Silicon Institute of Technology
| An Autonomous Institute |

Curriculum Structure and Detailed Syllabus

Master in Computer Application

Department of Computer Application
Silicon Institute of Technology
Silicon Hills, Patia, Bhubaneswar - 751024

Effective from Academic Year 2018-19
Version: 1.30 (Build: 25-09-2020)

Approval History

ACM#	Date	Resolutions
AC-1	14/08/2018	The curriculum & detailed syllabus of 1st Year, as proposed by the Board of Studies, is provisionally approved by the Academic Council.
AC-2	11/05/2019	The curriculum & detailed syllabus up to 2nd Year, as proposed by the Board of Studies, is approved by the Academic Council.
AC-3	28/09/2019	The curriculum & detailed syllabus up to 3rd Year, as proposed by the Board of Studies, is approved by the Academic Council.

Program Outcomes

Graduates Attributes (GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The National Board of Accreditation (NBA) has defined Program Outcomes (POs) for UG Engineering programmes, but not for the MCA programme. Silicon Institute of Technology has defined POs for MCA programme in line with NBA, so that the outcomes can be assessed in a similar manner to UG programmes. The Program Outcomes for MCA programme are given below:

PO1. Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.

PO2. Design and develop applications to analyze and solve all computer science related problems.

PO3. Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.

PO4. Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.

PO5. Integrate and apply efficiently the contemporary IT tools to all computer applications.

PO6. Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

PO7. Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.

PO8. Communicate effectively and present technical information in oral and written reports.

PO9. Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

PO10. Appreciate the importance of goal setting and to recognize the need for life-long learning.

Program Educational Objectives (PEOs)

PEO1. Develop software solutions to problems across a broad range of application domains through analysis and design.

PEO2. Work professionally and communicate effectively in interdisciplinary environment, either independently or in team, and demonstrate leadership in academia and industry.

PEO3. Utilize computational techniques and develop software by integrating existing technologies and adapt to new technologies for building rich software applications for benefit of the society.

Program Specific Outcomes (PSOs)

PSO1. Understand the concepts and applications in various fields of Computer Application like Web designing and development, Mobile application development, and Network & communication technologies.

PSO2. Apply standard practices and strategies in software development & project development using open-ended programming environments to deliver quality applications for business success.

PSO3. Employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

Course Types & Definitions

L	Lecture
T	Tutorial
P	Practical / Sessional
WCH	Weekly Contact Hours
BS	Basic Sciences
HS	Humanities & Social Sciences (including Management)
ES	Engineering Sciences
PC	Professional Core
PE	Professional Elective
OE	Open Elective
MC	Mandatory Course
CC	Compulsory Course
AC	Audit Course
PJ	Project Work
VV	Viva Voce

Contents

Part I

1st Year MCA

Curriculum Structure

Semester I									
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY									
BS	18MC1T01	Discrete Mathematics	3	1	0	3	1	0
HS	18MC1T02	Engineering Economics	3	0	0	3	0	0
ES	18MC1T03	Digital Electronics	3	0	0	3	0	0
PC	18MC1T04	Problem Solving & Programming Using C	3	0	0	3	0	0
PC	18MC1T05	Computer Organization & Architecture	3	0	0	3	0	0
MC	18MC1T06	Professional Ethics & Values	2	0	0	0	0	0
PRACTICAL								
PC	18MC1L01	C Programming Lab	0	0	6	0	0	3
PC	18MC1L02	Computer Organization & Architecture Lab	0	0	2	0	0	1
ES	18MC1L03	Digital Electronics Lab	0	0	2	0	0	1
		SUB-TOTAL	**17**	**1**	**10**	**15**	**1**	**5**
		TOTAL	**28**			**21**		

Semester II									
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY									
HS	18MC1T07	Financial Accounting	3	0	0	3	0	0
BS	18MC1T08	Numerical Methods	3	0	0	3	0	0
PC	18MC1T09	Data Structures Using C	3	0	0	3	0	0
PC	18MC1T10	Graphics & Visual Computing	3	0	0	3	0	0
PC	18MC1T11	OOP Using C++	3	0	0	3	0	0
PC	18MC1T12	Management Information Systems & Business Intelligence	3	0	0	3	0	0
PRACTICAL								
PC	18MC1L04	Data Structures Using C Lab	0	0	4	0	0	2
PC	18MC1L05	Graphics & Visual Computing Lab	0	0	2	0	0	1
PC	18MC1L06	OOP Using C++ Lab	0	0	2	0	0	1
MC	18MC7L07	Yoga	0	0	2	0	0	0
		SUB-TOTAL	**18**	**0**	**10**	**18**	**0**	**4**
		TOTAL	**28**			**22**		

Type	Code	Discrete Mathematics	L-T-P	Credits	Marks
BS	18MC1T01		3-1-0	4	100

Objectives	The objective of this course is to familiarize the students with mathematical logic, counting techniques and abstract structures like groups, Boolean algebra and graphs.
Pre-Requisites	Basic knowledge of sets and matrices is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Propositional Calculus and Predicate Calculus, Rules of inference.	**8 Hours**
Module-2	Proofs and proof strategies, Summation of sequences, Mathematical induction.	**8 Hours**
Module-3	Basics of counting techniques, Recurrence relation and its solutions, Principle of inclusion and exclusion and its applications.	**10 Hours**
Module-4	Set Theory, Relation, Equivalence relation and Partial Order relation, Hasse-Diagram.	**10 Hours**
Module-5	Graphs, paths and connectivity in a graph, planar graph, Trees.	**10 Hours**
Module-6	Binary operation, semigroup, monoid, group and ring, group codes.	**10 Hours**
	Total	**56 Hours**

Text Books:

T1. K. H. Rosen, ***Discrete Mathematics and its Application***, 7th Edition, McGraw-Hill, 2017.
T2. C. L. Liu, ***Elements of Discrete Mathematics***, 2nd Revised Edition, Tata McGraw-Hill, 1985.

Reference Books:

R1. J. P. Tremblay and R. Manohar, ***Discrete Mathematical Structures with Applications to Computer Science***, Indian Edition, McGraw-Hill Education, 2017.
R2. T. Koshy, ***Discrete Mathematics and Applications***, 1st Edition, Academic Press (Elsevier), 2003.
R3. J. R. Mott, A. Kandel, and T. P. Baker, ***Discrete Mathematics for Computer Scientists and Mathematicians***, 2nd Edition, Pearson Education India, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/111105035
2. http://www.nptel.ac.in/courses/122104017
3. http://nptel.ac.in/courses/122102009
4. http://freevideolectures.com/Course/2267/Mathematics-I/22
5. http://nptel.ac.in/courses/111106086/
6. http://www.edx.org/Probability
7. https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/lecture-notes/

8. https://onlinecourses.nptel.ac.in/noc15_ec07/9.http://www.math.uvic.ca/faculty/gmacgill/guide/index.html
9. http://nptel.ac.in/courses/106106094/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand various logical connectives and expressions along with rules of inferences.
CO2	Understand various methods of proofs and proof strategies.
CO3	Acquire various counting techniques using recurrence relations, generating functions for future applications.
CO4	Acquire the knowledge on sets, relations and functions.
CO5	Understand the concepts and applications of graphs.
CO6	Understand various algebraic structures like group, ring, Boolean algebra and its applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	1						3	1	1
CO2	3	3	2	3	1						2	1	1
CO3	3	3	2	2	2						3	1	1
CO4	3	2	2	2	2						2	1	1
CO5	3	2	3	2	2						3	1	1
CO6	3	3	2	3	1						2	1	1

Type	Code	Engineering Economics	L-T-P	Credits	Marks
HS	18MC1T02		3-0-0	3	100

Objectives	The objective of this course is to familiarize the students with elementary principles of economics and introduce them to the dynamic environment of economic calculations and principles through the prism of engineering and technology to be able to evaluate, assess, estimate a given project from engineering stand point.
Pre-Requisites	Basic knowledge on interest formula and knowledge on derivatives is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Engineering Economics- its meaning and importance, Basic problems of an economy. Time value of equivalence, compound interest factors. Sinking– fund factor, Capital-recovery factor, Series compound factor, Series present worth factor, Arithmetic gradient factor, Geometric gradient factor, Cash flow diagrams, Calculation of time value of equivalence, Present worth comparison, Net Present worth, Present worth of equivalence, Comparison of Assets having equal, Unequal lives and infinite lives, Future worth Method, Payback period comparison.	**9 Hours**
Module-2	Equivalent Annual worth Method, EAC and EAW, Situations for equivalent Annual worth Comparison, Rate of Return, IRR Calculation, Incremental IRR Analysis, Depreciation Analysis, Causes of Depreciation, Methods of Depreciation, Straight line and Declining Balance Method, MACRS method and After Tax Comparison, Cost-Benefit Analysis, Public and Private projects, Enumeration of cost and benefit.	**9 Hours**
Module-3	Problems and introduction to Micro Economics, Micro and Macro Economics, Theory of Demand, Demand Function, Law of demand, Determinants of demand. Exceptions to the law of demand. Demand Forecasting. Elasticity of demand, Price elasticity, Determinants of elasticity of demand. Measurement of elasticity of demand. Income elasticity and cross elasticity of demand, Law of Supply, Determinants, Limitations and elasticity of Supply.	**8 Hours**
Module-4	Laws of Production, Laws of Variable Proportion, Laws of Return to scale, Cost concepts, Total Costs, Fixed cost, variable cost, AFC,AVC and MC, Revenue concepts, Total revenue, Average revenue and marginal revenue Market (Different market forms), Perfect Competitive market, Determination of price under perfect competition, Break-even Analysis.	**8 Hours**

Cont'd...

Module-#	Topics	Hours
Module-5	National Income, Definitions, Concepts of National Income, Methods of measuring national income, Commercial Banks, Functions of Commercial Bank, Central Bank, Functions of Central Bank, Inflation , Meaning of Inflation, Types, Causes, Measures to control inflation, Financial Market, Money and capital market.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. J. L. Riggs, D. D. Bedworth, and S. U. Randhawa, ***Engineering Economics***, 4th Edition, Tata McGraw-Hill, 2004.
T2. H. L. Ahuja, ***Principles of Micro Economics***, 22nd Edition, S. Chand Publishing, 2016.
T3. R. R. Paul, ***Monetary Economics***, 11th Edition, Kalyani Publishers, 2015.

