0-0	03	3-0-0	03	PC
116U40C304	Data Structures	3-0-0	03	3-0-0	03	PC
116U40C305	Networks, Signals and Systems	3-0-0	03	3-0-0	03	PC
116U40L301	Object Oriented Programming Laboratory	0-2-2	04	0-2-0	02	PC
116U40L302	Analog Electronic Circuits Laboratory	0-2-0	02	0-1-0	01	PC
116U40L303	Digital Electronics Laboratory	0-2-0	02	0-1-0	01	PC
116U40L304	Data Structures Laboratory	0-2-0	02	0-1-0	01	PC
116U40L305	Networks, Signals & Systems Laboratory	0-2-0	02	0-1-0	01	PC
TOTAL		**15-10-3**	**28**	**15-6-1**	**22**	

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Semester III - Examination Scheme

Course Category	Course Name	CA		ESE	TW	O*	P&O	Total
		ISE	IA					
116U40C301	Integral Transform and Vector Calculus	30	20	50	25	-	-	125
116U40C302	Analog Electronic Circuits	30	20	50	-	-	-	100
116U40C303	Digital Electronics	30	20	50	-	-	-	100
116U40C304	Data Structures	30	20	50	-	-	-	100
116U40C305	Networks, Signals and Systems	30	20	50	-	-	-	100
116U40L301	Object Oriented Programming Laboratory	-	-	-	50*	-	25	75
116U40L302	Analog Electronic Circuits Laboratory	-	-	-	25	-	25	50
116U40L303	Digital Electronics Laboratory	-	-	-	25	-	25	50
116U40L304	Data Structures Laboratory	-	-	-	25	-	25	50
116U40L305	Networks, Signals & Systems Laboratory	-	-	-	25	25	-	50
TOTAL		**150**	**100**	**250**	**175**	**25**	**100**	**800**

***Term work based on laboratory performance of 25 marks and one test of 25 marks**

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Semester IV Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH-P-TUT	Total Hrs.	Credits Assigned TH-P-TUT	Total Credits	Course Category
116U40C401	Complex Analysis, Statistics and Optimization Techniques	3-0-1	04	3-0-1	04	BS
116U40C402	Analog and Digital Communication	3-0-0	03	3-0-0	03	PC
116U40C403	Analysis of Algorithms	3-0-0	03	3-0-0	03	PC
116U40C404	Database Management Systems	3-0-0	03	3-0-0	03	PC
116U40C405	Discrete Mathematics	3-0-1	04	3-0-1	04	PC
116U40L401	Microprocessors and Microcontrollers Laboratory	1-2-0	03	0-2-0	02	PC
116U40L402	Analog and Digital Communication Laboratory	0-2-0	02	0-1-0	01	PC
116U40L403	Analysis of Algorithms Laboratory	0-2-0	02	0-1-0	01	PC
116U40L404	Database Management Systems Laboratory	0-2-0	02	0-1-0	01	PC
TOTAL		**16-8-2**	**26**	**15-5-2**	**22**	

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Semester IV - Examination Scheme

Course Category	Course Name	CA		ESE	TW	O*	P&O	Total
		ISE	IA					
116U40C401	Complex Analysis, Statistics and Optimization Techniques	30	20	50	25	-	-	125
116U40C402	Analog and Digital Communication	30	20	50	-	-	-	100
116U40C403	Analysis of Algorithms	30	20	50	-	-	-	100
116U40C404	Database Management Systems	30	20	50	-	-	-	100
116U40C405	Discrete Mathematics	30	20	50	25	-	-	125
116U40L401	Microprocessors and Microcontrollers Laboratory	-	-	-	50*	-	25	75
116U40L402	Analog and Digital Communication Laboratory	-	-	-	25	25	-	50
116U40L403	Analysis of Algorithms Laboratory	-	-	-	25	-	25	50
116U40L404	Database Management Systems Laboratory	-	-	-	25	-	25	50
TOTAL		**150**	**100**	**250**	**175**	**25**	**75**	**775**

***Term work based on laboratory performance of 25 marks and one test of 25 marks**

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Course Code	Course Title							
116U40C301	Integral Transform and Vector Calculus							
	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:

- Applied Mathematics-I
- Applied Mathematics-II
- Basics of Vector Algebra

Course Objectives:

The objective of this course is to introduce different methods of finding Laplace Transform and Inverse Laplace transform of given function. The course also familiarizes students with the concepts of Fourier series, Fourier Integral and Fourier Transform of a given function. The course also disseminates methods to find Z- Transform and Inverse Z- transform of a function. Concepts of Differentiation and Integration of Vector functions with their applications are also explained in this course. Using these methods it will be possible to analyze and interpret a given real life situation and think of possible solutions.

Course Outcomes:

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

CO 1. Apply Different methods to find Laplace Transform and Inverse Laplace Transform of a function
CO 2. Find Fourier series, Fourier Integral and Fourier Transform of functions.
CO 3. Apply Different methods to find Z-Transform and Inverse Z- Transform of a function.
CO 4. Apply concepts of Gradient, curl and Divergence of a vector function to solve problems.
CO 5. Apply concepts of Vector Integration to solve related problems.

Module No.	Unit No.	Details	Hrs.	CO
1	**Laplace Transform**		**12**	**CO1**
	1.1	Definition of Laplace Transform, Laplace Transform of sin(at), cos(at),sinh(at), cosh(at), erf(t), Heavi-side unit step, dirac-delta function, Laplace Transform of periodic function		
	1.2	Properties of Laplace Transform (without proof): Linearity, first shifting theorem, second shifting theorem, multiplication by t, division by t, Laplace Transform of derivatives and integrals, change of scale		
	1.3	Inverse Laplace Transform: Partial fraction method, convolution theorem, Application of Laplace Transform: Solution of ordinary differential equations		
2	**Fourier Series**		**10**	**CO2**
	2.1	Introduction: Definition, Dirichlet's conditions, Euler's formulae, Fourier Series of Functions: Exponential, trigonometric functions, even and odd functions, half range sine and cosine series		
	2.2	Complex form of Fourier series		
	2.3	Fourier Integral , Fourier Transform and Inverse Fourier Transform		
3	**Z-Transform**		**06**	**CO3**
	3.1	Z-transform of standard functions		
	3.2	Properties of Z-transform(without proof): Linearity, change of scale, shifting property, Multiplication by K, Initial and Final value, Convolution theorem		
	3.3	Inverse Z- transform: Binomial expansion and Method of Partial fraction		
4	**Vector Differentiation**		**08**	**CO4**
	4.1	Gradient of scalar point function, divergence and curl of vector point function.		
	4.2	Solenoidal and irrotational vector fields.		
		#Self-Learning topic: Scalar and vector product of three and four vectors and their properties.		

