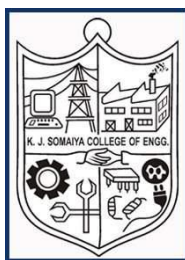# Syllabus

B. Tech Information Technology

(Second Year Semester III and IV)

From

Academic Year 2021-22

(Revision-1)

Approved by FOET 08/05/2021 and AC 28/06/2021

SY B. Tech IT Revision 1.0

It is notified for information of all concerned that the Board of Studies at its meeting held on May 03,2021, and the subsequent meeting of Faculty of Engineering & Technology held on May 08, 2021 and the Academic Council held on June 28, 2021 amended the syllabus of SY B. Tech IT and same be brought in to force from Academic Year 2021-22 with immediate effect.

Preamble

Technology is an integral part of everyday life. An Engineering education in Information Technology gives broad exposure to various technical subjects that develop skills that are transferable to most industries such as problem solving, decision making, innovation, project management, team working and communication which will contribute to a rapidly changing technological environment.

Academic Autonomy conferred by the University of Mumbai from the Academic Year 2014-15, gave us the freedom to develop and implement our own curriculum KJSCE2014 with features such as inclusion of choice based Interdisciplinary Course (IDC), Audit Courses, Add on Credit Courses, Add on Audit Courses, Exposure Courses, etc. Our revision in syllabus KJSCE2018, was introduced from the academic year 2018-19, has been designed based on the revised AICTE guidelines as well as various accrediting bodies. Some of the highlights of the KJSCE2018 syllabus are: more focus on hands on, wide choice for branch specific electives, more number of open or interdisciplinary electives, streamlined courses based on thrust areas, increased opportunity for internships, etc. Laboratory courses like Programming labs will enhance the practical skills of the students.

With the formulation of Somaiya Vidyavihar University, the curriculum of SVU 2020 started from the academic year 2020-2021. Some of the highlights are introduction of Minor degree, Honor degree. More option for programming Laboratory courses including a course of Competitive Programming laboratories to prepare the students better in terms of programming skills.

We at IT department of KJSCE endeavor continuously to enable our students to move forward and confidently embrace change rather than follow; to innovate rather than stagnate and to initiate rather respond to become efficient technocrats and dynamic entrepreneurs.

Dr. Irfan Siddavatam

Head, Department of Information Technology

Vision

To become a center of excellence for holistic education by preparing world class professionals in the dynamic field of Information Technology.

Mission

Providing quality education to

- Develop competent IT professionals with ethical values and enable them in lifelong learning.

- Promote conducive ambience for research and creativity.

Program Educational Objectives (PEO)

A graduate of Information Technology will

PEO1: Excel in professional career and contribute to social needs through Information Technology

PEO2: Pursue higher education, conduct research, demonstrate professionalism and ethics

PEO3: Exhibit innovation, adaptability, team work, leadership and communication skills

Program Outcomes (PO):

Engineering Graduates will be able to:

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

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

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

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

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

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

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

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

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

Program Specific Outcomes

PSO 1: Articulate, design, implement reliable, scalable, secure IT based solutions using latest practices and technologies.

PSO 2: Demonstrate competency of data analytics, interpretation, artificial intelligence in design and development of software systems.

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

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

Acronyms used in Course code e.g. 116U04C301

Acronym Serially as per code	Definition
1	First revision after Somaiya Vidyavihar University (First revision SVU 2020)
16	K J Somaiya College of Engineering
U	Undergraduate
04	Department of Information Technology
C	Core Course
L	Laboratory Course
T	Tutorial
E	Elective Course
S	Open Elective
M	Mandatory Non Credit Course
3	3- Semester 3 / 4- Semester 4
01	Course No.

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
116U04C301	Discrete and Applied Mathematics	3 – 0 – 1	04	3 – 0 – 1	04	BS
116U04C302	Data Structures$^{\$}$	3 – 0 – 0	03	3 – 0 – 0	03	PC
116U04C303	Database Management Systems	3 – 0 – 0	03	3 – 0 – 0	03	PC
116U04C304	Digital Systems	3 – 0 – 0	03	3 – 0 – 0	03	PC
116U04C305	Data Communication and Networking	3 – 0 – 0	03	3 – 0 – 0	03	PC
116U04 L301	Programming Laboratory I$^{@}$	0 – 2 – 1	03	0 – 1 – 1	02	LC
116U04L302	Data Structures Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
116U04L303	Database Management Systems Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
116U04L304	Digital Systems Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
116U04L305	Data Communication and Networking Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
Total		**15-10-02**	**27**	**15-05-02**	**22**	

@ Students will have a choice of Java Programming or Python Plus Language or C++

$ Course common with Computer Engineering

Examination Scheme

Course Code	Course Name	Examination Scheme							
		Marks							
		CA		ESE	TW	O%	P	P&O#	Total
		ISE	IA						
116U04C301	Discrete and Applied Mathematics	30	20	50	25	--	--	--	125
116U04C302	Data Structures$	30	20	50	--	--	--	--	100
116U04C303	Database Management Systems	30	20	50	--	--	--	--	100
116U04C304	Digital Systems	30	20	50	--	--	--	--	100
116U04C305	Data Communication and Networking	30	20	50	--	--	--	--	100
116U04 L301	Programming Laboratory I @	--	--	--	50*	--	--	25	75
116U04L302	Data Structures Laboratory	--		--	25	--	-	25	50
116U04L303	Database Management Systems Laboratory	--	--	--	25	--	--	25	50
116U04L304	Digital Systems Laboratory	--	--	--	25	25	--	--	50
116U04L305	Data Communication and Networking Laboratory	--	--	--	25	25	--	--	50
Total		**150**	**100**	**250**	**175**	**50**	**--**	**75**	**800**

$ Course common with Computer Engineering

@ Students will have a choice of Java Programming or Python Plus Language or C++

% Oral examination based on entire theory syllabus

 # Practical and Oral examination based on syllabus

* Term Work based on continuous assessment

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
116U04C401	Probability, Statistics and Optimization Techniques $	3 – 0 – 1	04	3 – 0 – 1	04	BS
116U04C402	Information Theory and Coding	3 – 0 – 1	04	3 – 0 – 1	04	PC
116U04C403	Analysis of Algorithms	3 – 0 – 0	03	3 – 0 – 0	03	PC
116U04C404	Advanced Databases	3 – 0 – 0	03	3 – 0 – 0	03	PC
116U04L401	Competitive Programming Laboratory	0 – 2 – 2	04	0 – 1 – 2	03	LC
116U04L402	Web Programming – I Laboratory	0 – 2 – 2	04	0 – 1 – 2	03	LC
116U04L403	Analysis of Algorithms Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
116U04L404	Advanced Databases Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
Total		**12-08-06**	**26**	**12-04-06**	**22**	

$ Course common with Computer Engineering

Examination Scheme

Course Code	Course Name	Examination Scheme							
		Marks							
		CA		ESE	TW	O%	P	P&O#	Total
		ISE	IA						
116U04C401	Probability, Statistics and Optimization Techniques$	30	20	50	25	–	–	–	125
116U04C402	Information Theory and Coding	30	20	50	25	–	–	–	125
116U04C403	Analysis of Algorithms	30	20	50	--	–	–	–	100
116U04C404	Advanced Databases	30	20	50	--	–	–	–	100
116U04L401	Competitive Programming Laboratory	--	--	--	50*	--	--	50	100
116U04L402	Web Programming – I Laboratory	--	--	--	50*	–	–	50	100
116U04L403	Analysis of Algorithms Laboratory	--	--	--	25	–	--	25	50
116U04L404	Advanced Databases Laboratory	--	--	--	25	–	--	25	50
Total		120	80	200	200	--	--	150	750

$ Course common with Computer Engineering
% Oral examination based on entire theory syllabus
 # Practical and Oral examination based on syllabus
* Term Work based on continuous assessment

Semester III

SY B. Tech. Information Technology

(KJSCE SVU 2020)

Course Code	Course Title			
116U04C301	**Discrete and Applied Mathematics**			
	TH	**P**	**TUT***	**Total**
Teaching Scheme(Hrs.)	**3**	**-**	**1**	**4**
Credits Assigned	**3**	**-**	**1**	**4**

Examination Scheme	Marks						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	30	**20**	**50**	**25**	**--**	**--**	**125**

 * Batch wise Tutorial

Course prerequisites: Applied Mathematics-I, Applied Mathematics –II

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 Relations, functions and different discrete structures. It will familiarize the students with different concepts of graph.