Reference Books:

R1. C. S. Park, ***Contemporary Engineering Economics***, 6th Edition, PHI, 2016.
R2. D. G. Newnan, T. G. Eschenbach, and J. P. Lavelle, ***Engineering Economics Analysis***, 10th Edition, Oxford Univ. Press, 2009.
R3. A. Koutsoyiannis, ***Modern Micro Economics***, Palgrave Macmillan UK, 1979.
R4. W. C. Lewis, S. K. Jain, and C. H. Petersen, ***Managerial Economics***, 4th Edition, Pearson Education India, 2006.
R5. N. G. Mankiw and M. P. Taylor, ***Macroeconomics***, 4th Edition, Cengage Learning India, 2017.
R6. M. P. Agasty, ***Engineering Economics and Costing***, 2nd Edition, Scitech Publication, 2009.

Online Resources:

1. http://www.m5zn.com/newuploads/2013/05/28/pdf/ed6f3d1f87b9cd2.pdf
2. http://site.iugaza.edu.ps/nsawalhi/files/2014/01/Engineering-Economic-Analysis-9th.pdf
3. http://site.iugaza.edu.ps/nsawalhi/files/2014/01/Engineering-Economic-Analysis-9th.pdf
4. http;//ncert.nic.in/ncerts/l/leec102.pdf
5. http://nptel.ac.in/courses/112107209/1
6. http://www.icaiknowledgegateway.org/littledms/folder1/chapter-5-part-2.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop the ability to account for time value of money using engineering economy factors and formulas for problem solving.
CO2	Apply knowledge of mathematics, economics and engineering principles to solve engineering problems , analyze decision alternatives in engineering projects and compute the depreciation of an asset using standard depreciation techniques.
CO3	Evaluate how changes in demand and supply affect market and production.
CO4	Assess the effects of changes in costs, selling price and units sold on the break-even point and target profit.
CO5	Analyze the macroeconomic environment of the business and its impact on society and enterprise.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.

Cont'd...

PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1							1		3			2	2
CO2	2	1	2		2		3		2			3	2
CO3	2	1		1	2		2		2			1	1
CO4	2	2	2	1	2		2	1	3	2		2	2
CO5								1	3			1	1

Type	Code	Digital Electronics	L-T-P	Credits	Marks
ES	18MC1T03		3-0-0	3	100

Objectives	To introduce the students to the concepts and techniques associated with the number systems and codes and to minimize the logical expressions using Boolean postulates, to design various combinational circuits, to analyse and design the sequential circuits, and to analyse programmable logic devices.
Pre-Requisites	Basic knowledge of elementary science is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Fundamental Concepts and Digital Logic Families: Introduction to Electronics and its applications, Digital Signals, Basic Digital Circuits, Different Logic Gates and their Logic Operations, Universal Logic Gates, Complete Logic Sets. Examples of IC Gates. CMOS Logic Family.	**7 Hours**
Module-2	Number Systems and Codes: Number Systems, Binary Number System, Signed Binary Numbers, Binary Arithmetic, 1's and 2's Complement Arithmetic, Octal Number System, Hexadecimal Number System, Codes, Error Detecting and Correcting Codes.	**6 Hours**
Module-3	Combinational Logic Design: Boolean Algebra and Identities, Algebraic Reduction and Realization using Logic Gates and Universal Logic Gates. Standard Representation for Logic Functions: Sum-of-Products (SOP) and Product-of-Sums (POS) forms, Canonical SOP and POS forms. K-map representation and simplification of logic functions using K-map, Minimization of 2, 3, 4 variable logical functions. Don't care conditions.	**7 Hours**
Module-4	Combinational Logic Components: Multiplexer, De-Multiplexer, Decoders, Encoder (Priority Encoder), Design of Combinational Circuits using Multiplexer and Decoder, Adders, Subtractors, Binary Multiplier, ALU (Arithmetic and Logic Unit), An Equality Detector and Comparator, BCD to 7-Segment Display Decoder.	**7 Hours**
Module-5	Sequential Logic Design(Flip-Flops): Flip Flops: A 1-bit memory, Bistable latch (SR and D), the clocked SR flip flop, J-K, T and D type flip-flops, Race Around Condition, Master Slave JK-flip flop, Conversion of flip-flops.	**8 Hours**
Module-6	Sequential Logic Design (Shift Registers and Counters): Shift Registers: (SISO, SIPO, PISO, PIPO and Universal Shift Register), Applications of Shift Registers (Serial to Parallel Converter, Parallel to Serial Converter), Ring Counter, Twisted Ring Counter (Johnson Counter). Counters: Design of Ripple (Asynchronous) Counters (Up/ Down Counter, Mod-N Counter), Design of Synchronous Counters.	**9 Hours**
	Total	**44 Hours**

Text Books:

T1. R. P. Jain, ***Modern Digital Electronics***, 4th Edition, McGraw-Hill Education, 2009.
T2. M. M. Mano & C. Kime, ***Digital Logic and Computer Design***, 4th Edition, Pearson Education India, 2013.
T3. A. A. Kumar, ***Fundamentals of Digital Circuits***, 4th Rev. Edition, Prentice Hall India, 2016.

Reference Books:

R1. J. F. Wakerly, ***Digital Design: Principles and Practices***, 4th Edition, Pearson Education.
R2. J. P. Uyemura, ***A First Course in Digital System Design: An Integrated Approach***, India Edition, PWS Publishing Company.
R3. R. J. Tocci, N. S. Widemer, and G. L. Moss, ***Digital Systems – Principles and Applications***, 10th Edition, Pearson Education.
R4. A. Agarwal and J. Lang, ***Foundations of Analog and Digital Electronic Circuits***, 1st Edition, Morgan Kaufmann, 2005.

Online Resources:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/
2. http://nptel.ac.in/courses/117106086/1
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-111-introductory-digital-systems-laboratory-spring-2006/
4. https://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/
5. http://www.allaboutcircuits.com

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Gain familiarity with various logic operations and logic gates.
CO2	Understand different number systems, codes and their applications.
CO3	Analyze combinational logic functions, learn how to minimize and realize those using universal gates.
CO4	Design and implement the combinational logic circuits for various day-to-day applications.
CO5	Understand the design and operations of different kinds of flip-flops.
CO6	Design and implement the sequential logic circuits for various day-to-day applications like registers and counters.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

P.T.O

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	1		1							3		1
CO2	3	2	1	1							3		2
CO3	2	3	1	2							2		2
CO4	3	2	3	2	1						3		1
CO5	1	1	2	2							3		2
CO6	2	3	3	2	1						3		1

Type	Code	Problem Solving & Programming Using C	L-T-P	Credits	Marks
PC	18MC1T04		3-0-0	3	100

Objectives	The course aims to provide exposure to problem-solving through programming and train the students on the basic concepts of the C-programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to computers, basic organization of a computer, number system and conversion, algorithm, flowchart, structure of C program, character set, identifier, keywords, constants, variables, data types, expression, statements, operators, operator precedence and associativity, type conversion; Decision making and branching: if, if-else, nested if-else, else-if ladder, switch statement; Loop constructs: while, for, do-while, nested loops, jump statements (break, continue, goto), exit statement.	**10 Hours**
Module-2	Functions: monolithic vs modular programming, user defined function vs library function, introduction to function, function prototype, function definition, function call, parameter passing, recursion, storage classes (auto, register, static, extern); Arrays: declaration and initialization of arrays, accessing array elements, basic operation on arrays,multidimensional array, array and function.	**7 Hours**
Module-3	String: declaration and initialization, manipulation, string handling functions: strlen, strcpy, strcat, strcmp; Pointers: concepts of pointer, declaration and initialization of pointer variable, accessing variable through pointer, pointer arithmetic, pointer expression, chain of pointers, using pointer with arrays and string, array of pointers, pointer to an array, pointer as function argument, function returning pointer, pointer to function.	**7 Hours**
Module-4	Structures: declaration and definition, initialization, accessing members of structure, copying and comparing structure variables, nested structures, array of structure, structure and function, pointer to structure, self-referential structure, union; Dynamic Memory Management using the malloc, calloc, realloc and free functions.	**8 Hours**

Cont'd...

Module-#	Topics	Hours
Module-5	File Handling: concept of files, text vs binary file, data file manipulation, file opening and closing, standard and formatted input/output operation on files, random access on files using functions ftell, fseek, and rewind; Command-line arguments, typedef, bit-field, enumerated data type, pre-processor directives, macros, file inclusion.	**10 Hours**
	Total	**42 Hours**

Text Books:

T1. E. Balagurusamy, ***Programming in ANSI C***, 4th Edition, Tata McGraw-Hill, 2008.
T2. Y. Kanetker, ***Let Us C***, 15th Edition, BPB Publications, 2016.

Reference Books:

R1. B. W. Kernighan and D. M. Ritchie, ***The C Programming Language***, 2nd Edition, PHI, 1988.
R2. H. M. Deitel and P. J. Deitel, ***C : How to Program***, 3rd Edition, Pearson Education Asia.
R3. B. S. Gottfried, ***Programming with C***, 2nd Edition, Tata McGraw-Hill.
R4. H. Schildt, ***C: The Complete Reference***, 4th Edition, Tata McGraw-Hill.
R5. R. Thareja, ***Programming in C***, 1st Edition, Oxford University Press.