Module No.	Unit No.	Details	Hrs.	CO
5	**Vector Integration**		**09**	**CO5**
	5.1	Vector Integral: Line integral, Properties of line integral, Surface integral, Volume integrals.		
	5.2	Green's theorem in a plane (without proof) and related problems		
	5.3	Gauss divergence theorem (without proof), Stokes theorem (without proof) and related problems		
		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.S. Grewal	*Higher Engineering Mathematics*	Khanna Publications, India	43^{rd} Edition, 2014
2.	Erwin Kreyszig	*Advanced Engineering Mathematics*	Wiley Eastern Limited, India	10^{th} Edition, 2015
3.	N.P. Bali and Manish Goyal	*A Textbook of Engineering Mathematics*	Laxmi Publications LTD, India	9^{th} Edition, 2016
4.	P.N. Wartikar and J.N. Wartikar	*A text book of Applied Mathematics Vol I & II*	Pune Vidyarthi-Gruha, India	6^{th} Edition, 2012

Term-Work will consist of Tutorials covering entire syllabus. Students will be graded based on continuous assessment of their term work.
At least 2 tutorials will be conducted with the help of Mathematical and Statistical software in the Laboratory.

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Course Code	Course Title							
116U40C302	Analog Electronic Circuits							
	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 objective of the course is to impart fundamental knowledge and applications of semiconductor devices like BJT and MOSFET. This course aims to build a foundation for DC analysis, biasing circuits of BJT, FET and small signal analysis of mid, low and high frequency range amplifiers using hybrid models. The course imparts knowledge of frequency response of single stage amplifiers. It conveys the concept of different types of feedback used in amplifiers and oscillators. It explains the importance of Differential Amplifiers, current mirrors and its application. Analysis of the MOSFET based circuits provides the necessary foundation for Analog and digital VLSI design.

Course Outcomes:

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

CO 1. Analyze BJT transistor circuits for DC and AC operations
CO 2. Analyze MOSFET circuits for DC and AC operations
CO 3. Learn the dependency of the amplifier gain over the frequency range
CO 4. Understand the concept of feedback and apply it to amplifiers and oscillators
CO 5. Understand the need of Differential Amplifiers

Module No.	Unit No.	Details	Hrs.	CO
1	**Bipolar Junction Transistor (BJT)**		**10**	**CO1**
	1.1	BJT (npn and pnp) construction, Working, input and output characteristics, DC Load Line, Concept of Biasing		
	1.2	DC Analysis of BJT circuits, Basic Transistor Application: Amplifier and as a switch		
	1.3	Basic BJT amplifier configuration, Small signal hybrid pi model of BJT, Small signal mid – frequency analysis of CE, CB and CC BJT amplifiers.		
		#Self learning topic: Stability factor S(Ico) for all BJT biasing circuits		
2	**The Field Effect Transistor**		**10**	**CO2**
	2.1	MOS Field-Effect Transistor: Construction, Working, transfer and output characteristics, Enhancement and Depletion MOSFETs		
	2.2	MOSFET Biasing and DC Circuit Analysis, MOSFET application as Amplifier and Switch		
	2.3	Basic MOSFET amplifier configuration, Small signal model of MOSFET, Small signal mid – frequency analysis of CS,CG and CD MOSFET amplifiers.		
3	**Frequency Response of Single Stage Amplifiers**		**08**	**CO3**
	3.1	**Low frequency Response:** Effect of coupling and bypass capacitor on frequency response of single stage Common Source MOSFET amplifier.		
	3.2	**High frequency Response:** High frequency model of MOSFET, Miller effect and miller capacitance, Unity gain bandwidth f_T and beta-cutoff frequency f_β, high frequency response of single stage MOSFET amplifiers.		

Module No.	Unit No.	Details	Hrs.	CO
4	**Feedback Circuits**		**08**	**CO4**
	4.1	**Negative feedback:** Basic feedback theory, characteristics of negative feedback, Effect of negative feedback with derivation for input impedance, output impedance, gain and bandwidth for the four feedback topologies. (no numerical examples to be included)		
	4.2	**Positive Feedback:** Introduction and classification of oscillators, Barkhausen criterion for sustained oscillations. **Audio frequency oscillators:** Transistorized RC phase shift oscillator and Wein bridge oscillator. (theoretical description only – no analysis or numerical examples to be included) **Radio frequency oscillators:** LC tank circuit, Hartley, Colpitt's and clapp's oscillators,(theoretical description only – no analysis or numerical examples to be included)		
		#Self learning topic: Crystal Oscillator		
5	**Differential Amplifiers**		**09**	**CO5**
	5.1	**Single ended and Differential signaling MOSFET Differential Amplifiers:** Terminology and qualitative description, DC transfers characteristics, differential gain, common mode gain, and CMRR. AC (small signal analysis) and DC analysis of MOSFET differential amplifier		
	5.2	**Current mirrors:** Basic two transistor MOSFET current mirror, Three transistor MOSFET current mirror		
		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 A. Neamen	*Microelectronics: Circuit Analysis and Design*	McGraw Hill, India	4^{th} Edition, 2021
2.	Robert L. Boylestad, Louis Nashelesky	*Electronic Devices and Circuit theory*	Pearson Education, India	11^{th} Edition, 2015
3.	Behzad Razhavi	*Fundamentals of Microelectronics*	Wiley, India	3^{rd} Edition, 2021
4.	S. Salivahanan, N. Suresh Kumar	*Electronic Devices and Circuit*	McGraw Hill, India	4^{th} Edition, 2017
5.	Jacob Millman and C. Halkias	*Millman's Electronic Devices and circuits*	McGraw Hill, India	4^{th} Edition, 2015