Course Outcomes

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

   CO1. Apply Different methods to find Laplace Transform and Inverse Laplace Transform of
      a function

   CO2. Find Fourier series, Fourier Integral and Fourier Transform of functions.

   CO3. Apply Relations, Functions and different discrete structures to solve Engineering
      problems.

   CO4. Apply various concepts of Graph theory to solve Engineering 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**	12	CO2
	2.1	Introduction: Definition, Dirichlet's conditions, Euler's formulae		
	2.2	Fourier Series of Functions: Exponential, trigonometric functions, even and odd functions, half range sine and cosine series .		
	2.3	Complex form of Fourier series.		
3		**Relations and Functions**	9	CO3
	3.1	Pigeon hole principle		
	3.2	Relations: Definition, Types of relations, Equivalence relations, Partial ordering relations		
	3.3	Functions: Definition, Types of functions: Injective, Surjective, Bijective, Invertible function, Composite function .		
4		**Algebraic Structure**	6	CO3
	4.1	Operations, Semi-groups, Groups, Rings, Integral Domains and Fields .		
	4.2	Isomorphism and Homomorphism of groups .		
5		**Graph Theory**	8	CO4
	5.1	Introduction to graphs, graph terminology, representing graphs and graph isomorphism, connectivity.		
	5.2	Euler and Hamilton paths .		
	5.3	Introduction to Planar graphs .		
	5.4	Introduction to trees, Isomorphism of trees, Prefix code , application of trees to coding and decoding of a message		
		Total	45	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	B. S. Grewal	*Higher Engineering Mathematics*	Khanna Publications, India	43rd Edition 2014
2.	Erwin Kreyszig	*Advanced Engineering Mathematics*	Wiley Eastern Limited, India	10th Edition 2015
3.	N.P. Bali and Manish Goyal	*A Textbook of Engineering Mathematics*	Laxmi Publications LTD, India	9th Edition 2016
4.	P. N. Wartikar and J. N. Wartikar	*A text book of Applied Mathematics Vol I & II*	Pune VidyarthiGruha , India	6th Edition 2012

Term-Work will consist of Tutorials covering entire syllabus of "Discrete and Applied Mathematics" (116U04C301). 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.

Course Code	Course Title						
116U04C302	**Data Structures**$^\$$						
	TH			**P**		**TUT**	**Total**
Teaching Scheme(Hrs.)	3			-		-	3
Credits Assigned	3			-		-	3
Examination Scheme	**Marks**						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	30	20	50		--	--	100

$ Course Common with Computer Engineering

Course prerequisites: Programming Language

Course Objectives:

The objective of this course is to introduce different types of data structure and how user can use data structure in software development. The course also familiarizes students with the concepts of advanced data structures such as balanced search trees, hash tables, priority queues, sorting and searching. Students will be master in the implementation of linked data structures such as linked lists and binary trees using any preferable language. Course mainly focuses on choosing the appropriate data structure for a specified application.

Course Outcomes

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

   CO1. Explain the different data structures used in problem solving.
   CO2. Apply linear and non-linear data structure in application development..
   CO3: Describe concepts of advance data structures like set, map & dictionary.
   CO4. Demonstrate sorting and searching methods.

Module No.	Unit No.	Details	Hrs.	CO
1		**Introduction to Data Structures**	**04**	**CO1**
	1.1	Defining Data structure, Types of Data Structures, Abstract Data Type (ADT), Static and Dynamic Implementations		
	1.2	Applications of data structures.		
2		**Linear data structures : Linked List, Stack and Queue**	**16**	**CO2**
	2.1	Introduction and Representation of Linked List, Linked List v/s Array, Implementation of Linked List, Circular Linked List, Doubly Linked List, Application – Polynomial Representation and Addition, Other additional applications/Case study.		
		#Self-learning - Sparse matrix addition		
	2.2	The Stack as an ADT, Stack operations, Array Representation of Stack, Linked Representation of Stack, Application of stack – Polish Notation, Recursion and other applications/Case study.		
		#Self-learning - Application of stack in evaluation of postfix and prefix expression.		
	2.3	The Queue as an ADT, Queue operation, Array Representation of Queue, Linked Representation of Queue, Circular Queue, Priority Queue, and Double ended queue, Application of Queues – Simulation and other applications/Case study.		
		#Self-learning - Application of queue in Josephus's Problem.		
3		**Non-linear data structures: Tree and Graph**	**10**	**CO2**
	3.1	Basic tree terminologies, Types of trees, 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 Trie, Applications/Case study of trees.		
		#Self-learning Learning – Red-Black and Splay Trees.		
	3.2	Introduction to graph as a data structure, Terminologies, Representation, Traversals – Depth First Search (DFS) and Breadth First Search (BFS). Applications/Case study of Graphs.		
4		**Set, Map and Dictionary**	**7**	**CO3**
	4.1	Set ADT, Set Implementation, and Partitions with Union-Find operations, Tree based partition implementation.		
	4.2	Map ADT, Implementation, Hash Tables Application of Maps		

	4.3	Dictionary ADT, Implementation, Application of Dictionaries		
		#Self-earning - Exploring case studies on use of set, map and dictionary		
5	**Searching and Sorting**		**8**	**CO 4**
	5.1	Sort Concept, Sort Stability , Bubble Sort, Insertion Sort, Counting Sort		
		#Self-learning - Bucket and Radix sort		
	5.2	Search concept, Linear Search, Binary Search, Hashed List Search, Comparison of searching Techniques		
		Total	**45**	

 # Self-learning topics may be evaluated through IA and/or Lab.

Recommended Books:

Sr. 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	Second Edition 2008
2.	Michael T Goodrich Roberto Tamassia David Mount	*Data Structure and Algorithm in C++*	Wiley	Second Edition 2011
3.	Richard F. Gilberg & Behrouz A. Forouzan	*Data Structures A Pseudocode Approach with C*	CENGAGE Learning	Second Edition 2005
4.	Aaron M Tanenbaum Yedidyah Langsam Moshe J Augentstein	*Data structure Using C*	Pearson	Twelfth Impression 2013
5.	Jean Paul Tremblay, Paul G. Sorenson	*An introduction to data structures with applications*	Tata McGraw-Hill Education	Second Edition 1984

Course Code	Course Title			
116U04C303	**Database Management Systems**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	3	-	-	3
Credits Assigned	3	-	-	3

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

Course prerequisites: Nil

Course Objectives:

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

Course Outcomes

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

   CO1. Realize the features of Relational database management systems.
   CO2. Apply data models to real world scenario.
   CO3. Illustrate the concept of security, Query processing, indexing and Normalization for Relational database.
   CO4. Apply the concept of transaction, concurrency control and recovery techniques

Module No.	Unit No.	Details	Hrs.	CO
1		**Database concepts and Systems**	6	**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**	9	**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		
4		● **Indexing, Hashing , Query processing and Optimization**	10	**CO3**
	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	Query Optimization: Overview, Transformation of relational expressions, Estimating statistics, Choice of evaluation plan		
5	● **Transactions, Concurrency control and Recovery system**		**10**	**CO4**
	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:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Elmasri and Navathe	*Fundamentals of Database Systems*	Pearson Education	7th Edition 2015
2.	Korth, Slberchatz,Sudarshan	*Database System Concepts*	McGraw – Hill	6th Edition 2010
3.	Raghu Ramakrishnan and Johannes Gehrke	*Database Management Systems*	McGraw Hill	3rd Edition 2002
4.	Paulraj Ponniah,	*Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals*	Wiley India	2nd Edition 2009
5.	McCreary, D., and Kelly	*Making sense of No SQL*	Manning Press	2014

● Instructor needs to provide additional resources to students for in-depth understanding and practical applicability of the indicated topic/topics.