Online Resources:

1. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C_%28programming_language%29.html
2. http://www.stat.cmu.edu/~hseltman/c/CTips.html
3. http://www.c-faq.com/
4. http://www.learn-c.org/
5. https://www.javatpoint.com/c-programming-language-tutorial

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop simple C programs using data types, variables, operators and control transfer statements.
CO2	Design C programs to handle similar data items using arrays and construct modular programs.
CO3	Use string and pointer to design efficient C programs for manipulating real life situations.
CO4	Manipulate memory during run time and handle heterogeneous data items using structure and union.
CO5	Design C programs to create and manipulate files. Write efficient C programs using command line arguments, macros and pre-processor directives.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2		1					2	3	1	2
CO2	3	3	3		3					2	3	1	2
CO3	3	3	3		3					2	3	1	2
CO4	3	3	3		3					2	3	1	2
CO5	3	2	3		2					2	2	1	2

Type	Code	Computer Organization & Architecture	L-T-P	Credits	Marks
PC	18MC1T05		3-0-0	3	100

Objectives	The objective of this course is to familiarize students about hardware design including logic design, basic structure and behaviour of the various functional modules of the computer and how they interact to provide the processing needs of the user.
Pre-Requisites	Knowledge of Basic Digital Electronics and computer fundamentals.
Teaching Scheme	Regular classroom lectures with use of ICT wherever required, and planned interactive sessions with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Basic structure of Computer: Functional Units & Operation concepts, Bus Structures, Performance, Multiprocessors and Multi computers, Memory Location and Address, Memory Operations, Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Addressing Modes, Basic I/O Operation, Subroutines.	**9 Hours**
Module-2	Binary Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of positive numbers, Signed Operand Multiplication, Fast multiplication, Integers Division, Floating–Point numbers representation, Floating – Point numbers operations.	**8 Hours**
Module-3	Memory System: Basic Concepts, Semiconductor RAM memories, ROM, Speed size and cost, Cache Memory concepts, Cache Memory mapping techniques, Performance consideration, Virtual Memory concepts, Translation Look-aside Buffer, Replacement techniques, Secondary Storage.	**9 Hours**
Module-4	Basic Processing Unit: Fundamental Concepts, Execution of Complete Instruction, Multi-bus Organization, Hardwired control, Micro-programmed control. I/O Interface, Isolated vs Memory Mapped I/O, Mode of transfer: Programmed I/O, interrupt I/O, DMA.	**8 Hours**
Module-5	Pipelining: Basic Concepts, Parallel Processing, Pipeline Hazards, Data Hazard, Structural Hazard, Control Hazard, Super Scalar Operation, Case Study: Ultra Sparc II.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. C. Hamacher, Z. Vranesic, and S. Zaky, ***Computer Organization***, 5th Edition, TMH, 2011.
T2. M. M. Mano, ***Computer System Architecture***, 3rd Edition, PHI, 2003.

Reference Books:

R1. B. Govindarajalu, ***Computer Architecture and Organization***, 5th Edition, TMH, 2004.
R2. N. Carter, ***Schaum's Outline of Computer Architecture***, TMH, 2002.

Online Resources:

1. https://nptel.ac.in/courses/106/103/106103068/
2. https://nptel.ac.in/courses/106/106/106106166/
3. https://nptel.ac.in/courses/106/105/106105163/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Identify and describe the functionality of various functional units of digital computer. Compare different addressing modes, instruction formats and their implementation in programming.
CO2	Perform various binary arithmetic operations using different techniques. Represent floating point numbers and perform various operations on them.
CO3	Describe the working principle of Main Memory, Cache Memory and Virtual Memory organization and solve numerical problems based on memory management.
CO4	Identify the components of single & multi bus organization and describe execution of complete instruction. Compare different modes of data transfer techniques.
CO5	Describe the working principle of pipeline and identify various pipeline hazards. Explain the principle behind super scalar operation.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	3	1					1	2		3
CO2	2	2	3	3	1					1	2	1	2
CO3	3	3	3	2	2					1	2	1	2
CO4	2	2	2	1	1					1	3	2	3
CO5	3	3	3	3	1					1	1		1

Type	Code	Professional Ethics & Values	L-T-P	Credits	Marks
MC	18MC1T06		2-0-0	0	100

Objectives	To enable the students to create an awareness on professional ethics and human values, to instill moral and social values and loyalty to appreciate the rights of others, and to provide the basis for deciding that a particular action is morally good or bad.
Pre-Requisites	Elementary idea on Psychology, sensitivity to professionalism with respect to morality, judgment, and commitment.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, and planned interactive sessions.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Ethics: Basic terms- Moral, Ethics, Ethical dilemma, Emotional intelligence, Moral development theories of Kohlberg and Piaget, Views on ethics by Aristotle, Governing factors of an individual's value system, Personal and professional ethics.	**6 Hours**
Module-2	Profession and Professionalism: Clarification of the concepts: Profession, Professional, Professionalism, Professional accountability, Professional risks, Profession and Craftsmanship, Conflict of interest, Distinguishing features of a professional, Role and responsibilities of professionals, Ethical Theories: Various ethical theories and their application- Consequentialism, Deontology, Virtue theory, Rights Theory, Casuist theory, Ethical terms: Moral absolutism, Moral Relativism, Moral Pluralism etc., Resolving Ethical Dilemma.	**9 Hours**
Module-3	Ethics in Engineering: Purpose and concept of Engineering Ethics, Engineering as social experimentation, Types of enquiry, Issues in engineering ethics.	**3 Hours**
Module-4	Engineers' Responsibility and Safety: Safety, Risk, Underestimating the risk, Over estimating the risk, Indifferent to risk, Risk-benefit analysis, Causes of an accident and identification of the preventive measures to be taken.	**3 Hours**
Module-5	Global Ethical Issues: Different ethical issues in business, environment, IT, Bioethics, Intellectual Property Rights, Research, Media.	**7 Hours**
	Total	**28 Hours**

Text Books:

T1. R. Subramanian, ***Professional Ethics***, 2nd Edition, Oxford University Press, 2017.

Reference Books:

R1. M. W. Martin and R. Schinzinger, ***Ethics in Engineering***, Tata McGraw Hill, 2013.

R2. C. E. Harris, M. S. Pritchard, and M. J. Rabins, ***Engineering Ethics - Concepts and Cases***, Thompson Learning, 2003.
R3. D. Albuquerque, ***Business Ethics***, Oxford University Press, 2013.
R4. E. G. Seebauer and R. L. Barry, ***Fundamentals of Ethics***, Oxford University Press, 2012.

Online Resources:

1. https://india.oup.com/orcs/9780199475070/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Learn ethical concepts which will enable them to effectively resolve ethical issues in their personal and professional lives.
CO2	Be aware of their duties and responsibilities as professionals towards their organization and society.
CO3	Gather primary knowledge on engineering ethics and its objectives, different parameters of enquiry and engineering as an experiment in society.
CO4	Be conscious about risk and safety while finding a solution to an engineering problem.
CO5	Become attentive of the different global ethical issues.

Program Outcomes Relevant to the Course:

PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1			1		1	3	1		1	1		3	1
CO2					1	1	1		1	1		3	1
CO3			1		1	2	1		1	1		3	1
CO4			1		1	2	1		1			3	1
CO5			1		1	2	1		1	1		3	2

Type	Code	C Programming Lab	L-T-P	Credits	Marks
PC	18MC1L01		0-0-6	3	100

Objectives	Formulate problems and implement algorithms using C programming language. The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C.
Pre-Requisites	Basic knowledge of computers and knowledge of C programming language.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Linux operating system and simple Linux commands.
2	Working with the vi Editor.
3	Compilation and execution of simple C programs.
4	Programs using arithmetic operators.
5	Programs using relational and logical operators.
6	Formulate problems on Decision making statements using if-else.
7	Formulate problems on Decision making statements using nested if-else.
8	Implement decision making statements using switch-case.
9, 10	Implement loop-control structures using while construct.
11	Implement loop-control structures using do-while construct.
12, 13	Programs on loop-control structures using for loops.
14	Programs on loop-control structures using nested loops.
15	Programs on control transfer statement using break, continue, goto.
16	Develop Programs for 1-Dimensional array operations.
17	Develop programs for 2-Dimensional array operations.
18	Programs on using pointers with variables of different data-types.
19	Operations on Array using Pointer.
20	Programs on functions using call by value.
21	Programs on functions using call by reference.
22,23	Develop programs on functions using recursion.
24	Develop programs on storage classes.
25	Programs on creating and using strings.
26	Programs on string manipulation functions in C.
27	Programs on string manipulation using pointers.
28, 29	Programs on creating and using simple structures.

Cont'd...

Experiment-#	Assignment/Experiment
30	Programs on array of structures.
31	Programs on nested structures.
32	Programs on use of pointers to structures.
33	Passing Array and structure to user defined functions.
34	Programs on creating and using unions.
35	Formulate problems on dynamic memory management using malloc() and calloc().
36	Formulate problems on dynamic memory management using realloc() and free().
37	Programs on passing parameters through command-line arguments.
38	Programs on pre-processor directives.
39	Programs on use of enumeration.
40	Programs for opening of files in different modes and closing of file.
41	Programs on read and write operations on text file.
42	Programs on random access operations on text file.

Text Books:

T1. E. Balagurusamy, ***Programming in ANSI C***, 7th Edition, McGraw-Hill Education, 2017.
T2. M. Sprankle, ***Programming and Problem Solving***, 9th Edition, Pearson Education, 2011.

Reference Books:

R1. B. W. Kernighan and D. M. Ritchie, ***The C Programming Language***, 2nd Edition, PHI, 2012.
R2. H. M. Deitel and P. J. Deitel, ***C How to Program***, 3rd Edition, Pearson Education Asia,2001.
R3. H. Schildt, ***C: The Complete Reference***, 4th Edition, McGraw-Hill Education, 2017.

Online Resources:

1. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C_%28programming_language%29.html
2. http://www.stat.cmu.edu/~hseltman/c/CTips.html
3. http://www.c-faq.com/
4. http://www.learn-c.org/
5. https://www.javatpoint.com/c-programming-language-tutorial

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Construct C programs for mathematical operations using control statements.
CO2	Develop C programs for Array and String manipulation.
CO3	Construct modular programs for better maintenance and reusability.
CO4	Manipulate heterogeneous data using structure & union and apply dynamic memory management techniques to solve different problems.
CO5	Create and manipulate files using C programs and develop the programs using command line arguments.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.

Cont'd...

PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2		2					2	3	1	2
CO2	3	2	2		2					2	3	1	2
CO3	3	2	2		2					2	3	1	2
CO4	2	2	2		3					2	2	1	1
CO5	2	2	3		2					2	2	1	2

Type	Code	Computer Organization & Architecture Lab	L-T-P	Credits	Marks
PC	18MC1L02		0-0-2	1	100

Objectives	To study different parts of computer and realize different computer arithmetic, memory management operations through simulation.
Pre-Requisites	Knowledge of computer basics and programming logic.
Teaching Scheme	Regular laboratory classes with use of ICT wherever required, demonstration through various computer system components, and simulation of some concepts using SciLab.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Study of Computer Components.
2	Study of Motherboard of a Computer.
3	Assembling and dissembling of a computer system.
4	BIOS setting and installation
5	Introduction to SciLab.
6	SciLab Functions and control structure.
7	Script files and functions in SciLab.
8	Implementation of Basic Gates.
9	Design of Adders.
10	Simulation of Booth Algorithm and Integer division.
11	Simulation of Cache Memory mapping functions.
12	Simulation of page replacement algorithms.
13	Simulation of Pipelining.
14	Project

Text Books:

T1. C .Hamacher, Z Vranesic, and S Zaky, ***Computer Organization***, 5th Edition, Tata McGraw-Hill, 2011.
T2. T. Sheth, ***SCILAB: A Practical Introduction to Programming and Problem Solving***, 1st Edition, CreateSpace Independent Publishing Platform, 2016.