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Course Code	Course Title							
116U40C303	Digital 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:

- Number systems to different bases and conversion from one base to another

Course Objectives:

Digital systems have a prominent role in everyday life. To understand the operation of digital systems, it is necessary to have a basic knowledge of digital circuits and their logical functions. The objective of this course is to familiarize the student with fundamental principles of digital design. It provides coverage of classical hardware design for both combinational and sequential logic circuits

Course Outcomes:

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

CO 1. Use different techniques of minimization for combinational logic design
CO 2. Design combinational logic circuits using MSI devices
CO 3. Design sequential circuits using MSI devices
CO 4. Analyze and design synchronous sequential circuits using flip flops
CO 5. Understand characteristics of different logic families and semiconductor Devices

Module No.	Unit No.	Details	Hrs.	CO
1	**Fundamentals of Digital Design**		**10**	**CO1**
	1.1	Review of basic gates, Universal gates, Minimization of logical expressions with Boolean Algebra		
	1.2	Review of Number system and coding techniques.		
	1.3	Combinational logic representation using truth table, sum of products(SOP) and products of sum(POS), Minimization of logical expressions with Karnaugh Map (up to five variables) and realization.		
	1.4	Quine McCluskey Method for minimization		
2	**Combinational Logic Circuits**		**10**	**CO2**
	2.1	Design of different combinational circuits, Adder, subtractor, controlled adder/ subtractor, BCD adder/subtractor, Use of MSI devices		
	2.2	Multiplexer, demultiplexer, decoder, encoder, comparator, multiplexer tree and decoder tree. Use of MSI devices		
	2.3	Introduction, realization of logic expressions with PROM, PLA and PAL.		
		#Self Learning Topic: Carry Look ahead adder		
3	**Sequential Logic Design**		**09**	**CO3**
	3.1	Latches and flip flops		
	3.2	Asynchronous counters, synchronous counter, up/down counter, mod counter, shift register		
	3.3	Design using MSI counters and shift register		
4	**Finite State Machines Design**		**10**	**CO4**
	4.1	Mealy and Moore Machines, Clocked synchronous state machine analysis		
	4.2	Development of state diagram, State reduction techniques and state assignment, Clocked synchronous state machine design.		
	4.3	Design applications like sequence detectors, vending machines		

Module No.	Unit No.	Details	Hrs.	CO
5	**Logic Families and Programmable Devices**		**06**	**CO5**
	5.1	Introduction to CPLD and FPGA architectures.		
	5.2	Introduction to HDL		
		#Self Learning Topic: Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in)		
		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.	Morris Mano and Michael D. Ciletti	*Digital Design: With an Introduction to Verilog HDL*	Pearson Education, India	5^{th} Edition, 2013
2.	R.P.Jain	*Modern Digital Electronics*	McGraw Hill Education, India	4^{th} Edition, 2015
3.	John M Yarbrough	*Digital logic: Applications and design*	Thomson Brooks/ Cole, India	Second Indian Reprint,2007
4.	A.P. Malvino and D.P.Leach	*Digital Principles and Applications*	McGraw Hill Education, India	10^{th} Edition, 2015

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Course Code	Course Title							
116U40C304	Data Structures							
	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:

- Any Programming language

Course Objectives:

The objective of this course is to introduce different types of data structure and how data structures can be used in software development. The course is designed to develop skills to implement and analyze simple linear and nonlinear data structures. The course enables students to gain knowledge about practical applications of data structures. It also strengthens the ability of the students to identify and apply the suitable data structure for the given real world problem.

Course Outcomes:

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

CO 1. Understand and implement the different data structures used in problem solving
CO 2. Apply linear and non-linear data structure in application development
CO 3. Explain concepts of advanced data structures like set, map dictionary
CO 4. Demonstrate sorting and searching methods

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction**		**02**	**CO1**
	1.1	**Introduction to Data Structures** Types of Data Structures, ADT (Abstract data type)		
2	**Linear Data Structure**		**18**	**CO1 CO2**
	2.1	**Linked List:** Introduction, Representation of Linked List, Linked List vs Array, Implementation of Linked List, Circular Linked List, Doubly Linked List, Application – Polynomial Representation and Addition, other additional applications/Case study		
	2.2	**Stack**: The Stack as an ADT, Stack operations, Array Representation of Stack, Linked Representation of Stack, Application of stack –Recursion and evaluation of postfix and prefix expressions, Case study		
	2.3	**Queues:** The Queue as an ADT, Queue operation, Array Representation of Queue, Linked Representation of Queue, Circular Queue, Priority Queue, Double ended queue, Application of Queues –Application of queue in Josephus Problem, Other applications, Case study.		
		#Self learning Topic: Sparse Matrix Addition		
3	**Non-Linear Data Structures: Trees, Graph**		**10**	**CO2**
	3.1	Trees: Basic trees concept, Binary tree representation, Binary tree operation, Binary tree traversal, Binary search tree implementation, Threaded binary trees. Different Search Trees -AVL tree, Multiway Search Tree, B Tree, B+ Tree and Tree, Applications,Case study of trees.		
	3.2	Graph - Introduction, Graph Terminologies, Representation, Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS). Applications/Case study of Graphs.		
		#Self learning topic: Red-Black Trees		