Course Code	Course Title						
116U04C304	**Digital Systems**						
	TH		**P**		**TUT**		**Total**
Teaching Scheme(Hrs.)	3		-		-		3
Credits Assigned	3		-		-		3
Examination Scheme	**Marks**						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	30	20	50		--	--	100

Course prerequisites: Nil

Course Objectives:

This course lays the foundation for understanding the basics of digital
Logic Design as well as Computer Organization and Architecture.

Course Outcomes

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

- CO 1. Solve problems on various number systems, Boolean algebra and graphical techniques.
- CO 2. Understand the basic building blocks, techniques used in digital logic design.
- CO 3. Design the combinational and sequential circuits using basic building blocks.
- CO 4. Understand the basic concepts of memory elements.
- CO 5. Understand the fundamental concepts of microprocessors.

Module No.	Unit No.	Details	Hrs.	CO
1		**Number Systems, Codes, Logic gates and Simplification Techniques**	13	CO1
	1.1	Introduction to digital Systems, Number systems- Binary, octal, and hexa-decimal number systems, Codes- Binary code, BCD code, excess-3 code, gray code, ASCII code		
	1.2	Binary Arithmetic, Binary Addition and Subtraction (1's and 2's complement method)		
	1.3	Basic Digital Circuits: NOT, AND, OR, NAND, NOR, EXOR, EX-NOR		
	1.4	Theorems and Properties of Boolean Algebra, Standard SOP and POS form. Simplification of expressions, K-map method (2,3,4), NAND-NOR Realization.		
2		**Combinational Logic Design**	09	CO2
	2.1	Introduction to combinational logic design, Half and Full Adder, Half and Full Subtractor, Ripple carry Adder, Magnitude comparator		
	2.2	Multiplexers and De-multiplexers/Decoder, Binary Encoder, Priority Encoder, Code Conversion.		
	2.3	Design of combinational logic systems using Logic gates , Multiplexer, Demultiplexer, Encoder and Decoder		
3		**Sequential Logic Design**	10	CO3
	3.1	Flip Flops: SR, D, JK, JK Master Slave and T Flip Flop, Truth Tables and Excitation Tables, Flip-flop conversion		
	3.2	Counters: Design of Asynchronous and Synchronous Counters, Modulo Counters, Up- Down counter.		
	3.3	Shift Registers: Bidirectional Shift Register, Ring and Johnson Counter.		
4		**Functional Units of Digital Systems**	07	CO4
	4.1	Von Neumann architecture, Functional units of Computer, Basic Instruction Cycle, Interrupts		
	4.2	Memory sub-system-Typical architecture of RAM and ROM, SRAM and DRAM – architecture and comparison, Memory hierarchy		

5	**Introduction to Microprocessors**		06	CO5
	5.1	Introduction to Functional Block diagram of microprocessor 8086		
	5.2	MOV Instruction Formats, Addressing modes of microprocessor 8086		
	5.3	Segmented memory and interleaved memory architecture in 8086		
		Total	45	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1	R. P. Jain	*Modern Digital Electronics*	Tata McGraw Hill	4th Edition, 2009
2	Donald P Leach, Albert Paul Malvino	*Digital principles and Applications*	Tata McGraw Hill	8 th Edition, 2014
3	William Stallings	*Computer Organization and Architecture*	Pearson Education India	10th Edition, 2016
4	D. V. Hall,	*Microprocessor and Interfacing Programming Hardware*	Tata McGraw Hill	2nd Edition, 2006
5	Shibu K. V.	*Introduction to embedded Systems*	McGraw Hill Education India Private Limited	2nd edition, July 2017

Course Code	Course Title					
116U04C305	**Data Communication and Networking**					
	TH		**P**		**TUT**	**Total**
Teaching Scheme(Hrs.)	**3**		**-**		**-**	**3**
Credits Assigned	**3**		**-**		**-**	**3**
Examination Scheme	**Marks**					
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	30	**20**	**50**		**--**	**--**	**100**

Course prerequisites: Fundamentals of Computer Programming

Course Objectives:

This course provides an understanding of the concepts and mechanisms underlying the telecommunications and networking. Starting with the basics of data communication and types of networks, it introduces the transmission media. It also explains how two public networks, telephones and cable TV can be used for data transfer. A thorough background of the ISO- OSI model and the TCP/IP model will be given. The Application layer, Transport layer, Internet layer, Data link layer and Physical layers are covered in detail along with the protocols used. Top-down approach is used for this course will give students a better perception in terms of both usefulness and ease of understanding.

Course Outcomes

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

   CO1 . Understand the data communication systems, network topologies and network
           devices
   CO2. Enumerate the layers of the OSI model and TCP/IP model, their functions and
           Protocols.
   CO3. Build the skills of sub-netting and routing mechanisms.
   CO4. Execute their knowledge of computer communication principles, including
           Error detection and correction, multiplexing, flow control, and error control.

Module No.	Unit No.	Details	Hrs.	CO
1		**Introduction**	05	CO1
	1.1	Data Communications, Networks, The Internet , Protocols and Standards, Uses of Computer networks		
	1.2	Network Models: Layered tasks ,The OSI Model, Layers in the OSI Model, TCP/IP Protocol Suite		
2		**The Application Layer**	09	CO2
	2.1	Providing services, Application layer paradigms: Client Server and Peer to Peer paradigm. Client Server paradigm: Application programming Interface, Using services of the Transport layer. Peer to Peer Paradigm: P2P networks, Protocols, A popular P2P Network (BitTorrent).		
	2.2	Standard client server applications: Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Remote Logging(Telnet),Email(SMTP,MIME,POP3),File Transfer(FTP) and SNMP		
3		**The Transport Layer**	07	CO2
	3.1	The Transport Layer Services, Protocols: UDP, TCP		
	3.2	User datagram protocols: User datagram, services and UDP application		
	3.3	TCP features and services, Flow control, Error Control, Congestion Control, TCP segment, TCP Connection Establishment, Data transfer , TCP Connection Release		
4		●**The Network Layer**	08	CO 3
	4.1	Network Layer Design Issues, IP Addressing, Sub-netting		
	4.2	The Network Layer In The Internet: The IP Protocol, IPv4 header, IPv6 header, Routing Algorithms, Congestion Control Algorithms, Quality Of Service		
		# Self learning: Internet Control protocols, Routing protocols (Intra-domain-RIP,OSPF and Inter-domain-BGP)		
5		**The Data Dink Layer & Physical layer (Host layer)**	16	CO4
	5.1	Error detection and correction: Types of errors, redundancy, detection versus correction, forward error correction versus retransmission, Error detection, Error		

		correction, Hamming Code ,CRC, Checksum		
	5.2	Data Link Control: Framing, Fixed size and variable size framing; Flow and Error control, Protocols for Noiseless and Noisy Channels, Piggybacking, HDLC, PPP. Multiple Access: Random Access, Controlled Access, Channelization.		
	5.3	Data and Signals: Analog and Digital Signals, Transmission impairments, Data Rate Limits, Performance. Digital transmission: Digital –to-Digital Conversion, Analog –to-Digital Conversion.Analog transmission: Digital –to-Analog Conversion, Analog –to-Analog Conversion.		
	5.4	Transmission Media: Guided Media, Unguided Media, Switching and Multiplexing.		
		Total	**45**	

 # Self-learning topics may be evaluated through IA and/or Lab.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	B. A. Forouzan and Firouz Mosharraf	*Computer Networks A Top down Approach*	Tata McGraw Hill,India	1st Edition, 2011
2.	James F. Kurose and Keith W. Ross	*Computer Networking: A top down approach*	Pearson, India	5th Edition, 2012
3.	A. S. Tanenbaum	*Computer Networks*	Prentice Hall, India	5th Edition, 2014
4.	B. F. Ferouzan	*TCP/IP Protocol Suite*	Tata McGraw Hill,India	4th Edition,2010
5.	Williams Stallings	*Data & Computer Communications*	Pearson	9th Edition, 2017

● Instructor needs to provide additional resources to students for in-depth understanding and practical applicability of the indicated topic/topics.