Reference Books:

R1. S. Nagar, ***Introduction to SciLab for Engineers & Scientists***, 1st Edition, A Press, 2017.
R2. V. V. Das, ***Programming in SciLab 4.1***, 1st Edition, New Age International Publisher, 2008.

Online Resources:

1. https://help.scilab.org/docs/6.0.1/en_US/index.html
2. https://www.it.iitb.ac.in/~vijaya/ssrvm/dokuwiki/media/cm7_l1_14oct.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Identify and analyze the components of digital computer. Disassemble and Assemble a modern digital computer and implementation of BIOS setting.
CO2	Develop programs in MATLAB using control structure and script files.
CO3	Analyze and develop code for simulation of various basic gates.
CO4	Implement the logic for various binary arithmetic operations.
CO5	Simulate different memory management operations.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	1	2	2					1	1		3
CO2	2	2	3	3	2					1	1	1	1
CO3	3	2	3	1	1					1	1	1	1
CO4	3	2	3	2	2					1	1	1	1
CO5	3	2		2	2					1	2	2	2

Type	Code	Digital Electronics Lab	L-T-P	Credits	Marks
ES	18MC1L03		0-0-2	1	100

Objectives	To introduce the concepts and techniques associated with the number systems and codes and to minimize the logical expressions using Boolean postulates, To design various combinational and sequential circuits, and to understand the concepts of modeling a digital system using Hardware Description Language.
Pre-Requisites	Knowledge of digital electronics and programming language is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. Demonstration shall be given for the experiments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates, use of Universal NAND Gate.
2	Gate-level minimization: Two level and multi level implementation of Boolean functions.
3	Combinational Circuits: design, assemble and test: adders and subtractors, code converters, gray code to binary and 7 segment displays.
4	Design, implement and test a given design example with (i) NAND Gates only (ii)NOR Gates only and (iii) using minimum number of Gates
5	Design with multiplexers and de-multiplexer.
6	Flip-Flop: assemble, test and investigate operation of SR, D & J-K flip-flops.
7	Shift Registers: Design and investigate the operation of all types of shift registers with parallel load.
8	Counters: Design, assemble and test various ripple and synchronous counters -decimal counter, Binary counter with parallel load.
9	Memory Unit: Investigate the behaviour of RAM unit and its storage capacity – 16 X4 RAM: testing, simulating and memory expansion.
10	Clock-pulse generator: design, implement and test.
11	Parallel adder and accumulator: design, implement and test.
12	Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bit product
13	Verilog/VHDL simulation and implementation of experiments 3 to 12 listed above.

Text Books:

T1. R. P. Jain, ***Modern Digital Electronics***, 4th Edition, McGraw-Hill Education, 2009.
T2. M. M. Mano, ***Digital Logic and Computer Design***, Pearson Education India, 2016.
T3. A. Kumar, ***Fundamentals of Digital Circuits***, Prentice Hall India, 2016.

Reference Books:

R1. J. P. Uyemura, ***A First Course in Digital System Design: An Integrated Approach***, India Edition, Cengage Learning, 2006.
R2. R. J. Tocci, N. S. Widemer, and G. L. Moss, ***Digital Systems - Principles and Applications***, 10th Edition, Pearson Education.

Online Resources:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-111-introductory-digital-systems-laboratory-spring-2006/
2. http://vlab.co.in/ba_labs_all.php?id=1
3. http://iitg.vlab.co.in/?sub=59&brch=165

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Realize digital circuits using number systems and their conversion.
CO2	Design and implement the combinational logic circuits by optimization.
CO3	Examine and differentiate logic components utilized in Communication Networks.
CO4	Design various synchronous sequential circuits and analyze their finite state machines.
CO5	Understand and design shift registers and counters.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3							1		3		1
CO2	3	2			2				1		3		2
CO3	3	3	1		2				1		2		2
CO4	2	2	2		3				2		3		1
CO5	1	2	2		3				2		3		2

Type	Code	Financial Accounting	L-T-P	Credits	Marks
HS	18MC1T07		3-0-0	3	100

Objectives	To provide basic knowledge of financial accounting and equip the students with the knowledge of accounting process and preparation of final accounts.
Pre-Requisites	Basic knowledge of day to day transactions of any business organization.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Fundamentals of Accounting: Accounting as a business function and language of business, Functions and objectives of Accounting, Users of Accounting information, Limitations of Accounting, Cyclical nature of business and Accounting cycles, Accounting concepts – as applicable to Balance sheet and Income Statements, The rule of debit and credit.	**7 Hours**
Module-2	Accounting equations, Accounting events and transactions, Classification of transaction and their effect on Accounting Equation, Statement showing the effect of transaction on assets, liabilities and capital, Capital and revenue transactions, Fixed assets and depreciation policy and methods.	**8 Hours**
Module-3	Recording of transaction: The journal, The ledger postings, Subsidiary Books of Accounts: purchase books, sales books, Cash books.	**7 Hours**
Module-4	Preparation of Financial Statements of a sole trader: Trial balance, Trading Account, Manufacturing Account, Profit and Loss account, Balance sheet with basic adjustments.	**10 Hours**
Module-5	Company Accounts: Types of Companies - Private sector, Public sector, Private limited, public limited, Govt. company, holding company and subsidiary company, Capital and types of capital - Authorized Share Capital, Subscribed, issued, paid up share capital, Shares - Equity Shares, Preference shares and types of preference shares, Issue of share capital and treatment of books of Accounts, Journal entries for issue only (forfeiture of shares excluded).	**10 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Dash, S. Sahu, and R. K. Bal, ***A New Approach to Financial Accounting for Professional Student***, S. Chand Publication, 2010.
T2. S. P. Jain and K. L. Narang, ***Financial Accounting***, Latest Edition, Kalyani Publishers.

Reference Books:

R1. A. K. Bhattacharya, ***Financial Accounting***, Latest Edition, Prentice Hall of India.
R2. S. N. Maheshwari, Sharad K. Maheshwari, and Suneel K. Maheshwari, ***Principles of Financial Accounting***, Vikas Publishing, 2013.

Online Resources:

1. https://www.mbacrystalball.com/blog/accounting/financial-accounting/
2. https://www.myaccountingcourse.com/accounting-basics/financial-accounting
3. http://accounting-simplified.com/financial/fixed-assets/capital-and-revenue-expenditure.html
4. https://accountlearning.com/understanding-various-types-of-assets-and-liabilities/
5. https://syskool.com/a-company-definition-features/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the concept of accounting and its application in engineering.
CO2	Develop the ability to find out the effects of a transaction on assets, liabilities and capital.
CO3	Apply the rules and regulation of financial accounting to record the day to day transactions and events to keep records.
CO4	Evaluate the profit and loss of the organization.
CO5	Introducing to the corporate world, Learn about Companies, Shares and position of the company in the corporate world.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1		1					1	1	3			1
CO2	1				1		1			2	1		2
CO3			1	1			1			2			1
CO4	1		1	1			1			2		1	2
CO5			1	1			1						2

Type	Code	Numerical Methods	L-T-P	Credits	Marks
BS	18MC1T08		3-0-0	3	100

Objectives	The objective of this course is to make the students aware of different error calculations in numerical computations, Polynomial interpolation, Numerical differentiation and Integration. Also the students will be able to know Numerical solution of differential equations and system of linear equations.
Pre-Requisites	Basics of number systems, calculus and matrices.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Errors in numerical calculations, finding roots of algebraic and transcendental equations.	**8 Hours**
Module-2	Solution of system of linear equations by elimination methods and iterative methods, inverse of a matrix and finding eigen values.	**9 Hours**
Module-3	Interpolation, Lagrange interpolation, Newton's divided difference formula, Newton's forward and backward interpolation, cubic splines.	**8 Hours**
Module-4	Numerical differentiation and integration, trapezoidal and Simpson's rules, Gaussian integration.	**7 Hours**
Module-5	Numerical solution of ordinary differential equations by Euler method, improved Euler method, RungeKutta method, Predictor Corrector method.	**10 Hours**
	Total	**42 Hours**

Text Books:

T1. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, ***Numerical Methods for Scientific and Engineering Computation***, New Age International Publisher.

Reference Books:

R1. J. H. Mathews and K. D. Fink, ***Numerical Methods Using MATLAB***, Prentice Hall India.

Online Resources:

1. https://ocw.mit.edu/courses/mathematics/18-335j-introduction-to-numerical-methods-fall-2010/
2. https://onlinecourses.nptel.ac.in/noc17_ma14/course
3. https://www.class-central.com/tag/numerical%20methods
4. https://www.mooc-list.com/tags/nunerical-methods

P.T.O

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the concepts of error in numerical computations, its control and methods of root fining.
CO2	Acquire numerical skills and concepts of computation of matrix inverse and solution of linear systems.
CO3	Understand and apply the concepts of interpolation for approximating functions.
CO4	Perform differentiation and integration using various numerical methods.
CO5	Solve ordinary differential equations using various numerical techniques.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2			2						3	2	1
CO2	3	3			1						3	2	1
CO3	3	2			2						3	2	1
CO4	2	1			1						3	1	1
CO5	2	1			1						3	1	1

Type	Code	Data Structures Using C	L-T-P	Credits	Marks
PC	18MC1T09		3-0-0	3	100

Objectives	To understand the abstract data types, solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps, binary search trees and graphs.
Pre-Requisites	Knowledge of programming using C language is essential.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with programming and problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to data structures, classification of data structures, algorithms, time and space analysis of algorithms, asymptotic notation, abstract data types, Arrays- introduction, basic operations, row and column major representation, sparse matrix. Linked list- single linked list, double linked list, circular linked list.	**9 Hours**
Module-2	Representation of polynomial and its operations. Stack- representation using array and linked list, basic operations, applications- recursion, polish notation (conversion of infix to post fix expression and evaluation of postfix expression). Queue- representation using array and linked list, basic operations, circular queue.	**8 Hours**
Module-3	Tree- terminology, representation, binary tree - tree traversal algorithms with and without recursion. Binary search tree, Height balanced tree (AVL tree), m-way search trees, B-trees, applications of tree. Graph- terminology, representation, path matrix, graph traversal (BFS, DFS), all pair shortest path, topological sort.	**9 Hours**
Module-4	Searching and sorting techniques: linear and binary search, bubble sort, insertion sort, selection sort, quick sort, merge sort, radix sort.	**8 Hours**
Module-5	Introduction to heap, priority queue, applications of priority queue. Hashing- hash functions and hashing techniques. collision resolution techniques- linear probing, quadratic probing, chaining.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Tenenbaum, ***Data Structures Using C***, 3rd Edition, Pearson Education 2007.
T2. E. Horowitz, S. Sahni, and S. Anderson-Freed, ***Fundamentals of Data Structures in C***, 2nd Edition, Universities Press, 2008.