Module No.	Unit No.	Details	Hrs.	CO
4	**Non-Linear Data Structures: Map, Dictionary**		**07**	**CO3**
	4.1	**Set:** Set ADT, Set Implementation, Partitions with Union-Find operations, Tree based partition implementation. **Map:** Map ADT, Implementation, Hash Tables Application of Maps **Dictionary:** Dictionary ADT, Implementation, Application of Dictionaries		
		#Self-learning topic: Application of Dictionaries, Exploring case studies on use of map and dictionary		
5	**Searching and Sorting**		**08**	**CO4**
	5.1	**Sorting:** Introduction to Sorting, Bubble Sort, Insertion Sort, Selection Sort, Merge Sort, Shell Sort, Counting Sort		
	5.2	**Searching:** Search concept, Linear Search, Binary Search, Hashed List Search, Comparison of searching Techniques		
		#Self-learning topic: Application of Dictionaries, Exploring case studies on use of map and dictionary		
		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.	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed	*Fundamentals Of Data Structures In C*	University Press, India	2^{nd} Edition, 2012
2.	Richard F. Gilberg & Behrouz A. Forouzan	*Data Structures A Pseudocode Approach with C*	CENGAGE Learning, India	2^{nd} Edition, 2004
3.	Reema Thareja	*Data Structure and Algorithm*	Oxford University Press, India	2^{nd} Edition, 2011
4.	Jean Paul Tremblay, Paul G. Sorenson	*An introduction to data structures with applications*	McGraw Hill Education, India	2^{nd} Edition, 2017
5.	Aaron M Tanenbaum, Yedidyah Langsam and Moshe J Augentstein	*Data structure Using C*	Pearson Education, India	12^{th} Impression, 2013
6.	Michael T Goodrich, Roberto Tamassia, David Mount	*Data Structure and Algorithm in C++*	Wiley, India	1^{st} Edition, 2011

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Course Code	Course Title							
116U40C305	Networks, Signals and Systems							
	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 (116U06C107)
- Partial fraction expansion, matrices, Laplace transforms, and differential equations

Course Objectives:

This course is an introduction to the fundamental concepts and techniques of signals and systems in the continuous time domain. It will also help the students to understand Electrical Networks and find their applications in various allied disciplines of Electronics and Computer Engineering.

Course Outcomes:

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

CO 1. Analyze DC and AC circuits using mesh, nodal analysis, and network theorems.
CO 2. Analyze transient and steady-state response using Laplace Transform
CO 3. Determine two-port network parameters
CO 4. Understand operations of continuous signals and systems
CO 5. Apply Fourier series and transform for spectral analysis

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to Network Elements and Sources**		**10**	**CO1**
	1.1	Introduction to Linearity and Nonlinearity, Distributed & Lumped Parameters 2-port Networks		
	1.2	Network analysis (AC and DC) using dependent Sources: Mesh and Nodal analysis, Superposition, Thevenin's, Norton's and Max power transfer theorems.		
	1.3	Introduction to Graph Theory, Cut set, Tie set matrix, Principle of Duality		
		#Self learning topic: Millman's and Tellegan's theorem		
2	**Transient response of R-L, R-C, R-L-C circuits (Series and Parallel combination)**		**12**	**CO2**
	2.1	One-sided and two-sided Laplace Transform and Inverse Laplace Transform. Definition, Concept of Region of Convergence (ROC), BIBO stability and pole-zero diagrams, the Impulse response of a system.		
	2.2	Test inputs for transient response: step, impulse, and ramp input, Initial conditions, Solution based on time domain analysis and Laplace Transform		
3	**Two port networks Z, Y. ABCD and Hybrid Parameters**		**06**	**CO3**
	3.1	Driving point and transfer function, Concept of reciprocity and symmetry		
	3.2	Two-port network parameters and their interrelation		
	3.3	Interconnection of two-port networks		
		#Self learning topic: Inverse transmission and Inverse Hybrid Parameters.		
4	**Introduction to CT signals and systems**		**10**	**CO4**
	4.1	Definition of basic signal: Elementary Continuous Time (CT) signals, Operations on a signal like shifting, flipping, scaling, addition, multiplication. Signal classification, Decomposition of a signal in different basic components		
	4.2	Concept of system, Classification of systems with stability, Convolution and correlation in CT, Concept of Impulse Response,Convolution integral and system response and its properties, correlation and its properties.		

Module No.	Unit No.	Details	Hrs.	CO
5	**Fourier Transform**		**07**	**CO5**
	5.1	Fourier series: Properties and uses, Single sided double sided Spectra. Amplitude & phase spectra, Power Spectral Density, Parseval's relation, Gibbs Phenomenon.		
	5.2	Fourier transform: The Fourier Transform (FT) of basic signals, Energy and Power Spectral Density.		
		#Self-learning topic: Trigonometric series, Exponential series		
		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. K. Alexander and M. N. O. Sadiku	*Fundamental of Electric Circuits*	McGraw Hill Education , India	8^{th} Edition, 2021
2.	D. Roy Choudhury	*Networks and Systems*	New Age Publication , India	2^{nd} Edition, 2018
3.	J.G. Proakis, D. G. Manolakis	*Digital Signal Processing: Principles, Algorithms and Applications*	Pearson Education, India	4^{th} Edition, 2020
4.	Ashok Ambardar	*Analog and Digital Signal Processing*	Thomson Learning, India	2^{nd} Edition, 2019

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Course Code	Course Title							
116U40L301	Object Oriented Programming Laboratory							
	TH			P		TUT		Total
Teaching Scheme (Hrs.)	–			02		02		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 one test of 25 marks

Course prerequisites:

- Programming in C(111U06L101)
- Python Programming(116U06L108)

Course Objectives:

The objective of this course is to familiarize the student with concepts and features of Object Oriented Programming. The student will be able to develop programs and applications using Java.

Course Outcomes:

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

CO 1. Understand concepts of Object Oriented Programming and basic characteristics of Java.
CO 2. Understand the principles of packages, inheritance and interfaces.
CO 3. Define exceptions and use I/O streams.
CO 4. Develop a Java application with threads and generics classes.
CO 5. Design and build simple Graphical User Interfaces.