Course Code	Course Title			
116U04L301	**Programming Laboratory-I** @			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	**--**	**2**	**1**	**3**
Credits Assigned	**--**	**1**	**1**	**2**

Examination Scheme	**Marks**						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	--	**--**	**--**	**50**	**--**	**25**	**75**

@Java Programming

Course prerequisites: Knowledge of Object Oriented Programming language(116U06L108)

Course Objectives:

The objective of the course is to impart knowledge of Java Programming language. The course introduces the implementation of Object Oriented Methodology concepts to solve problem using Java Programming. Further the course also covers concepts of Packages, Multithreading, Collection classes, GUI programming with JDBC and Functional Programming in java

Course Outcomes

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

   CO1. Apply fundamental Object Oriented Methodology concepts using java programming.
   CO2. Apply String manipulation functions ,inheritance and polymorphism using Java
         programming.
   CO3. Demonstrate the concept of packages, multithreading and exception handling in java.
   CO4. Illustrate the use of collection classes ,functional programming and GUI
         programming with java.

Module No.	Unit No.	Details	Hrs.	CO
0		**Introduction to Test Case Driven Development**	**01**	
	0.1	Testing a code, Manual and Automated Testing, Basic structure of Test Case, Writing Test Cases		
1		**Classes, Objects and Arrays**	**03**	**CO1**
	1.1	Features of Java programming Language, JDK and JVM , Classes Object , Method, Member, Dot Operator, Command Line Argument, Input using Scanner Class		
	1.2	Constructor, Constructor Overloading, Garbage Collection		
	1.3	1D Array, 2D Array, Jagged Array, Array of Objects		
2		**String Handling and Inheritance**	**03**	**CO2**
	2.1	String Class and Methods, String Buffer Class and Methods		
	2.2	Types of Inheritance, Polymorphism – method overloading, method overriding		
	2.3	Final class and method, Abstract class, Interface		
3		**Exception Handling, Packages and Multithreading in Java**	**03**	**CO3**
	3.1	Types of Exception, try-catch-finally, throw, throws Input using BufferedReader Class		
	3.2	User Defined Exception		
	3.3	Creating and Using User Defined Package		
	3.4	Introduction to Multithreading, Thread Life Cycle, Creating Threads using Runnable Interface and Thread Class		
4		**Collection Classes and Functional Programming**	**03**	**CO4**
	4.1	Collection classes- ArrayList, HaspMap, HashTable		
	4.2	Introduction to functional programming, lambda expressions, method references, predefined functional interfaces, Streams API		
5		**GUI Programming with Java**	**02**	**CO4**
	5.1	Introduction to GUI Programming		
	5.2	Introduction to JDBC,CRUD operation in JDBC		
		#Self Learning : Classes of swing package		
		Total	**15**	

Module 0 is to introduce the concepts of software testing in the syllabus. It will have no weightage in End-semester examination. It may be evaluated through IA and/or Lab.
 # Self-learning topics may be evaluated through IA and/or Lab.

Recommended Books:

Sr. 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*	Tata McGraw-Hill Publishing Company Limited	Tenth Edition, 2017
2.	Sachin Malhotra, Saurab Choudhary	*Programming in Java*	Oxford University Press	Second Edition, 2018
3.	D.T. Editorial Services	*Java 8 Programming Black Book*	Dream tech Press	Edition 2015

- **Term-Work will consist of Tutorials and laboratory work covering entire syllabus of Programming Laboratory-I" (116U04L301) with Java Programming. Students will be graded based on continuous assessment of their term work.**
- **Practical and Oral examination will be based on tutorial work, laboratory work and entire syllabus of Programming Laboratory-I" (116U04L301) with Java Programming.**

Course Code	Course Title			
116U04L301	**Programming Laboratory-I**[@]			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	--	**02**	**01**	**3**
Credits Assigned	--	**01**	**01**	**2**

Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	--	--	--	**50**	--	**25**	**75**

@Python Plus

Course prerequisites: Basics of Python Programming

Course Objectives:

The objective of this laboratory course is to impart knowledge of testing python applications, multithreading, scientific and mathematical computing, database handling, GUI design and networking based applications using various python libraries.

Course Outcomes

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

   CO1. Understanding the usage of multithreading.
   CO2. Inculcate the knowledge of python libraries like numpy, pandas, matplotlib for scientific- computing and data visualization.
   CO3. Designing a graphical interface for python applications
   CO4. Demonstrate handling database with python and to understand network programming with Python scapy.

Module No.	Unit No.	Details	Hrs.	CO
0		**Introduction to Unit Testing**	01	
	0.1	Testing a python code, Automated vs Manual Testing, Unit Testing vs Integration Testing, Test case writing, Basic Test structure, Test Runners, Writing Assertions		
1		**Multithreading in Python**	02	CO1
	1.1	Multithreading in Python, Process vs Thread, Lifecycle of a Thread, Thread Class, Methods of thread object		
		# Self Learning: Thread Synchronization, Locking Mechanism, Semaphore		
2		**Introduction to Numpy for data computing**	02	CO2
	2.1	Introduction to modules, Packages and Exploratory Data Analysis, Reading different data formats in Python		
	2.2	Numpy in Python for data computing, array creation, array attributes, array manipulation methods, Shaping and transposition, mathematical operations, indexing and slicing, broadcasting		
		# Self Learning: Data reading and cleansing using numpy		
3		**Scientific computing using Pandas and visualization using Matplotlib**	04	CO2
	3.1	Pandas for data computing, series and data frames, Data reading using Pandas		
	3.2	Analyzing dataset with Pandas, statistical functions		
	3.3	Use of Matplotlib for data Visualization, Bar graphs, Pie charts, area plots, pivot table, scatter plots, histograms, sub plot function, boxplot		
4		**GUI design using Tkinter**	02	CO3
	4.1	Introduction to Tkinter, Labels, widget, Buttons, check box, sliders, Layout management, Event Creation		
		# Self Learning: Python Date and Time		
5		**Database connectivity and Networking in Python**	04	CO4
	5.1	SQL Relational Databases Connection: Exception handling, Cursor, Row Objects, CRUD operations accomplishment using python, Transactions and Rollbacks		
	5.2	Introduction to Socket Programming, Scapy for Network Analysis		
		# Self Learning: Python network scanner, Telnet connection using python		

		Total	**15**	

Module 0 is to introduce the concepts of software testing in the syllabus. It will have no weightage in End-semester examination. It may be evaluated through IA and/or Lab.
 # Self-learning topics may be evaluated through IA and/or Lab.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Daniel Arbuckle	*Learning Python Testing*	Packt Publishing	1st Edition, 2014
2.	Wesly J Chun	*Core Python Applications Programming*	Pearson Publications	3rd Edition, 2015
3.	Wes McKinney	*Python for Data Analysis*	O'Reilly	1st edition, 2017
4.	Albert Lukaszewsk	*MySQL for Python*	Packt Publishing	1st Edition, 2010
5.	Eric Chou	*Mastering Python Networking*	Packt Publishing	2nd edition, 2017

- **Term-Work will consist of Tutorials and laboratory work covering entire syllabus of Programming Laboratory-I" (116U04L301) with Python Programming. Students will be graded based on continuous assessment of their term work.**
- **Practical and Oral examination will be based on tutorial work, laboratory work and entire syllabus of Programming Laboratory-I" (116U04L301) with Python Programming.**

Course Code	Course Title			
116U04L301	**Programming Laboratory I@**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	**0**	**2**	**1**	**3**
Credits Assigned	**0**	**1**	**1**	**2**

Examination Scheme	Marks						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	-	**-**	**-**	**50**	**--**	**25**	**75**

@ C++ Programming

Course prerequisites: Programming in C

Course Objectives:

The major objective of the course is to introduce fundamental concept of Object Oriented Programming (OOP) using C++. Students will be able to develop the skills with the comprehensive capabilities that are required for the efficient programming. Develop applications for a range of problems using object-oriented programming techniques.

Course Outcomes

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

CO1. Inculcate fundamental concepts of Object Oriented Programming.