Reference Books:

R1. M. Weiss, ***Data Structures and Algorithm Analysis in C***, 2nd Edition, Pearson Education, 2002.
R2. J. P. Tremblay and P. G. Sorenson, ***An Introduction to Data Structures with Applications***, 2nd Edition, Tata McGraw-Hill, 1981.
R3. S. Lipchitz, ***Data Structures***, 1st Edition, Tata McGraw-Hill, 2005.

Online Resources:

1. http://nptel.ac.in/courses/106102064/1
2. http://www.nptelvideos.in/2012/11/programming-and-data-structure.html
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
4. https://www.coursera.org/learn/data-structures

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Compare different programming methodologies and define asymptotic notations to analyze performance of algorithms and get acquainted with array and linked list.
CO2	Extrapolate the concepts of polynomial and use appropriate data structures like arrays, linked list, stacks and queues to solve real world problems efficiently.
CO3	Represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications.
CO4	Apply the knowledge of different searching and sorting techniques to real-life problems.
CO5	Appreciate different memory management techniques, their significance and illustrate various hashing methods.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	2						1	3		3
CO2	3	3	2	2						1	3		3
CO3	3	3	2	2						1	3		3
CO4	3	3	3	2						1	3		3
CO5	3	3	2	2						1	3		3

Type	Code	Graphics & Visual Computing	L-T-P	Credits	Marks
PC	18MC1T10		3-0-0	3	100

Objectives	To understand the basics of various inputs and output computer graphics hardware devices as well as the course will offers an in-depth exploration of fundamental concepts in 2D and 3D computer graphics including 3D modeling, geometric transformations, 3D viewing and rendering.
Pre-Requisites	Knowledge of C programming, linear algebra, and matrix operations are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with programming and problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Basic of Computer Graphics, Applications of computer graphics, Display devices, Random and Raster scan systems, Graphics input devices, Graphics software and standards.	**6 Hours**
Module-2	Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributers.	**8 Hours**
Module-3	2D and 3D Transformations (translation, rotation, scaling), matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping (cohen-sutherland, liang- bersky), polygon clipping.	**10 Hours**
Module-4	3D display methods, polygon surfaces, tables, equations, meshes, curved lies and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods, Bazier curves and surfaces, B-spline curves and surfaces , general (parallel and perspective) projection transformations.	**10 Hours**
Module-5	Visible surface detection concepts, back-face detection, depth buffer method, illumination, light sources, illumination methods (ambient, diffuse reflection, specular reflection), Color models: properties of light, XYZ, RGB, YIQ and CMY color models, introduction to animation.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. D. Hearn and M. P. Baker, ***Computer Graphics - C Version***, 2nd Edition, Pearson Education, 2004.
T2. F. S. Hill, ***Computer Graphics using OpenGL***, 2nd Edition, Pearson Education,2003.

Reference Books:

R1. J. D. Foley, A. Vandam, S. K. Feiner, J. F. Huges, and others, ***Computer Graphics: Principles and Practice***, 3rd Edition, Addison-Wesley Professional, 2013.

R2. D. Hearn, M. P. Baker, and W. Caritthers, ***Computer Graphics with OpenGL***, 4th Edition, Prentice Hall India, 2010.
R3. S. Harrington, ***Computer Graphics – A Programming Approach***, 2nd Edition, Tata McGraw-Hill Publications, 2004.

Online Resources:
1. http://nptel.ac.in/courses/106102065/
2. https://www.tutorialspoint.com/computer_graphics/index.htm

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply concepts of graphics system, output primitives such as VDU, raster-scan, random scan, line drawing algorithms, basic transformation and matrix representation to represent various patterns in 2-dimensions.
CO2	Transform real-world objects to any view-ports, and compare the accuracy and quality of the images in both the coordinate systems especially for live video streaming.
CO3	Apply the process of line clipping, polygon clipping, aliasing and anti aliasing, two dimensional object representation, fractal geometry, three dimensional geometric representations to display real-world objects.
CO4	Exhibit projection, 3D-transformation of objects and represent multiple images in a scene with visible surface detection mechanisms such as Z-Buffer, A-Buffer, Painter's and scan-line algorithms.
CO5	Employ Illumination and polygon rendering techniques such as Back-Face detection, Gouraud Shading, Phong-Shading to various 3-dimensional images, design various animation applications using Virtual Reality environment.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	2	1							2	1	1
CO2	3	1	2	1							3	1	1
CO3	3	2	3	2							1		
CO4	1	1	2			2					2	1	1
CO5	3	2	2	1							1		

Type	Code	OOP Using C++	L-T-P	Credits	Marks
PC	18MC1T11		3-0-0	3	100

Objectives	The objective of this course is to facilitate the students to master the techniques of software development in C++ Programming Language and to demonstrate these techniques by implementing solutions for a variety of problems spanning the breadth of the language.
Pre-Requisites	Knowledge of programming using C language is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with programming and problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Object-Oriented Paradigm, Elements of Object Oriented Programming, Merits and Demerits of OO Methodology, C++ fundamentals - Data types, Operators and Expressions; Control flow, Arrays, Structure and Functions.	**8 Hours**
Module-2	Classes and Objects - Passing objects as arguments, returning objects, Static data and member functions; Constructors- Parameterized constructor, Copy Constructors, Destructor; Array of Objects, pointer to object members.	**8 Hours**
Module-3	Polymorphism, Function overloading, Unary operator overloading, binary operator overloading, Type Conversion, Overloading with Friend Functions, Inheritance, Derived class, Abstract Classes, Types of Inheritance.	**10 Hours**
Module-4	Virtual functions, Pure Virtual Functions, Virtual Destructors Template, Class template, Function Template, Basic concepts of STL.	**10 Hours**
Module-5	C++ streams – console streams, console stream classes, formatted and unformatted console I/O operations, Manipulators; File stream classes - File modes, File pointers and Manipulations, File I/O, Exception handling.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. H. Schildt, ***The Complete Reference C++***, 4th Edition, Tata McGraw-Hill, 2005.
T2. E. Balagurusamy, ***Object Oriented Programming with C++***, 2nd Edition, Tata McGraw-Hill, 2011.

Reference Books:

R1. B. Stroustrup, ***The C++ Programming Language***, 4th Edition, Addison Wesley, 2013.
R2. K. R. Venugopal and R. Buyya, ***Mastering C++***, 2nd Edition, Tata McGraw-Hill, 2013.
R3. J. R. Hubbard, ***Schaum's Outline of Programming with C++***, 2nd Edition,TMH, 2000.
R4. R. Lafore, ***Object Oriented Programming in C++***, 4th Edition, Galgotia Publications, 2001.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_cs17
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-096-introduction-to-c-january-iap-2011/lecture-notes/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Distinguish between Structured and Object Oriented problem solving approaches and apply them as per problem requirements.
CO2	Identify classes and objects from the given problem description and able to create classes and objects using C++.
CO3	Improve secured data processing by applying Abstraction, Encapsulation and Information hiding.
CO4	Achieve code reusability and extensibility by means of Inheritance and Polymorphism.
CO5	Use additional C++ features such as dynamic memory management, object copying, templates, and namespaces to formulate and solve complex societal problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1				3		2
CO2	3	3	2	1	1	1	1				3		2
CO3	3	2	3	2	1	1	1				3		2
CO4	3	3	3	2	2	1	1				3		2
CO5	3	3	3	3	1	1	1				3		2

Type	Code	Management Information Systems & Business Intelligence	L-T-P	Credits	Marks
PC	18MC1T12		3-0-0	3	100

Objectives	To enable the students to make or influence decisions related to the selection, design and support of software management and information systems.
Pre-Requisites	Basic knowledge of Information Technology is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Importance of Management Information Systems (MIS), logical foundation of MIS, Manager's view of information systems, functions of Management, managerial role, activities of a construction organization.	**8 Hours**
Module-2	Management and decision making in construction industry, classification of information systems, and impact of construction work on management information systems.	**8 Hours**
Module-3	Strategic uses of Information Technology, inter-organizational systems, strategic information systems related to construction industry	**8 Hours**
Module-4	Information technology, role of information technology in construction industry, impact of information technology on the individuals, impact on the construction organization, and process of re-engineering work.	**9 Hours**
Module-5	Business intelligence definition, business intelligence decision support initiative, development approaches, engineering stages and the development steps, business intelligence project team structure managing the business intelligence project, project planning activities, deliverables, general business requirement, the interviewing process, data analysis, data cleaning.	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. G. Devis and M. H. Oison, ***Management Information System***, 3rd Edition, TMH, 2008.
T2. E. Turban, R. Sharda, and D. Delen, ***Decision Support and Business Intelligence Systems***, 9th Edition, Pearson Education, 2013.

Reference Books:

R1. C. S. V. Murthy, ***Management Information System***, 1st Edition, Himalaya Publishing House, 1999.
R2. K. C. Laudon Jone and P. Laudon, ***Management Information Systems***, 13th Edition, Pearson Education, 2014.
R3. C. S. V. Murthy, ***Management Information Systems: Text, Cases & Application***, 3rd Edition, Himalaya Publishing House, 2004.