Module No.	Unit No.	Details	Lab	Tut	CO
1	**Introduction to OOP and JAVA fundamentals**		**06**	**06**	**CO1**
	1.1	Object Oriented Programming, Abstraction, objects and classes, Encapsulation, Inheritance, Polymorphism			
	1.2	OOP in Java, Characteristics of Java, The Java Environment, Java Source File Structure, Compilation			
	1.3	Fundamental Programming Structures in Java, Defining classes in Java, constructors, methods, access specifiers, static members			
	1.4	Comments, Data Types, Variables, Operators, Control Flow, Arrays, Packages, JavaDoc comments			
2	**Inheritance and interfaces**		**06**	**06**	**CO2**
	2.1	Inheritance, Super classes, sub classes, Protected members, constructors in sub classes, the Object class, abstract classes and methods, final methods and classes			
	2.2	Interfaces, defining an interface, implementing interface, differences between classes and interfaces and extending interfaces, Object cloning, inner classes, Array Lists, Strings			
3	**Exception handling and I/O**		**08**	**08**	**CO3**
	3.1	Exceptions, exception hierarchy, throwing and catching exceptions, built-in exceptions, creating own exceptions, Stack Trace Elements			
	3.2	Input / Output Basics, Streams, Byte streams and Character streams, Reading and Writing Console, Reading and Writing Files			

Module No.	Unit No.	Details	Lab	Tut	CO
4	**Multithreading and generic programming**		**04**	**04**	**CO4**
	4.1	Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups.			
	4.2	Generic Programming, Generic classes, generic methods, Bounded Types, Restrictions and Limitations.			
5	**Event driven programming**		**06**	**06**	**CO5**
	5.1	Graphics programming, Frame, Components, working with 2D shapes, Using color, fonts, and images			
	5.2	Basics of event handling, event handlers, adapter classes, actions, mouse events, AWT event hierarchy			
	5.3	Introduction to Swing, layout management, Swing Components, Text Fields, Text Areas, Buttons, Check Boxes, Radio Buttons, Lists-choices- Scrollbars, Windows, Menus, Dialog Boxes.			
		Total	**30**	**30**	

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	Herbert Schildt	*JAVA The Complete Reference*	McGraw Hill Education, India	11^{th} Edition, 2020
2.	Cay Horstmann	*Core Java Volume - I Fundamentals: 1 (Core Series)*	Pearson Education, India	11^{th} Edition, 2020
3.	Cay Horstmann	*Core Java Volume - II Advanced Features*	Pearson Education, India	11^{th} Edition, 2020
4.	Herbert Schildt	*Java A Beginner's Guide*	McGraw Hill Education, India	8^{th} Edition, 2020
5.	Sachin Malhotra,Saurabh Chaudhary	*Programming in JAVA*	Oxford University, India	Revised 2^{nd} Edition, 2018
6.	E Balagurusamy	*Programming with JAVA*	McGraw Hill Education, India	6^{th} Edition, 2019

Course Code	Course Title							
116U40L302	Analog Electronic Circuits 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 Electronic Circuits" (116U40C302). 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.

Course Code	Course Title							
116U40L303	Digital Electronics 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 Electronics" (116U40C303). 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.

Course Code	Course Title							
116U40L304	Data Structures 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 "Data Structures" (116U40C304). 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.

Course Code	Course Title							
116U40L305	Networks, Signals & Systems 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 "Networks, Signals and Systems" (116U40C305). 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.

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Course Code	Course Title							
116U40C401	Complex Analysis, Statistics and Optimization Techniques							
	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:

- Basics of Statistics and Probability
- Introductory Linear programming problems
- Applied Mathematics-I

Course Objectives:

This course exposes students to the concepts of Correlation, Regression for given bivariate data. Students are made familiar with different discrete and continuous probability distributions. The course acquaints students with concepts of Large sample test, Small sample test and Chi–Square test. The course familiarizes students with different methods of solving Linear and Non Linear Programming problems. The course explains analytic functions and the method of evaluating line integrals using Cauchy integral theorem and Cauchy integral formula. The course explains how to write a function of complex variable in terms of Taylors and Laurent's series.

Course Outcomes:

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

CO 1. Apply concepts of correlation, regression for given bivariate data
CO 2. Apply concepts of Binomial, Poisson, Exponential and Normal distribution to solve Engineering problems
CO 3. Apply Large sample test and small sample test to analyze collected data
CO 4. Apply concepts of Linear and Nonlinear programming methods to solve problems
CO 5. Apply the concept of analytic functions in evaluation of complex integrals and expansion of Taylors and Laurents series

Module No.	Unit No.	Details	Hrs.	CO
1	**Correlation and Regression**		**06**	**CO1**
	1.1	Correlation, Co-variance, Karl Pearson Coefficient of Correlation & Spearman's Rank Correlation Coefficient		
	1.2	Regression Coefficients , lines of regression & logistic regression		
2	**Probability and Probability Distribution**		**12**	**CO2**
	2.1	Conditional Probability, Bayes' theorem, Joint Probability		
	2.2	Discrete and Continuous Probability Distribution		
	2.3	Binomial Distribution, Poisson Distribution		
	2.4	Continuous Uniform Distribution, Normal Distribution, Exponential Distribution		
		#Self-Learning topic: Addition and multiplication rules of probability		
3	**Sampling Theory**		**07**	**CO3**
	3.1	Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small samples.		
	3.2	Difference between sample mean and population means for large samples, Test for significance of the difference between the means of two large samples.		
	3.3	Student's t-distribution: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test.		
	3.4	Chi-square distribution as a Test of Independence, Test of the Goodness of fit and Yate's correction.		

Module No.	Unit No.	Details	Hrs.	CO
4	**Optimization Techniques**		**13**	**CO4**
	4.1	Types of solution, Standard and Canonical form of LPP, Basic and feasible solutions, simplex method.		
	4.2	Artificial variables, Big –M method (method of penalty).		
	4.3	Duality		
	4.4	Unconstrained optimization, problems of two variables with one equality constraint using Lagrange's Multiplier method.		
	4.5	Problems of two variables with one inequality constraint using Kuhn-Tucker conditions		
5	**Complex Differentiation and Integration**		**07**	**CO5**
	5.1	Analytic Function: Necessary and sufficient conditions (only statement), Cauchy Reimann equations in polar form, Harmonic function, orthogonal trajectories		
	5.2	Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula (Only Statement)		
	5.3	Taylor's and Laurent's series (Only Statement)		
		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.S. Grewal	*Higher Engineering Mathematics*	Khanna Publications, India	43^{rd} Edition, 2014
2.	Erwin Kreyszig	*Advanced Engineering Mathematics*	Wiley Eastern Limited, India	10^{th} Edition, 2015
3.	J. K. Sharma	*Operation Research: Theory and Applications*	Laxmi Publications LTD, India	6^{th} Edition, 2017
4.	S.C.Gupta and V.K.Kapoor	*Fundamentals of Mathematical Statistics*	Sultan Chand & Sons, India	11^{th} Edition, 2009
5.	Ronald E.Walipole, Raymond H.Myers	*Probabilities & Statistics for Engineers & Scientists*	Pearson Education, India	9^{th} Edition, 2010
6.	P.N. Wartikar and J.N. Wartikar	*A text book of Applied Mathematics Vol I & II*	Pune Vidyarthi-Gruha, India	6^{th} Edition, 2012

Term-Work will consist of Tutorials covering entire syllabus. Students will be graded based on continuous assessment of their term work.
At least 2 tutorials will be conducted with the help of Mathematical and Statistical software in the Laboratory.