CO2. Implement the principles of Data Abstraction Inheritance & Polymorphism.

CO3. Understand the concepts of streams and templates.

CO4. Implement exception handling and test driven development using C++.

Module No.	Unit No.	Details	Hrs.	CO
0		**Introduction to Test Case Driven Development**	**01**	
	0.1	Testing a code, Manual and Automated Testing, Basic structure of Test Case, Writing Test Cases		
1		●**Introduction C++ fundamentals**	**02**	**CO1**
	1.1	C Vs. C++, C++ Basics: I/O in C++, Object-Oriented Thinking: Different paradigms for problem solving, need for OOP paradigm, differences between OOP and Procedure oriented programming, Overview of OOP concepts Abstraction, Encapsulation, Inheritance and Polymorphism.		
	1.2	Pointers, Dynamic memory allocation and de-allocation using calloc, malloc and realloc and free, Pointers and functions		
2		●**Classes, Data Abstraction & Operator Overloading**	**03**	**CO2**
	2.1	Introduction, Class Scope and accessing Class Members, Separating Interface from Implementation, Controlling Access Function And Utility Functions		
	2.2	Initializing Class Objects: Constructors, Using Default Arguments With Constructors, Using Destructors, Classes : Const(Constant) Object And Const Member Functions, Object as Member of Classes, Friend Function and Friend Classes, Using This Pointer, Dynamic Memory Allocation with New and Delete, Pointers to objects, Static Class Members, Container Classes And Integrators, Proxy Classes, Function overloading.		
	2.3	Fundamentals of Operator Overloading, Restrictions On Operators Overloading, Operator Functions as Class Members vs. as Friend Functions, Overloading, <<, >> Overloading Unary Operators, Overloading Binary Operators.		
3		●**Inheritance, Virtual Functions and Polymorphism**	**03**	**CO2**
	3.1	Introduction to Inheritance, Base Classes And Derived Classes, Protected Members, Casting Base- Class Pointers to Derived- Class, Using Member Functions, Overriding Base – Class Members in a Derived Class, Public, Protected		

		and Private Inheritance, Using Constructors and Destructors in derived Classes, Implicit Derived –Class Object To Base-Class Object Conversion, Composition Vs. Inheritance.		
	3.2	Introduction to Virtual Functions, Abstract Base Classes And Concrete Classes, Polymorphism, New Classes And Dynamic Binding, Virtual Destructors, Pointers to virtual functions		
4	●**I/O Streams, files and Templates**		**03**	**CO3**
	4.1	Concept of streams, cin and cout objects, C++ stream classes, Unformatted and formatted I/O, manipulators, File stream, C++ File stream classes, File management functions,		
	4.2	Templates, Exceptions and STL : What is template? function templates and class templates, Overview and use of Standard Template Library,		
5	●**Exception Handling and Test Driven Development**		**03**	**CO4**
	5.1	Introduction, Basics of C++ Exception Handling: Try Throw, Catch, Throwing an Exception, Catching an Exception, Rethrowing an Exception, Exception specifications, Processing Unexpected Exceptions, Stack Unwinding, Constructors, Destructors and Exception Handling, Exceptions and Inheritance.		
	5.2	Test Driven Development using C++		
		Total	**15**	

Module 0 is to introduce the concepts of software testing in the syllabus. It will have no weightage in End-semester examination. It may be evaluated through IA and/or Lab.

Self-learning topics may be evaluated through IA and/or Lab.

● Instructor needs to provide additional resources to students for in-depth understanding and practical applicability of the indicated topic/topics.

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	B. Stroutstrup	*The C++ Programming Language*	Pearson Education India	3rd Edition 1 January 2002
2.	E Balagurusamy	*Object oriented Programming with C++*	Tata McGraw-Hill	8th Edition 24 September 2020
3.	Robert Lafore	*Object Oriented Programming C++*	Pearson Education India	4th edition 1 January 2008
4.	Herbert Schildt	*C++: The Complete Reference*	McGraw Hill Education	4th edition 1 July 2017
5.	Jeff Langr	*Modern C++ Programming with Test-Driven Development : Code Better, Sleep Better*	O'Reilly	1st edition 5th November 2013

- **Term-Work will consist of Tutorials and laboratory work covering entire syllabus of Programming Laboratory-I" (116U04 L301) with C++ Programming. Students will be graded based on continuous assessment of their term work.**
- **Practical and Oral examination will be based on tutorial work, laboratory work and entire syllabus of Programming Laboratory-I" (116U04 L301) with C++ Programming**

Course Code	Course Title			
116U04L302	**Data Structures Laboratory**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	-	**2**	-	**2**
Credits Assigned	-	**1**	-	**1**

Examination Scheme	Marks						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	-	-	-	**25**	-	**25**	**50**

- **Term-Work will consist of practical covering entire syllabus of "Data Structures" (116U04C302). Students will be graded based on continuous assessment of their term work.**
- **Practical and Oral Examination will be based on laboratory work and entire theory syllabus of "Data Structures" (116U04C302).**

Course Code	Course Title			
116U04L303	**Database Management Systems Laboratory**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	-	**2**	-	**2**
Credits Assigned	-	**1**	-	**1**

Examination Scheme	Marks					
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	-	-	-	**25**	-	**25**	**50**

- **Term-Work will consist of practical covering entire syllabus of "Database Management Systems" (116U04C303). Students will be graded based on continuous assessment of their term work.**
- **Practical and Oral Examination will be based on laboratory work and entire theory syllabus of "Database Management Systems" (116U04C303).**

Course Code	Course Title			
116U04L304	**Digital Systems Laboratory**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	-	**2**	-	**2**
Credits Assigned	-	**1**	-	**1**

Examination Scheme	Marks						
	CA		ESE	TW	O	P&O	Total
	ISE	IA					
	-	-	-	**25**	**25**	-	**50**

- **Term-Work will consist of practical covering entire syllabus of "Digital Systems" (116U04C304). Students will be graded based on continuous assessment of their term work.**
- **Oral Examination will be based on laboratory work and entire theory syllabus of "Digital Systems" (116U04C304).**

Course Code	Course Title			
116U04L305	**Data Communication and Networking Lab**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	-	2	-	2
Credits Assigned	-	1	-	1

	Marks						
	CA		ESE	TW	O	P&O	Total
Examination Scheme	ISE	IA					
	-	-	-	25	25	-	50

- **Term-Work will consist of practical covering entire syllabus of "Data Communication and Networking" (116U04C305) . Students will be graded based on continuous assessment of their term work.**
- **Oral Examination will be based on laboratory work and entire theory syllabus of "Data Communication and Networking" (116U04C305) .**

Semester IV

Course Code	Course Title			
116U04C401	**Probability, Statistics and Optimization Techniques**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	**3**	**-**	**1**	**4**
Credits Assigned	**3**	**-**	**1**	**4**

Examination Scheme	Marks						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	30	**20**	**50**	**25**	**--**	**--**	**125**

$ Course Common with Computer Engineering

Course prerequisites: Basics of Statistics and Probability, Introductory Linear programming problems

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. Some basic queuing theory models are also discussed in the 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

CO1. Apply concepts of Binomial, Poisson, Exponential and Normal distribution to solve Engineering problems.

CO2. Apply concepts of correlation, regression for given bivariate data.

CO3. Apply Large sample test and small sample test to analyze collected data.

CO4. Apply concepts of Linear and Nonlinear programming methods to solve problems.

CO5. Apply the methods of single server limited queue and single server unlimited queue models to analyze and interpret the data.