Online Resources:

1. http://www.amazon.com/Data-Mining-Business-Intelligence-Applications
2. http://mbaexamnotes.com/management-information-system-notes.html

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop an understanding of the role of information systems in organizations, strategic management processes and the implications for the management.
CO2	Know about different types of Management Information Systems.
CO3	Understand the basic technologies used in the field of Management Information Systems.
CO4	Understand processes required for development and implementation of information systems.
CO5	Describe key information technologies used in today's businesses, such as databases and business intelligence tools.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1		3	2	3	2	2	2	3	1	1	1	2	1
CO2		2	2	1	2	1	1	2	1		2	2	2
CO3		2		1	3	1		2	2	1	1	2	2
CO4	2	2	3	2	2	1	1	2	1	1	1	2	1
CO5	1	1	2	3	2	2		1	2	1	2	2	2

Type	Code	Data Structures Using C Lab	L-T-P	Credits	Marks
PC	18MC1L04		0-0-4	2	100

Objectives	Formulate problems and implement algorithms using the C programming language, to enhance their analysis and problem-solving skills and use the same for developing C programs for the computer.
Pre-Requisites	Basic knowledge of computers and knowledge of C programming language.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Design, develop and implement insert operation on array
2	Design, develop and implement delete operation on array
3	Develop a program for triplet representation of sparse matrix
4	Develop a program for transpose of sparse matrix
5, 6	Develop programs on structure, pointer and dynamic memory allocation
7, 8	Create a single linked-list and perform different operations on single linked-list
9, 10	Create a double linked-list and perform different operations on double linked-list
11, 12	Create a circular linked-list and perform different operations on circular linked-list
13	Develop a program to implement polynomial addition using linked-list
14, 15	Design, develop and implement stack using array and linked list
16, 17	Write programs to implement different applications of stack
18	Develop program to implement of queue using array
19	Develop program to implement queue using linked list
20	Write a program for implementation of circular queue
21, 22	Write program to implement of BST
23	Design, develop and implement graph traversal algorithms
24	Implementation of linear search and binary search
25	Implementation of bubble and selection sort
26, 27, 28	Implementation of insertion sort, quick sort, and merge sort

Text Books:

T1. A. Tenenbaum, ***Data Structures Using C***, 3rd Edition, Pearson Education, 2007.
T2. E. Horowitz, S. Sahni, S. Anderson-Freed, ***Fundamentals of Data Structures in C***, 2nd Edition, Universities Press, 2008.

Reference Books:

R1. M. Weiss, ***Data Structures and Algorithm Analysis in C***, 2nd Edition, Pearson Education, 2002.

R2. J. P. Tremblay and P. G. Sorenson, ***An Introduction to Data Structures with Applications***, 2nd Edition, Tata McGraw-Hill, 1981.
R3. S. Lipchitz, ***Data Structures***, 1st Edition, Tata McGraw-Hill, 2005.

Online Resources:

1. http://nptel.ac.in/courses/106102064/1
2. http://www.nptelvideos.in/2012/11/programming-and-data-structure.html
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
4. https://www.coursera.org/learn/data-structures

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Implement various operations on array and Sparse matrix.
CO2	Design functions to implement basic operations on stack and Queue. Apply the concept of stack and queue for solving real world problems.
CO3	Implement various operations of single, double and circular linked list and apply them in various real life applications.
CO4	Construct binary search tree and perform traversal, insertion, deletion, and search operations on it.
CO5	Compare between BFS and DFS traversal operations in a graph and implement various sorting and searching techniques.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2						1	3		3
CO2	3	3	3	2						1	3		3
CO3	3	3	3	2						1	3		3
CO4	3	3	3	2						1	3		3
CO5	3	3	3	2						1	3		3

Type	Code	Graphics & Visual Computing Lab	L-T-P	Credits	Marks
PC	18MC1L05		0-0-2	1	100

Objectives	To make the students understand and learn computer graphics programming and create 2D & 3D graphical scenes using open graphics library suites.
Pre-Requisites	Knowledge of C programming language, matrix operations and graphics.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Develop simple graphics program using OpenGL environment.
2	DDA algorithm for Line Drawing.
3	Bresenham's algorithm for Line Drawing.
4	Bresenham's algorithm for Circle Drawing.
5	Line, Circle attributes – Type, Width, Color.
6	Bresenham's algorithm for Ellipse Drawing.
7	Create scenery (with mountain, sun & tree etc.) and a solar system using Line, Circle & Ellipse generating algorithms.
8	2D transformation (Object-ship)– Translation, Rotation, Scaling, Reflection and shearing.
9	Composite 2D Transformations.
10	Cohen-Sutherland 2D clipping.
11	Cohen-Sutherland Window – View port Mapping.
12	Sutherland-Hodgeman polygon clipping.
13	3D transformation – Translation, Rotation, Scaling.
14	Three dimensional objects and Scenes using OpenGL, such as a teapot, solar system, cube etc.

Text Books:

T1. D. Hearn, M. P. Baker, and W. Carithers, ***Computer Graphics with OpenGL***, 4th Edition, Pearson Education, 2014.
T2. F. S. Hill & S. M. Kelley, ***Computer Graphics using OpenGL***, 3rd Edition, Pearson Education, 2014.

Reference Books:

R1. W. M. Newmann and R. F. Sproull, ***Principles of Interactive Computer Graphics***, 2nd Edition, Tata McGraw-Hill, 2008.
R2. E. Angel, ***OpenGL A Primer***, 2nd Edition, Addison-Wesley, 2005.

Online Resources:

1. http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-837-computer-graphics-fall-2003/

2. http://www.cs.mtu.edu/~shene/COURSES/cs3621/NOTES/spline/B-spline/bspline-curve-prop.html

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Draw basic objects like lines, triangles and polygons using OpenGL built-in functions.
CO2	Use matrix algebra in computer graphics and implement fundamental algorithms and transformations involved in viewing models.
CO3	Write basic graphics software systems projection models, illumination models and handling of hidden surfaces and clipping in computer graphics.
CO4	Analyze and evaluate the use of computer graphics methods in practical applications and describe effects such as texture mapping, bump mapping and anti-aliasing.
CO5	Apply computer graphics techniques to create aesthetic effects.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2		1					1	3		1
CO2	1		2		1	1				1	3		1
CO3	1		2		1	1				1	2		1
CO4	3				1					1	2		2
CO5	3		2	2	1					1	3		2

Type	Code	OOP Using C++ Lab	L-T-P	Credits	Marks
PC	18MC1L06		0-0-2	1	100

Objectives	The objective of this course is to provide the students hands-on experience in implementing object oriented programming concepts and impart skills required to solve real life problems using object oriented approach.
Pre-Requisites	Knowledge of C and object oriented concepts of C++ programming languages.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Programs on array, structure and functions.
2	Object oriented programs using class, objects and array of objects.
3	Function overloading, passing default argument and objects to function.
4	Inline functions, Static data member and Static member function.
5	Constructor, Constructor Overloading.
6	Copy Constructor, Destructor.
7	Unary and binary operator overloading.
8	Programs on Type conversion.
9	Single, Multiple and Multilevel Inheritance.
10	Hybrid Inheritance, virtual base class.
11	Virtual function, Exception handling.
12	Programs on File Handling (open, read, write, close etc.)
13	Programs on Class Templates, Function Templates.
14	Programs on Standard Template Library (STL).

Text Books:

T1. H. Schildt, ***The Complete Reference C++***, 4th Edition, Tata McGraw-Hill, 2005.
T2. E. Balagurusamy, ***Object Oriented Programming with C++***, 2nd Edition, Tata McGraw-Hill, 2011.

Reference Books:

R1. B. Stroustrup, ***The C++ Programming Language***, 4th Edition, Addison Wesley, 2013.
R2. K. R. Venugopal and R. Buyya, ***Mastering C++***, 2nd Edition, Tata McGraw-Hill, 2013.
R3. J. R. Hubbard, ***Schaum's Outline of Programming with C++***, 2nd Edition,TMH, 2000.
R4. R. Lafore, ***Object Oriented Programming in C++***, 4th Edition, Galgotia Publications, 2001.
R5. P. Deitel and H. Deitel, ***How to Program C++***, 9th Edition, Pearson Education, 2013.

P.T.O

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_cs17
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-096-introduction-to-c-january-iap-2011/lecture-notes/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Design, develop, and debug C++ programs using class and objects.
CO2	Implement different types of inheritance to achieve code reusability.
CO3	Apply static and dynamic polymorphism to solve various real life problems.
CO4	Use dynamic memory management, object copying, templates, and namespaces to formulate and solve complex problems.
CO5	Design and develop real-life applications using generic programming and file handling concepts.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	1				3	1	2
CO2	3	3	2	2	2	1	1				3	1	2
CO3	3	3	3	3	2	1	1				3	1	2
CO4	3	3	3	3	2	1	1				3	1	1
CO5	3	3	3	3	2	1	1				3	1	1

Type	Code	Yoga	L-T-P	Credits	Marks
MC	18MC7L07		0-0-2	0	100

Objectives	To impart skills in students for control of mind, body and soul, enhance self-awareness, focus, and concentration, bring together physical and mental wellness, manage stress and anxiety, achieve perfect equilibrium and harmony of body & mind, and promote self-healing.
Pre-Requisites	There are no pre-requisites for this course.
Teaching Scheme	Regular practice classes conducted under supervision of the qualified Yoga teacher with necessary explanation and demonstration for each session.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction; introduction of Yoga
2	*Pranayama*; performing breathing exercise
3	*Mudra*; learning various types of *Mudra*s and their benefits
4	*Bandha*: learning various types of *Bandha*s and their benefits
5	*Chakra*; learning various types of *Chakra*s and their benefits
6	*Chakshu Visrant Asana Samuha*; eye movement and exercises
7	Twisting set; standing twisting asana
8	Side stretching set; standing Side stretching *asana*
9	Forward bending set; standing Forward bending *asana*
10	Backward bending set; standing Backward bending *asana*
11	Balancing set; learning *Vrikshasana*, *Ekpada Pranamasana* and benefits
12	*Surya Namaskar*; surya namaskar mantra and poses
13	*Vajrasana* set; sitting *asana* sets
14	*Padmasana* set; sitting *asana* sets
15	Sleeping asana and *Yoga Nidra*; relaxation postures

Text Books:

T1. E. F. Bryant, ***The Yoga Sutras of Patanjali***, 1st Edition, North Point Press, 2009.