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Course Code	Course Title							
116U40C402	Analog and Digital Communication							
	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 Electronic Circuits

Course Objectives:

The objective of the course is to introduce basic principles and techniques used in analog and digital communication systems. The course includes analog and digital communication systems such as modulation, demodulation, transmitter and receiver. The course also introduces analytical techniques to evaluate the performance of communication systems in time and frequency domains.

Course Outcomes:

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

CO 1. Understand various amplitude modulation techniques
CO 2. Learn frequency and phase modulation and demodulation techniques
CO 3. Understand the working principle of radio receivers
CO 4. Learn and describe Pulse code modulation and demodulation
CO 5. Understand and analyze various digital modulation and demodulation technique

Module No.	Unit No.	Details	Hrs.	CO
1	**Amplitude Modulation and Demodulation**		**10**	**CO1**
	1.1	Basic block diagram of communication system, types, concept of modulation and demodulation. Amplitude Modulation (AM) waveform, mathematical representation, spectrum, modulation index, and bandwidth. Demodulation: practical diode detector		
	1.2	**DSB-SC system:** Balanced modulator, Ring modulator, Demodulation: Coherent Detector, Product detector		
	1.3	**SSB system:** Filter method, Phase shift method, and Third method, concept of pilot carrier SSB, Demodulation, Coherent detector, envelope detector; Concept of VSB and ISB.		
		#Self-Learning topic: Introduction to Noise and noise parameters like noise figure, factor, gain and properties of white noise.		
2	**Angle Modulation and Demodulation**		**12**	**CO2**
	2.1	Angle Modulation: waveform, mathematical representation, modulation index, frequency and phase deviation, spectrum, bandwidth, Narrow Band FM, Wide Band FM.		
	2.2	FM system: FET reactance modulator, Armstrong's method, Noise triangle in FM, pre-emphasis and de-emphasis		
	2.3	FM Demodulation: Foster-Seeley discriminator, Ratio detector, comparison between AM, FM and PM		
3	**Radio Receivers**		**05**	**CO3**
	3.1	Limitations of TRF receiver, Super-heterodyne receiver, characteristics, choice of intermediate frequency, image frequency		
	3.2	Receivers: AM, FM. Concept of AGC and AFC		

Module No.	Unit No.	Details	Hrs.	CO
4	**Pulse Modulation and Demodulation**		**08**	**CO4**
	4.1	Sampling theorem for low pass signals(no derivations), PAM, PWM and PPM systems and applications		
	4.2	PCM: transmitter and receiver; noise considerations in PCM.		
	4.3	DPCM: transmitter and receiver; noise considerations in DPCM, Adaptive delta modulation.		
5	**Digital Modulation Techniques**		**10**	**CO5**
	5.1	Concept of binary modulation techniques: BPSK, DPSK, DEPSK, BFSK, BASK		
	5.2	M-ary modulation techniques: QPSK , concept of M-ary PSK, M-ary FSK, QAM,MSK and GMSK		
	5.3	Inter symbol interference, SNR and BER, Properties of white Gaussian noise, Matched filter receiver.		
		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.P. Lathi, Zhi Ding	*Modern Digital and Analog Communication System*	Oxford University Press, India	4^{th} Edition, 2017
2.	Herbert Taub,Donald Schilling, Goutam Saha	*Principles of Communication Systems*	McGraw-Hill Electrical and Electronic Engineering Series, India	4^{th} Edition, 2017
3.	Wayne Tomasi	*Electronics Communication Systems*	Pearson Education, India	5^{th} Edition, 2008
4.	Ronald E.Walipole, Raymond H.Myers	*Communication systems Analog and Digital*	McGraw Hill Education, India	2^{nd} Edition, 2017
5.	Gorge Kennedy, Bernard Davis, SRM Prasanna	*Electronic Systems*	McGraw Hill Education, India	6^{th} Edition, 2017
6.	Bernad Sklar	*Digital Communications*	Pearson Education, India	4^{th} Edition, 2012

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Course Code	Course Title							
116U40C403	Analysis of Algorithms							
	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:

- Data Structures

Course Objectives:

The course aims to teach various techniques for practical problem-solving in computing. The different algorithm paradigms for problem-solving will be used to illustrate efficient problem-solving methods. The analysis of the algorithm will be demonstrated to show its efficiency of the algorithm. The complexity theory of the problems is introduced to students for further study of algorithms.

Course Outcomes:

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

CO 1. Analyze the asymptotic running time and space complexity of algorithms
CO 2. Describe various algorithm design strategies to solve different problems
CO 3. Develop string matching techniques
CO 4. Describe the classes P, NP, and NP-Complete

Module No.	Unit No.	Details	Hrs.	CO
1	**Introduction to analysis of algorithm**		**05**	**CO1**
	1.1	Performance analysis, space and time complexity, Growth of function-Big-Oh; Omega; Theta Notation, Analysis of insertion sort		
	1.2	Solving Recurrence Problems by Substitution Method, Recursion Tree Method, Masters Method		
		#Self-Learning topic: Introduction to randomized algorithm.		
2	**Algorithm Design Techniques**		**30**	**CO2**
	2.1	**Divide and Conquer Technique** General method, Finding minimum and maximum algorithm and analysis, Analysis of Merge sort and Quick sort		
	2.2	**Greedy Technique** General method, Knapsack problem, Minimum cost spanning trees-Kruskal's and Prims algorithm, Single source shortest path		
	2.3	**Dynamic Programming Technique** General method, Multistage graphs, 0/1 knapsack, Traveling salesman problem, Single source shortest path, All pairs shortest path, Matrix chain multiplication		
	2.4	**Backtracking Technique** General method, Sum of subsets, N queens problem, Graph coloring		
	2.5	**Branch and Bound** General method, 0/1 Knapsack		
3	**String Matching Algorithms**		**05**	**CO3**
	3.1	The naïve string-matching Algorithms, String matching with finite automata		
	3.2	The Knuth-Morris-Pratt algorithm		
	3.3	Longest common subsequence		