Module No.	Unit No.	Details	Hrs.	CO
1		**Probability and Probability Distribution**	**12**	**CO1**
	1.1	Conditional Probability, Bayes' theorem, Joint Probability		
	1.2	Discrete and Continuous Probability Distribution		
	1.3	Binomial Distribution, Poisson Distribution		
	1.4	Uniform Distribution, Normal Distribution, Exponential Distribution		
2		**Correlation and Regression**	**06**	**CO2**
	2.1	Correlation, Co-variance, Karl Pearson Coefficient of Correlation & Spearman's Rank Correlation Coefficient.		
	2.2	Regression Coefficients, lines of regression& logistic regression.		
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.		
	3.5	Fisher's z-test		
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 and Dual Simplex method		
	4.4	Unconstrained optimization, problems of two or three variables with one equality constraint using Lagrange's Multiplier method.		
	4.5	Problems of two or three variables with one inequality constraint using Kuhn-Tucker conditions		
5		**Queuing Theory**	**07**	**CO5**
	5.1	Introduction, Features of Queuing , solution of Queuing Models.M/M/1(Single Server ,Unlimited Queue Model)		
	5.2	M/M/1 Single Server ,limited Queue Model		
		Total	**45**	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1	B. S. Grewal	*Higher Engineering Mathematics*	Khanna Publications, India	43rd Edition 2014
2	Erwin Kreyszig	*Advanced Engineering Mathematics*	Wiley Eastern Limited, India	10th Edition 2015
3	J. K. Sharma	*Operation research: Theory and Applications*	Laxmi Publications, India	6th Edition 2017
4	S.C.Gupta and V.K.Kapoor	*Fundamentals of Mathematical Statistics*	Sultan Chand & Sons	11th Edition 2009
5	Ronald E.Walipole, Raymond H.Myers	*Probabilities & Statistics for Engineers & Scientists*	Pearson Education	9th Edition 2010
6	P. N. Wartikar and J. N. Wartikar	*A text book of Applied Mathematics Vol I & II*	Pune VidyarthiGruha, India	6th Edition 2012

Term-Work will consist of Tutorials covering entire syllabus of "Probability, Statistics and Optimization Techniques"(116U04C401). 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.

Course Code	Course Title			
116U04C402	**Information Theory and Coding**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	**3**	**-**	**1**	**4**
Credits Assigned	**3**	**-**	**1**	**4**

Examination Scheme	Marks						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	30	**20**	**50**	**25**	**--**	**--**	**125**

Course prerequisites: Basic concepts of Discrete Mathematics, Data Communication and Networking

Course Objectives:

The objective of the course is to impart knowledge of foundation of Information theory – the theory that provides quantitative measures of information and allows us to analyze and characterize the fundamental limits of communication systems. It includes detailed knowledge of compression techniques and error control methods . The Course also covers concept of basic number theory which forms the foundation for the cryptography

Course Outcomes

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

CO 1. Understand basics of Information Theory, Information Source and Channel.

CO 2. Illustrate different Data Compression algorithms.

CO 3. Demonstrate the concepts and techniques for error detection and correction.

CO 4. Apply basic number theory concepts for securing information.

Module No.	Unit No.	Details	Hrs.	CO
1		**Basics of Information Theory**	**6**	**CO1**
	1.1	Introduction, Measure of Information, Entropy, Information Rate.		
	1.2	Joint and Conditional Entropies, Mutual Information for two discrete random variables.		
	1.3	Channel models, Channel Capacity, Shannon's Theorem		
2		**Source Codes**	**10**	**CO2**
	2.1	Introduction, Coding Parameters, Source coding Theorem		
	2.2	Classification of Codes, Shannon-Fano coding, Huffman coding, Arithmetic coding		
	2.3	LZW coding, Run Length Encoding, Image Compression		
3		**Error Control Code :Linear block code**	**10**	**CO3**
	3.1	Introduction, Types of codes, Types of Errors, Error Control Strategies, Modular Arithmetic ,Use of Galois field and Primitive root for generator polynomial		
	3.2	Linear block codes-Introduction, Generator matrices, Parity check matrices.		
	3.3	Error syndrome, Error detection, Error detecting and error correcting capability.		
	3.4	Standard Array and Syndrome, Decoding, Hamming Code.		
4		**Error Control Code: Cyclic code and Convolution code**	**09**	**CO3**
	4.1	Cyclic codes- Introduction, Generation, Syndrome computation and error detection, Decoding.		
	4.2	Hamming code- Error syndrome, Error Detection and correction, Decoding, Extended Hamming Code, Golay code, Error detection using Cyclic Redundancy check		
	4.3	Convolution codes- Introduction, Tree and Trellis Codes		
	4.4	Encoding, Decoding, Applications		
5		**Basics of Number Theory and Cryptography**	**10**	**CO4**
	5.1	Prime Number Generation, Random Number Generation. Congruences, Solving Linear Congruences ax+by=d.		
	5.2	Chinese Remainder Theorem, Fermat's Little and Euler Theorem, Quadratic Residue, Legendre and Jacobi Symbols		
	5.3	Shannon's characteristics of good cipher, confusion and diffusion, concepts of encryption, decryption.		
	5.4	Historical background, Transposition: row key and column key, Substitution: Ceaser cipher (additive), Affine cipher (additive and multiplicative), Polyalphabetic and Monoalphabetic Ciphers: Vignere cipher.		
		Total	**45**	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	ArijitSaha,Nilotpal Manna,Surajit Mandal	*Information Theory Coding and Cryptography*	Pearson Education, India	First Edition 2013
2.	Ranjan Bose	*Information Theory Coding and Cryptography*	TMH, India	Third Edition 2016
3.	Khalid Sayood	*Introduction to Data Compression*	Elsevier	Fourth Edition, 2013
4.	Trappe and Washington	*Introduction to Cryptography with Coding theory*	Pearson Education, India	Second Edition 2006
5.	S Gravano	*Introduction to Error Control Codes*	Oxford University Press	First Edition 2007
6.	William Stallings	*Data and Computer Communications*	Pearson Education, India	Eighth Edition, 2007

- **Term-Work will consist of tutorial covering entire syllabus of "Information Theory Coding" (116U04C402). Students will be graded based on continuous assessment of their term work.**

Course Code	Course Title			
116U04C403	**Analysis of Algorithms**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	**3**	**-**	**-**	**3**
Credits Assigned	**3**	**-**	**-**	**3**

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

Course prerequisites: Data Structures and Programming concepts

Course Objectives:
The objective of the course is to introduce the fundamentals of analysis of algorithms. The Specifications and process for algorithm analysis is covered using sample algorithms. The course helps understanding efficiency of algorithms and comparison of algorithms based on Efficiency. The course also covers different algorithm design strategies, along with examples.

Course Outcomes
At the end of successful completion of the course the student will be able to
   CO 1. Analyze time and space complexity of basic algorithms
   CO 2. Implement Greedy and Dynamic Programming algorithms
   CO 3. Implement Backtracking and Branch-and-bound algorithms
   CO4.   Understand NP-Completeness concept

Module No.	Unit No.	Details	Hrs.	CO
1		**Introduction to Algorithms**	07	CO1
	1.1	Algorithms as a Technology, Analyzing and Designing Algorithms, Rate of growth of functions, Asymptotic notations and order of growth. Common running times: Linear, quadratic, logarithmic etc. and its examples.		
	1.2	Recurrence relations and methods to solve them: Recursion tree, Substitution and Master Method. Probabilistic Analysis, The Hiring Problem, Indicator Random Variables, Randomized Algorithms		
2		**Analysis of Basic Algorithms**	12	CO1
	2.1	Insertion sort, Selection sort , Heap sort, Sorting in Linear Time, Lower bounds for sorting, Counting Sort, Radix Sort		
	2.2	Medians and Order Statistics: Minimum and Maximum, Selection in expected Linear time, Selection in worst-case Linear Time.		
	2.3	Divide and Conquer: Quick sort, randomized Quick sort, Merge sort, Strassen's Matrix Multiplication Algorithm		
3		**Greedy Algorithms and Dynamic Programming**	12	CO2
	3.1	The Greedy Approach, Kruskal's algorithm for Minimum Spanning Tree, Dijkstra's algorithm Single Source Shortest Path, Job Sequencing: With and Without Deadlines, Knapsack Problem : 0/1 Knapsack		
		#Self-learning topic: Prim's Algorithm for Minimum Spanning Trees, Huffman Algorithm		
	3.2	Dynamic Programming and Optimization problems, Optical Binary Search Trees, Floyd-Warshall Algorithm for All Pair Shortest Path, Longest Common Subsequence, Travelling Salesman Problem		
		#Self-learning topic: Travelling Salesman Problem using Greedy Approach and Dynamic Programming		
4		**Backtracking and Branch and Bound Algorithms**	08	CO3
	4.1	The Backtracking Technique, N-Queens Problem, Hamiltonian Circuit Problems, Sum of Subsets Problem,		
	4.2	Travelling Salesman Problem, 15 Puzzle Problem and 0/1 Knapsack using Branch and Bound		