Reference Books:

R1. Swami Satyananda Saraswati, ***Asana Pranayama Mudra Bandha***, 4th Edition, Yoga Publication Trust, Munger (Bihar), India, 2008.

Online Resources: *There are a number of online resources available for this subject. The student is advised to search on the Internet and locate the required study materials as per advise of the teacher.*

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Promote positive health, get relief from stress and obtain balance of body & mind.
CO2	Acquire knowledge of integral approach of Yoga Therapy to common ailments.
CO3	Develop skills to adopt Yoga practices for health and general well-being.
CO4	Develop overall personality through control of body, mind and soul.
CO5	Enhance scientific attitude and team spirit for creative and constructive endeavors.

Program Outcomes Relevant to the Course:

PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1						1			3	2			1
CO2										3			1
CO3						2			3	3			1
CO4									3	3		1	2
CO5						2			2	3	1	1	2

Part II

2nd Year MCA

Curriculum Structure

Semester III								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
HS	18MC1T13	Advanced Communication Skills	3	0	0	3	0	0
PC	18MC1T14	Computer Networks	3	0	0	3	0	0
PC	18MC1T15	Python Programming	3	0	0	3	0	0
PC	18MC1T16	Operating Systems	3	0	0	3	0	0
PE	18MC2T**	Professional Elective - I	3	0	0	3	0	0
PRACTICAL								
HS	18MC1L08	Advanced Communication Skills Lab	0	0	2	0	0	1
PC	18MC1L09	Computer Networks Lab	0	0	2	0	0	1
PC	18MC1L10	Python Programming Lab	0	0	4	0	0	2
PC	18MC1L11	Operating Systems Lab	0	0	2	0	0	1
		SUB-TOTAL	**15**	**0**	**10**	**15**	**0**	**5**
		TOTAL	**25**			**20**		

List of Electives

Code	Elective # and Subjects
	Professional Elective - I
18MC2T22	Probability & Statistics
18MC2T23	Linear Algebra
18MC2T24	Graph Theory

Semester IV								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
PC	18MC1T17	Design & Analysis of Algorithms	3	1	0	3	1	0
PC	18MC1T18	Database Management Systems	3	1	0	3	1	0
PC	18MC1T19	Java Programming	3	1	0	3	1	0
PE	18MC2T**	Professional Elective - II	3	0	0	3	0	0
PRACTICAL								
PC	18MC1L12	Design & Analysis of Algorithms Lab	0	0	2	0	0	1
PC	18MC1L13	Database Management Systems Lab	0	0	4	0	0	2
PC	18MC1L14	Java Programming Lab	0	0	4	0	0	2
HS	18MC1L15	Personality Development & Soft Skills Lab	0	0	2	0	0	1
PJ	18MC7L16	Seminar	0	0	2	0	0	1
		SUB-TOTAL	**18**	**0**	**10**	**18**	**0**	**4**
		TOTAL	**28**			**22**		

List of Electives

Code	Elective # and Subjects
	Professional Elective - II
18MC2T25	Simulation & Modeling
18MC2T26	Optimization Techniques
18MC2T27	Stochastic Process

Type	Code	Advanced Communication Skills	L-T-P	Credits	Marks
HS	18MC1T13		3-0-0	3	100

Objectives	To develop the students' communication proficiency with an emphasis on Language Skills, make them aware of the importance of cross–cultural communication, help them read and comprehend texts of different genres, and compose effective business messages with the correct use of English Grammar.
Pre-Requisites	Basic knowledge of English grammar and the ability to read and write using the English language.
Teaching Scheme	Regular classroom lectures with use of PPTs as and when required; sessions are planned to be interactive with a focus on improving spoken and written communication skills in English.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Communication Process and Types; Process and factors involved: code, channel, message, context, feedback; Importance of communication; differences between General and Technical communication; Communication across cultures; Barriers to effective communication; Verbal and Non-verbal communication.	**7 Hours**
Module-2	Language Skills and Usage: Four skills of language (L, S, R, W); Importance of a common language; Importance of communication through English; Language functions (Speech Acts); Art of Public Speaking: Styles and techniques (assertiveness, convincing, argumentation, negotiation); Presentation skills: The four Ps' (Plan, Prepare, Practice, Present), Content development, Clarity of speech, Non-verbal gestures.	**9 Hours**
Module-3	Sounds of English: An introduction to English phonology; Consonants; Vowels and Diphthongs; Consonant clusters and Problem sounds; Phonemic Transcriptions; Syllabic Division; Stress; Intonation.	**6 Hours**
Module-4	Reading Skills: Importance of reading; Sub Skills of Reading; Reading Comprehension; Techniques of Summarizing and Note making; Introduction to genres of short stories; Short Stories 1 – 4; Critical analysis of the prescribed texts.	**11 Hours**
Module-5	Effective Formal Writing Skills: Difference between Speech and Writing; Elements of effective Business Writing; Basic understanding of the English Verb system; Identifying the common errors; Process Writing; Writing a paragraph; Writing an essay: descriptive, informative; Letter writing: formal and informal; Memo and email; Report Writing.	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. M. A. Rizvi, ***Effective Technical Communication***, Tata McGraw-Hill.

T2. T. Balasubramaniam, ***English Phonetics for Indian Students***, Trinity Press.
T3. M. Raman, S. Sharma, ***Technical Communication: Principles and Practice***, Oxford University Press.
T4. D. K. Das, A. Kumari, and K. K. Padhi, ***Anthology of Modern English Prose***, Triniti Press.

Reference Books:

R1. S. Samantray, ***Business Communication and Communicative English***, S. Chand.
R2. J. Seeley, ***The Oxford Guide to Writing and Speaking***, Oxford University Press.
R3. B. K. Mitra, ***Communication Skills for Engineers***, Oxford University Press, 2011.
R4. B. K. Das, ***An Introduction to Professional English and Soft Skills***, Cambridge University Press, 2009.

Online Resources:

1. http://www.cambridgeindia.org
2. http://www.cambridgeenglish.org/exams/business-certificates/business
3. https://steptest.in
4. https://www.coursera.org/specializations/business-english
5. http://www.academiccourses.com/Courses/English/Business-English

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the process and types of communication, and the nuances of communication across cultures.
CO2	Understand and apply the skills of language in day-to-day communication as well as in public speaking.
CO3	Understand the sounds of the English language and be able to check their pronunciation through phonemic transcriptions in order to speak with a neutral accent.
CO4	Enhance their reading skills and be able to critically analyse texts of various kinds.
CO5	Compose different types of business correspondences effectively with a proper use of grammar.

Program Outcomes Relevant to the Course:

PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1						2		3		2			2
CO2						1	1	3		2	1	1	2
CO3						1	1	3		2			1
CO4						1	1	3		2	1	1	2
CO5						2	2	3		2		1	2

Type	Code	Computer Networks	L-T-P	Credits	Marks
PC	18MC1T14		3-0-0	3	100

Objectives	The objective of this course are to develop an understanding of modern network architectures from a design and performance perspective, introduce the major concepts involved in WANs, LANs, and WLANs, and provide fundamental knowledge on network programming & WLAN measurement.
Pre-Requisites	Basic knowledge of Computer Organization, Operating Systems, and programming using C language is required.
Teaching Scheme	Regular classroom lectures with use of PPTs as and when required; sessions are planned to be interactive with focus on problem solving and programming.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.	**8 Hours**
Module-2	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple Access Protocols. Pure ALOHA, Slotted ALOHA, CSMA, CSMA-CD and CSMA-CA.	**10 Hours**
Module-3	Network Layer: Switching, Logical addressing – IPV4, IPV6; Error reporting and Management protocols: ICMP, IGMP. Address mapping – ARP, RARP, Bootstrap protocol and DHCP–Delivery, Forwarding and Unicast Routing protocols.	**9 Hours**
Module-4	Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	**9 Hours**
Module-5	Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), World Wide Web, HTTP, SNMP. Basic concepts of Bluetooth, Firewalls and Cryptography.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. B. A. Forouzan, ***Data Communication and Networking***, 4th Edition, Tata McGraw–Hill, 2011.
T2. L. L. Peterson and B. S. Davie, ***Computer Networks: A Systems Approach***, 5th Edition, Morgan Kaufmann Publishers, 2011.

Reference Books:

R1. J. F. Kurose and K. W. Ross, ***Computer Networking - A Top-Down Approach Featuring the Internet***, 5th Edition, Pearson Education, 2009.
R2. Y. D Lin, R. H Hwang, and F.Baker, ***Computer Networks: An Open Source Approach***, 1st Edition, McGraw-Hill, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105081/
2. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
3. https://www.geeksforgeeks.org/computer-network-tutorials

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Correlate the functionalities of the different layers of OSI and TCP/IP model.
CO2	Design functional blocks of Wide-Area Networks (WANs), Local Area Networks (LANs) & Wireless LANs (WLANs) and define the functions of each block.
CO3	Classify the routing protocols and assign the IP addresses for a given network using static and dynamic addressing techniques.
CO4	Simulate different transport layer protocols using network programming and develop client-server applications.
CO5	Analyze the features and operations of various application layer protocols such as HTTP, FTP, DHCP, RTP , SMTP and others.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	2	2							3	1	3
CO2	1	1	2	2							3	1	3
CO3	1	1	1	3					2	1	2	1	3
CO4	1	2	2	2					1	1	3	1	3
CO5	1	2	2	2					2	3	3	1	2

Type	Code	Python Programming	L-T-P	Credits	Marks
PC	18MC1T15		3-0-0	3	100

Objectives	The objective of this course is to introduce Python programming fundamentals and apply problem solving techniques to solve real life problems. The course will expose students to develop application for solving real life problems.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with programming and problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Overview of Python: Python features, basic syntax, interactive mode programming, script mode programming, input/output statements, keywords, identifiers, operators, expressions, string handling and manipulation, control statements, iterations.	**8 Hours**
Module-2	Lists: Operations, slicing, built in list functions, list comprehension; Tuple: introduction, accessing tuples, operations using built in tuple functions; Dictionaries: introduction, accessing values in dictionaries, built in dictionary functions, working with dictionaries, Sets, Sequences, Function, Recursion, Global variables; Modules: creating modules, import statement, packages.	**10 Hours**
Module-3	Object Oriented Programming: Abstract data types; Classes and Objects: Creating class and object, using a class, methods, overriding methods, Inheritance, types of inheritance, encapsulation and information hiding; Exception Handling: try, except and finally.	**9 Hours**
Module-4	File Handling: text files, opening and closing file, reading and writing files, format operator; command line arguments, Database: introduction, connections, executing queries, transactions, SQLDB, Database connection parameters, insert, update, delete.	**9 Hours**
Module-5	Regular Expression: match function, search function, matching vs searching, modifiers, pattern; CGI: introduction, architecture, CGI environment variable, GET and POST methods, cookies, file upload; GUI Programming: GUI programming toolkits, creating GUI widgets with Tkinter, creating layouts, radio buttons, checkboxes, dialog boxes.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. P. Barry, ***Head First Python***, 2nd Edition, O'Reilly Media, 2010.
T2. A. B. Downey, ***Think Python: How to Think Like a Computer Scientist***, 2nd Edition, O'Reilly Media, 2012.