Module No.	Unit No.	Details	Hrs.	CO
4	**Non-deterministic Polynomial Algorithms**		**05**	**CO4**
	4.1	Polynomial-time, Polynomial-time verification, NP-Completeness, and reducibility		
	4.2	NP-Completeness proof: Vertex Cover Problem, Clique Problem		
		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.	T. H. Coreman, C.E.Leiserson, R.L. Rivest, and C. Stein	*Introduction to Algorithms*	PHI Learning Pvt. Ltd. (Originally MIT Press), India	3^{rd} Edition, 2010
2.	Ellis Horowitz, Sartaj Sahni, S. Rajsekaran	*Fundamentals of Computer Algorithms*	University Press, India	2^{nd} Edition, 2008
3.	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman	*Data Structures and Algorithm*	Pearson Education, India	4^{th} Impression, 2009
4.	Michael Gooddrich & Roberto Tammassia	*Algorithm Design Foundation, Analysis and Internet Examples*	Wiley Student Edition, India	Student Edition, 2006

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Course Code	Course Title						
116U40C404	Database Management Systems						
	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:

- Nil

Course Objectives:

The objective of this course is to impart knowledge of database management system and its use in enterprise business and enable students to perform entity-relationship modeling and relational database design. Student will learn and use Structured Query Language (SQL). The course gives knowledge of applying normalization techniques to the database. Along with it, students are also introduced to the concept of transaction and query processing.

Course Outcomes:

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

CO 1. Understand the features of Relational database management systems
CO 2. Apply data models to real world scenario
CO 3. Apply the concept of data models to relational database design
CO 4. Illustrate the concept of security, Query processing, indexing and Normalization for Relational database
CO 5. Apply the concept of transaction, concurrency control and recovery techniques

Module No.	Unit No.	Details	Hrs.	CO
1	**Database concepts and Systems**		**06**	**CO1**
	1.1	Introduction- Purpose of Database Systems, DBMS system architecture, Data Models, Data Independence		
	1.2	Database languages, Database Users and Administrator		
	1.3	Different types of Database Systems		
2	**Database Models and SQL**		**12**	**CO2**
	2.1	Database design phases, E-R Model		
	2.2	Constraints, E-R Diagrams, E-R design issues		
	2.3	Entity set, Extended E-R features		
	2.4	Relational model concepts, Constraints		
	2.5	Relational Algebra: Unary, Binary and Set theory relational operations		
	2.6	Data definition commands, attribute constraints, SET operations, Aggregate functions, Null Values, Nested sub queries, complex queries, Views Data control commands		
	2.7	Data manipulation commands: Insert, Update, Joined relations		
	2.8	Integrity and security: Domain constraints, Referential integrity, Triggers; Security and Authorization in SQL		
3	**Relational Database Design**		**10**	**CO3**
	3.1	Design guidelines for relational schemas, Functional dependencies		
	3.2	First Normal form, Second Normal form, Third normal form.		
	3.3	Decomposition using functional dependencies, Boyce Codd normal form; decomposition using multivalued dependencies, fourth normal form.		
	3.4	The database design and implementation process		

Module No.	Unit No.	Details	Hrs.	CO
4	**Indexing, Hashing , Query processing and Optimization**		**10**	**CO4**
	4.1	Basic concepts, ordered indices: dense and sparse, multilevel indices, secondary indices		
	4.2	Hashing: Static hashing, dynamic hashing, comparison of ordered indexing and hashing		
	4.3	Query processing: Steps involved in query processing, measures of query cost, algorithms for SELECT and PROJECT operations.		
	4.4	Optimization: Overview, Transformation of relational expressions, Estimating statistics, Choice of evaluation plan		
5	**Transactions, Concurrency control and Recovery system**		**07**	**CO5**
	5.1	Transaction Concepts, Transaction state, ACID properties, concurrent executions, Serializability, Recoverability		
	5.2	Concurrency control: Lock based , Timestamp based, validation based protocol, Deadlock Handling		
	5.3	Recovery system: Failure classification, Recovery and Atomicity, Log based recovery, Shadow paging		
		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.	Elmasri and Navathe	*Fundamentals of Database Systems*	Pearson Education, India	7^{th} Edition, 2019
2.	Korth, Slberchatz,Sudarshan	*Database System Concepts*	McGraw Hill Education, India	7^{th} Edition, 2018
3.	Raghu Ramakrishnan and Johannes Gehrke	*Database Management Systems*	McGraw Hill Education, India	3^{rd} Edition, 2017
4.	C.J Date	*Introduction to Database Systems*	Pearson Education, India	8^{th} Edition, 2018

Somaiya Vidyavihar University
K.J. Somaiya College of Engineering
(A Constituent College of Somaiya Vidyavihar University)

Course Code	Course Title							
116U40C405	Discrete Mathematics							
	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:

- Basic Mathematics

Course Objectives:

The objective of this course is to enable students to think logically and mathematically. It will help them to solve the problems with mathematical reasoning, algorithmic thinking, and modeling.