5		Computability Theory	06	CO4
	5.1	NP and NP complete		
	5.2	NP reducibility		
		Total	45	

 # Self-learning topics will be evaluated through IA and/or Lab.

Recommended Books:

Sr. 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*	Prentice Hall India Publication	3rd Edition 2009
2	Richard E. Neapolitan	*Foundation of Algorithms*	Jones & Bartlett Students Edition	5th Edition 2016
3	Harsh Bhasin	*Algorithms : Design & Analysis*	Oxford Higher education, India	1st Edition 2013
4	Jon Kleinberg, Eva Tardos	*Algorithm Design*	Pearson India Education Services Pvt. Ltd.	10th Edition 2013
5	Jeffrey J. McConnell	*Analysis of Algorithms : An Active Learning Approach*	Jones and Bartlett Student Edition	2nd Edition 2017

● Instructor needs to provide additional resources to students for in-depth understanding and practical applicability of the indicated topic/topics.

Course Code	Course Title				
116U04C404	**Advanced Databases**				
	TH	**P**	**TUT**	**Total**	
Teaching Scheme(Hrs.)	**3**	**-**	**-**	**3**	
Credits Assigned	**3**	**-**	**-**	**3**	
Examination Scheme	Marks				
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**

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

Course prerequisites: Knowledge of Database Management systems

Course Objectives:

The course will impart the skills that can help design and develop advanced database models. Students will be able to select appropriate advanced database model depending on the application requirement. This course will also make them aware of challenges and limitations while implementing the models. Further, the student will learn that how enterprise can organize and analyze large amounts of data by creating a data warehouse.

Course Outcomes

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

CO 1. Design advanced database systems using Parallel, Distributed and In-memory databases and its implementation.

CO 2. Design advanced database systems using Object relational, Spatial and NOSQL databases and its implementation.

CO 3. Understanding of data warehouse and its multi-dimensional modeling.

CO 4. Apply ETL processing and Online Analytical Processing on the warehouse data.

Module No.	Unit No.	Details	Hrs.	CO
1		● **Parallel and Distributed Databases**	**10**	**CO 1**
	1.1	Parallel Database Concepts, Parallel Query Evaluation		
	1.2	Parallelizing Individual Operations-Sorting, Join		
	1.3	Distributed Database - Concepts, Types , Architecture		
	1.4	Distributed Database Design - Data Fragmentation, Replication, and Allocation Techniques		
	1.5	Query Processing and Optimization in Distributed Databases.		
	1.6	Concurrency Control and Recovery in Distributed Databases		
	1.7	In-memory Databases : Architecture, in- memory database vs disk residence database, practical applications of in-memory databases, challenges of in-memory database.		
2		● **Object Based, Spatial Databases and NOSQL Databases**	**10**	**CO 2**
	2.1	Features Of Object based DBMS		
	2.2	Database Design concepts for an ORDBMS		
	2.3	Nested Relations and Collections		
	2.4	Spatial Database Components, Spatial Objects		
	2.5	Spatial Dimensions, Spatial Relations, Spatial SQL Queries		
	2.6	NOSQL databases: What is NOSQL? , NOSQL business drivers		
	2.7	NOSQL data architectural patterns: Document type, Key-Value, Graph and Column family		
3		●**Introduction to Data Warehousing and multi-dimensional Modeling**	**10**	**CO 3**
	3.1	Operational Vs Decisional Support System ,The Need for Data Warehousing		
	3.2	Data Warehouse Definition, Features , The Information Flow Mechanism, Architecture , Role of Metadata, Classification of Metadata		
	3.3	Data Warehouse Vs Data Marts, Data Warehousing Design Strategies, Data Warehouse Modeling Vs Operational Database Modeling		
	3.4	The Star Schema - Fact Tables and Dimension Tables, The Fact less Fact Table, Keys in the Data Warehouse Schema- Primary		

		Keys, Surrogate Keys & Foreign Keys, The Snowflake Schema, Fact Constellation Schema(Family of Stars)		
	3.5	Updates To Dimension Tables - Slowly Changing Dimensions, Type 1, Type 2 and Type 3 Changes, Large Dimensions , Rapidly Changing Dimensions, Junk Dimensions, Aggregate Fact Tables		
	3.6	Data lake, Architecture of Data lake, Data Warehouse Vs Data lake		
4		● **ETL Process**		
	4.1	Introduction to ETL Process		
	4.2	Data Extraction - Identification of Data Sources, Types - Immediate Data Extraction and Deferred Data Extraction	**09**	**CO4**
	4.3	Data Transformation: Tasks Involved in Data Transformation		
	4.4	Data Loading: Techniques, Loading the Fact Tables and Dimension Tables		
	4.5	Data Quality, Issues in Data Cleansing		
5		**Online analytical processing (OLAP)**	**06**	**CO4**
	5.1	Need for Online Analytical Processing; OLTP Vs OLAP, OLAP and Multidimensional Analysis		
	5.2	● OLAP Operations in Multidimensional Data Model - Rollup, Drill-down, Dice, Slice and Pivot		
	5.3	OLAP Models: MOLAP, ROLAP, HOLAP		
		Total	**45**	

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Elmasri and Navathe	*Fundamentals of Database Systems*	Pearson Education	7th Edition 2015
2.	Korth, Slberchatz,Sudarshan	*Database System Concepts*	McGraw – Hill	6th Edition 2010
3.	Raghu Ramakrishnan and Johannes Gehrke	*Database Management Systems*	McGraw Hill	3rd Edition 2002
4.	Paulraj Ponniah,	*Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals*	Wiley India	2nd Edition 2009
5.	McCreary, D., and Kelly	*Making sense of NoSQL*	Manning Press	2014

● Instructor needs to provide additional resources to students for in-depth understanding and practical applicability of the indicated topic/topics.

Course Code		Course Title			
116U04L401		**Competitive Programming Laboratory**			
	TH	**P**	**TUT**	**Total**	
Teaching Scheme(Hrs.)	-	2	2	4	
Credits Assigned	-	1	2	3	
Examination Scheme	**Marks**				
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	-	-	-	50	-	50	100

Course prerequisites: Knowledge about any of the programming language, Data Structures

Course Objectives:

The major objective of the course is to develop the programmer with the comprehensive capabilities required for the efficient software development. It covers best practices required for the quick and optimized development of the most frequently used operations and algorithms belonging to different application domains.

Course Outcomes

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

CO1. Inculcate the best practices that are essential for competitive programming

CO2. Understand the fundamental concepts for managing the data using different data structures such as lists, queues, trees etc.