Course Outcomes:

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

CO 1. Use various mathematical notations, apply various proof techniques to solve real-world problems
CO 2. Learn and apply core ideas of Set Theory, Relations Functions
CO 3. Use graphs and their types, to solve the practical examples
CO 4. Understand the use of Algebraic Structures and lattice, to solve the problems

Module No.	Unit No.	Details	Hrs.	CO
1	**Set Theory**		**03**	**CO1**
	1.1	Sets, Venn diagrams, Operations on Sets		
	1.2	Laws of set theory, Power set and Products		
	1.3	Partitions of sets, The Principle of Inclusion and Exclusion		
2	**Logic**		**04**	**CO1**
	2.1	Propositions and logical operations, Truth tables		
	2.2	Equivalence, Implications		
	2.3	Laws of logic, Normal Forms		
	2.4	Predicates and Quantifiers		
	2.5	Mathematical Induction		
3	**Relations, Digraphs**		**09**	**CO2**
	3.1	Relations, Paths and Digraphs		
	3.2	Properties and types of binary relations		
	3.3	Manipulation of relations, Closures, Warshall's algorithm		
	3.4	Equivalence relationss		
4	**Posets and Lattice**		**09**	**CO3**
	4.1	Partial ordered relations (Posets) ,Hasse diagram		
	4.2	Lattice, sublattice		
	4.3	Types of Lattice ,Boolean Algebra.		
5	**Functions and Pigeon Hole Principle**		**03**	**CO3**
	5.1	Definition and types of functions: Injective, Surjective and Bijective		
	5.2	Composition, Identity and Inverse		
	5.3	Pigeon-hole principle, Extended Pigeon-hole principle		
6	**Graphs and Subgraphs**		**04**	**CO4**
	6.1	Definitions, Paths and circuits, Types of Graphs , Eulerian and Hamiltonian		
	6.2	Planer graphs		
	6.3	Isomorphism of graphs		
	6.4	Subgraph		

Module No.	Unit No.	Details	Hrs.	CO
7	**Algebraic Structures**		**13**	**CO4**
	7.1	Algebraic structures with one binary operation: semi-group, monoids and groups		
	7.2	Cyclic groups, Normal subgroups		
	7.3	Hamming Code ,Minimum Distance		
	7.4	Group codes ,encoding-decoding techniques		
	7.5	Parity check Matrix ,Maximum Likelihood		
		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.	Kenneth H. RosenKenneth H. Rosen	*Discrete Mathematics and its applications*	McGraw Hill Education, India	6^{th} Edition, 2017
2.	Bernard Kolman, Robert C. Busby	*Discrete Mathematical Structures*	Pearson Education, India	6^{th} Edition, 2017
3.	C. L. Liu, D. P. Mohapatra	*Elements of Discrete Mathematics West*	McGraw Hill Education, India	4^{th} Edition, 2012
4.	Douglas West	*Graph Theory*	Pearson Education, India	2^{nd} Edition, 2017

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Course Code	Course Title							
116U40L401	Microprocessors and Microcontrollers Laboratory							
	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						
	–	–	–	50*	–	–	25	75

*Term work based on laboratory performance of 25 marks and one test of 25 marks

Course prerequisites:

- Programming in C (116U06L101)
- Digital Electronics (116U40C303)

Course Objectives:

- To provide practical exposure and impart knowledge to the students on microprocessors, 80x86 family.
- To give the knowledge and practical exposure on interfacing devices with 8051 like LED displays, Keyboards, DAC/ADC, and various other devices

Course Outcomes:

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

CO 1. Explain basic operation of 8086 microprocessor system and its architectural features
CO 2. Develop 8086 based assembly language programs
CO 3. Understand the internal design of 8051 microcontrollers along with its features
CO 4. Build applications using 8051 and various I/O devices

Module No.	Unit No.	Details	Th	Lab	CO
1	**Introduction to Intel 8086 Microprocessors**		**03**	**00**	**CO1**
	1.1	Basic functions of the microprocessor, Programmer's model of 8086 microprocessor, 8086 CPU architecture and the pipelined operation, memory segmentation, Advanced features of 8086 processor			
		#Self-Learning topic: Read and Write Timing diagrams of 8086 microprocessor			
2	**Intel 8086 Microprocessor Programming**		**03**	**12**	**CO2**
	2.1	Programming 8086 microprocessor in assembly language. Study of assembler directives and procedures. Programs based on String Instructions			
		#Self-Learning topic: Stack and stack related instructions			
3	**Introduction to Microcontroller and its Features**		**03**	**00**	**CO3**
	3.1	Overview of microcontrollers,Architectural features and its purpose, Internal memory organization, Study of on chip peripherals like IO Ports, timers, interrupts, serialcommunication, Concept of PWM			

Module No.	Unit No.	Details	Th	Lab	CO
4	**Microcontroller Hardware and Software Applications using 8051**		**06**	**18**	**CO4**
	4.1	Introduction to Embedded C Programming, Programming of on-chip peripherals like timers, interrupts, serial port of 8051			
	4.2	Interfacing various off-chip peripherals with 8051 like LEDs, solid state switches, 7-segment displays, HEX key-pad, relays, LCD, speed control of DC motor using PWM, speed & direction control of stepper motor, ADC and DAC interface with microcontroller 8051			
		Total	**15**	**30**	

List of Programs:

1. Programs for 16 bit arithmetic operations for 8086 (using various addressing modes)
2. Programs for sorting an array for 8086
3. Program for searching for a number or character in a string for 8086
4. Program for string manipulations for 8086
5. Program for Arithmetic shifting operations
6. Program for shift, rotate, and palindrome verification operation
7. Program for verify Fibonacci series
8. Generation of symmetrical/asymmetrical square waves using a timer
9. Serial communication with PCs
10. Interfacing of switch controlled LED with 8051
11. Interfacing of Keypad and LCD with 8051
12. Interfacing of seven segment display with 8051
13. Interfacing of DC motor with
14. Interfacing of stepper motor with 8051
15. Interfacing ADC to 8051
16. Interfacing DAC to 8051

Recommended Books:

S.No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of publication
1.	John Uffenbeck	*8086/8088 family: Design Programming and Interfacing*	Prentice Hall of India, India	3^{rd} Edition, 2007
2.	Douglas Hall	*Microprocessor and Interfacing*	McGraw Hill Education, India	3^{rd} Edition, 2017
3.	Kenneth Ayala	*The 8051 Microcontroller Architecture, Programming and Applications*	Delmar Cengage Learning, India	3^{rd} Edition, 2012
4.	Mazidi and Mazidi	*The 8051 Microcontrollers & Embedded Systems*	Pearson International, India	2^{nd} Edition, 2012

Course Code	Course Title							
116U40L402	Analog and Digital Communication 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 and Digital Communication" (116U40C402). 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.

Course Code	Course Title							
116U40L403	Analysis of Algorithms 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 "Analysis of Algorithms" (116U40C403). 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.

Course Code	Course Title							
116U40L404	Database Management Systems 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 "Analysis of Algorithms" (116U40C403). 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.