CO3 . Understand the Graphs, related algorithms, efficient implementation of those algorithms and applications

CO4. Learn effective computation and programming practices for numeric and string operations and computation geometry

Module No.	Unit No.	Details	Hrs.	CO
1		● **Best practices for Competitive programing**	**05**	**CO1**
	1.1	Mastering the programming language, efficient testing and debugging		
	1.2	Quick identifying problem type, Algorithm analysis, time complexity, calculation rules, common time complexities, estimated efficiency, examples		
2		● **Optimization of Data Structures and Algorithms**	**08**	**CO2**
	2.1	Optimized implementation of Arrays, Dynamic arrays, single, doubly linked list		
	2.2	Optimized implementation of Stack, queue, priority queue, tree, Tree traversal, Optimized binary search tree (OBST), Heap, Hash tables, Set and Map structures, Trie structure Segment Trees using Lazy Propagation, Fenwick Trees or Binary Indexed Trees, Applications of Fenwick and Segment Trees, Heavy light Decomposition, Sparse table algorithm		
	2.3	Basic concepts of Greedy programming, coin problems , scheduling, data compression, knapsack problem		
	2.4	Basic concepts of dynamic programming, coin problems, longest increasing subsequence, knapsack problem		
3		● **Strings, Arithmetic and Algebra operations**	**08**	**CO3**
	3.1	Introduction to Strings, Arithmetic and Algebra operations and its applications Character codes, representing strings		
	3.2	Searching, Pattern searching, String manipulation, string merging , pruning search, generating subsets, generating permutations		
	3.3	Number theory, primes and factors, modular arithmetic, Program arithmetic operations on rationals, Algebra: square root algorithms – combining algorithms, Logarithm, Basic counting techniques, Other Counting Sequences		
	3.4	Recurrence Relations, Binomial Coefficients, Recursion and Induction Problems		
4		**Graphs**	**05**	**CO3**
	4.1	Introduction to Graph theory and applications, Data structure for graphs, Traversal: Breadth first and Depth first		
	4.2	Dijkstra's Shortest path algorithm, Kruskals algorithm for spanning trees, topological sorting, Cycle detection, all longest paths		
5		**Computational Geometry**	**04**	**CO4**
	5.1	Introduction to Computational Geometry and its applications, Line segment and intersections, Polygon and angle computation		
	5.2	Algorithms on Grids		
		Total	**30**	

- **Term-Work will consist of Tutorials and laboratory work covering entire syllabus and a Mini Project developed incorporating all the technical skills learned in "Competitive Programming Laboratory" (116U04L401), Students will be graded based on continuous assessment of their laboratory work; one of the assessment will be of 10 marks which may be conducted using any of the online platforms available to evaluate the best programming practices such as HackerRank, LeetCode, CodeChef etc.**

- **Practical and oral Examination will be based on laboratory work and entire syllabus of "Competitive Programming Laboratory" (116U04L401).**

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1.	Antti Laaksonen	*Guide to Competitive Programming*	Springer	2018
2.	Gayle Laakmann McDowell	*Cracking the Coding Interview*	CareerCup, LLC	2015
3.	Steven S. Skiena Miguel A. Revilla	*Programming challenges The Programming Contest Training Manual*	Springer	2006
4.	Antti Laaksonen	*Competitive Programmer's Handbook*	--	Hand book, 2018
5.	Steven Halim and Felix Halim	*Competitive Programming 3: The Lower Bounds of Programming Contests*	--	Handbook for ACM ICPC And IOI CONTESTANTS 2013

● Instructor needs to provide additional resources to students for in-depth understanding and practical applicability of the indicated topic/topics.

Course Code	Course Title			
116U04L402	**Web Programming I Laboratory**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	-	2	2	4
Credits Assigned	-	1	2	3

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

Course prerequisites: Knowledge of Programming language

Course Objectives:

The objective of this project-driven course is to acquaint with necessary techniques for developing client/server applications. The course will introduce concept of HTML and CSS to create and maintain Web pages, grid layout and responsive web page. Students will be familiarizing with Document Object Model to learn how browser represents web page. In addition, the course will make students conversant with JavaScript, ReactJS, JSON.

Course Outcomes

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

    CO1: Comprehend basics of web technologies

    CO2: Create Web pages using HTML 5 and CSS

    CO3: Apply JavaScript and JSON for web application development

    CO4: web application using ReactJS

Module No.	Unit No.	Details	Hrs.	CO
1		**Introduction to web technologies**	**02**	**CO1**
	1.1	Introduction to OSI layers, Web system architecture-1,2,3 and n tier architecture, URL, domain name system, overview of HTTP		
	1.2	Planning a Web Site – Objective and Goals, Audience, Organizing contents, Publishing of Web Site , Function of Web Server ,Introduction to user interface		
		#Self-learning topic: Working of Web Browser, Introduction to Internet Application Protocols – FTP, Telnet, SMTP		
2		● **Web Page Creation with HTML 5 and CSS3**	**09**	**CO2**
	2.1	Formatting and Fonts, Anchors, Backgrounds, images, Hyperlinks, Lists, Tables		
	2.2	HTML5, New Element, Forms, Audio and Video, HTML5 Canvas, SVG in HTML5, Google Map, Geolocation, Web storage, Web Worker, Application cache		
	2.3	Understanding the need for CSS, Basic syntax and structure using CSS, Positioning using CSS, Apply styles to Box Model Class and ID		
	2.4	Create a flexible content layout, Implement a layout using multi-column; implement a layout using position floating, implement a layout using grid alignment		
	2.5	Responsive Web page **,** Web accessibility		
		#Self-learning topic - HTML <Meta Tag>, Introduction to XHTML		
3		**Introduction to XML**	**02**	**CO1**
	3.1	Syntax, Document structure, Document type definitions, Namespaces, XML schemas, Displaying raw XML documents, XSLT,XML Parsing		
		#Self-learning topic - Using XML as Database		
4		**Working with JavaScript and JSON**	**08**	**CO3**
	4.1	Introduction to JavaScript with variables, Types, operators, conditions ,functions		
	4.2	JavaScript Object, Array, Regular Expression, Event Handling		
	4.3	Comprehending advanced Javascript functions-Closures, Callback, Promise and Arrow Functions		
	4.4	The DOM and the Web browser Environment, DOM Manipulation		
	4.5	Data handling with JSON – Data types, Objects, Arrays, JSON Parse, Stringify		
	4.6	Introduction to CBOR, JSON Vs. CBOR		

5		**Introduction to ReactJS**	**09**	**CO4**
	5.1	Evolutiion of React, Classes, ES6 Modules, Functional programming with Javascript		
	5.2	React page setup, React Elements, React components		
	5.3	React elements as JSX, Bable, Recipies as JSX, React Fragments		
	5.4	Working with webpack		
		Total	**30**	

- **Students should prepare all self-learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in term work and Laboratory.**
- **Term-Work will consist of Tutorials and laboratory work covering entire syllabus. Students will be graded based on continuous assessment of their term work. Practical and Oral examination based on laboratory experiments and entire syllabus**

Recommended Books:

Sr. No.	Name/s of Author/s	Title of Book	Name of Publisher with country	Edition and Year of Publication
1	Kogent Learning Solutions Inc.,	*HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and jQuery*	DreamTech Press,India	2nd Edition, 2016
2	Robin Nixon	*Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5*	O'Reilly Media	5th Edition, 2018
3	Flanagan, David	*JavaScript: the definitive guide*	O'Reilly Media, Inc	7th Edition, 2020
4	Kogent Learning Solutions Inc.,	*Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book: HTML, Javascript, PHP, Java, Jsp, XML and Ajax, Black Book*	DreamTech Press,India	2013
5	Alex Banks, Eve Porcello	*Learning React*	O'Reilly Media	2nd Edition, 2020

● Instructor needs to provide additional resources to students for in-depth understanding and practical applicability of the indicated topic/topics.

Course Code	Course Title			
116U04L403	**Analysis of Algorithms Laboratory**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	-	**2**	-	**2**
Credits Assigned	-	**1**	-	**1**

Examination Scheme	Marks						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	-	-	-	**25**	-	**25**	**50**

- **Term-Work will consist of practical covering entire syllabus of "Analysis of Algorithms Laboratory" (116U04C403). Students will be graded based on continuous assessment of their term work.**
- **Practical and Oral Examination will be based on laboratory work and entire theory syllabus of "Analysis of Algorithms Laboratory" (116U04C403).**

Course Code	Course Title			
116U04L404	**Advanced Databases Laboratory**			
	TH	**P**	**TUT**	**Total**
Teaching Scheme(Hrs.)	-	**2**	-	**2**
Credits Assigned	-	**1**	-	**1**

Examination Scheme	Marks						
	CA		**ESE**	**TW**	**O**	**P&O**	**Total**
	ISE	**IA**					
	-	-	-	**25**	-	**25**	**50**

- **Term-Work will consist of practical covering entire syllabus of "Advanced Databases" (116U04C404). Students will be graded based on continuous assessment of their term work.**
- **Practical and Oral Examination will be based on laboratory work and entire theory syllabus of "Advanced Databases" (116U04C404).**