Reference Books:

R1. J. Zelle, ***Python Programming: An Introduction to Computer Science***, 3rd Edition, Franklin, Beedle & Associates, 2016.
R2. L. Ramalho, ***Fluent Python***, 1st Edition, O'Reilly Media, 2015.

Online Resources:

1. https://nptel.ac.in/courses/106105166/26
2. https://nptel.ac.in/courses/117106113/34
3. https://help.uis.cam.ac.uk/service/help-support/training/downloads/course-files/programming-student-files/python-courses/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand Python syntax, flow control, and functions to solve real life application.
CO2	Proficiently use functions and core data structure like list, dictionaries, tuple.
CO3	Develop application using Object Oriented Programming concepts of Python.
CO4	Apply concept of file handling and database connectivity for real world applications.
CO5	Use regular expressions efficiently and develop GUI based Python applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1		1	1					2		2
CO2	1	2	1		1	1					2		2
CO3	1	2	1		1	1				1	3		1
CO4	1	2	1		1	2				1	2		1
CO5	2	2	1		1	1				1	3		2

Type	Code	Operating Systems	L-T-P	Credits	Marks
PC	18MC1T16		3-0-0	3	100

Objectives	The objective of this course is to introduce the fundamentals of operating systems, services, processes, process scheduling and synchronization, principles of primary, secondary and virtual memory management, and basics of structure & organization of file system & disk scheduling methods.
Pre-Requisites	Fundamentals of computer, data structures, programming knowledge in C or C++ is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	**Introduction**: concept of operating system, origin and evolution, types, resources managed, services provided, system calls and their types, system structure of operating system.	**6 Hours**
Module-2	**Process Management**: process concepts, states, PCB, types of schedulers, operations on process, inter-process communication, concept of buffering, thread overview, user & kernel threads, multi-threading models, issues with multi-threading; CPU Scheduling: scheduling criteria, scheduling algorithms: FCFS, SJF, SRTF, RR, Priority Scheduling, MLQ, MLQ with Feedback Scheduling.	**10 Hours**
Module-3	**Inter-Process Synchronization**: Bounded-buffer problem, shared-memory solution to producer-consumer problem; Critical section problem: Peterson's solution, synchronization hardware, Semaphores; Classical problems of synchronization: Bounded-Buffer problem, Readers-Writers Problem, Dining-Philosophers Problem, Sleeping Barber problem, monitors, Deadlock: characterization, prevention, avoidance, Banker's algorithm, deadlock detection and recovery.	**10 Hours**
Module-4	**Memory Management**: Logical and physical address space, dynamic loading and linking, swapping, contiguous memory allocation, dynamic storage allocation problem, overlays, paging and segmentation; Virtual Memory Management: Demand paging, page fault, basic page replacement policy, Page Replacement Algorithms: FIFO, OPT, LRU, LRU-Approximation, LFU, MFU, Thrashing, working-set model.	**9 Hours**
Module-5	**Secondary Storage Structure**: Overview of mass storage structure, disk structure; Disk Scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, RAID structure; Filie System: access methods, directory structure, access control list, I/O System: polling, interrupts, DMA, Case studies: The LINUX System.	**7 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Silberschatz, P. B Galvin, and G Gagne, ***Operating Systems Principles***, 7th Edition, Wiley India, 2006.
T2. M. Milenkovic, ***Operating Systems: Concepts & Design***, 2nd Edition, McGraw-Hill Education, 2001.

Reference Books:

R1. A. S. Tanenbaum, ***Modern Operating Systems***, 3rd Edition, PHI Learning, 2007.
R2. P. B. Prasad, ***Operating Systems and System Programming***, 2nd Edition, SciTech Publishres, 2015.

Online Resources:

1. https://nptel.ac.in/courses/106106144/
2. https://nptel.ac.in/courses/106108101/
3. http://web.stanford.edu/~ouster/cgi-bin/cs140-spring14/lectures.php
4. https://www.cl.cam.ac.uk/teaching/1011/OpSystems/os1a-slides.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explore principles behind various types of operating systems, system components, system calls, protection mechanisms and services.
CO2	Understand the benefits of thread over process, importance of inter-process communication, analyze various CPU scheduling algorithms and design new scheduling algorithms.
CO3	Understand the significance of process synchronization and get acquainted with various deadlock handling mechanisms.
CO4	Describe the working principle of main memory, cache memory & virtual memory, and solve memory allocation related problems.
CO5	Acquire knowledge on secondary storage management, performance of disk scheduling algorithms, identify issues in file structures, and protection & security mechanisms.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2								2	2	1
CO2	3	3	3	2							3	1	1
CO3	3	3	3	2	1	1					3	1	1
CO4	3	3	3	2	1	1					3	1	1
CO5	2	2	3	2	1	1					3	1	1

Type	Code	Probability & Statistics	L-T-P	Credits	Marks
PE	18MC2T22		3-0-0	3	100

Objectives	The objective of this course is to learn the basic concepts of probability and statistics including various methods of estimations & statistical testing useful for analysis of data.
Pre-Requisites	Basic knowledge of sets, coordinate geometry, and calculus is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Probability, Random variables and Probability Distributions: Probability, Conditional Probability, Bayes' Rule, Concept of a random variable, Discrete and Continuous probability distribution functions, Mean, Variance and Co-Variance of random variables.	**9 Hours**
Module-2	Discrete & Continuous Probability Distributions: Binomial distribution, Poisson distribution, Hypergeometric distribution, Normal distribution, Uniform distribution, Joint distribution.	**9 Hours**
Module-3	Fundamental Sampling Distributions and Data Description: Random sampling, Single sample – estimation of mean and variance, Two samples – estimating the difference between two means and ratio of two variances, Maximum likelihood estimation, Confidence interval.	**8 Hours**
Module-4	Hypothesis Testing: One and two tailed test, Single sample – test concerning single mean, two means, test of single and two proportions, Goodness of fit test.	**8 Hours**
Module-5	Simple Linear Regression and Correlation: Least square method, Correlation, Multiple linear regression, Analysis of variance.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. R. E. Walpole, R. H. Myers, S. L. Myers, and K. E. Ye, ***Probability & Statistics for Engineers & Scientists***, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. W. Mendenhall, R. J. Beaver, and B. M. Beaver, ***Probability and Statistics***, 1st Edition, Cengage Learning, 2009.

R2. R. A. Johnson, I. Miller, and J. E. Freund, ***Probability and Statistics for Engineers***, 9th Edition, Pearson Education, 2016.

Online Resources:

1. https://nptel.ac.in/courses/111105041/
2. https://nptel.ac.in/courses/111105090/

3. https://www.khanacademy.org/math/statistics-probability
4. https://stattrek.com/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Solve problems on probability of discrete nature.
CO2	Solve problems on probability of continuous nature.
CO3	Infer on mean and variance of a data set.
CO4	Identify the distribution type of a data set.
CO5	Fit a curve using regression model.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1	1							3	2	1
CO2	3	2	1	1							3	2	1
CO3	3	3	2	3					1		3	2	1
CO4	3	3	2	3					2		3	2	1
CO5	3	3	2	3					2		3	2	1

Type	Code	Linear Algebra	L-T-P	Credits	Marks
PE	18MC2T23		3-0-0	3	100

Objectives	The objective of this course is to learn the basic concepts of matrices including their factorization used to solve almost every type of linear system in engineering and business problems.
Pre-Requisites	Basic knowledge of Sets, elementary coordinate geometry and calculus is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Geometry of linear equations, Gauss elimination, concept of matrices with applications, vector spaces and subspaces, Echelon form, solution in matrix method.	**9 Hours**
Module-2	Linear Independence, Basis & Dimension, four fundamental subspaces, Linear Transformations; Orthogonal vectors & subspaces, cosines & projections onto lines.	**9 Hours**
Module-3	Projections & least squares, Orthogonal bases and Gram-Schmidt process; Introduction & properties of determinants and related properties & applications.	**8 Hours**
Module-4	Introduction to Eigen values and Eigen vector, diagonalization of matrix, complex matrices, Similarity Transformations.	**8 Hours**
Module-5	Maxima, minima & saddle points, tests for positive Definiteness, singular value decomposition, minimum principles.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. G. Strang, ***Linear Algebra and Its Applications***, 4th Edition, Cengage Learning, 2006.

Reference Books:

R1. T. K. Moon and W. C. Stirling, ***Mathematical Methods and Algorithms for Signal Processing***, 1st Edition, Pearson Education, 1999.
R2. K. Hoffman and R. Kunze, ***Linear Algebra***, 2nd Edition, Pearson Education, 1971.

Online Resources:

1. https://nptel.ac.in/courses/111106051/
2. https://nptel.ac.in/downloads/111102011/
3. https://www.khanacademy.org/math/linear-algebra
4. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/related-resources/

P.T.O

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Solve a system of linear equations by matrix methods.
CO2	Understand the concepts of orthogonality in vector space.
CO3	Identify least square approximation through projection in vector space.
CO4	Evaluate eigen values and eigen vectors of a matrix and use it for diagonalization.
CO5	Compute the singular value decomposition of a matrix and apply it.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1						1		2	1	1
CO2	1	2	1								2	1	1
CO3	2	3	2	1					2		3	2	1
CO4	3	3	2	1					2		3	2	1
CO5	3	3	2	2					2		3	2	1

Type	Code	Graph Theory	L-T-P	Credits	Marks
PE	18MC2T24		3-0-0	3	100

Objectives	The objective of this course is to provide a basic foundation of graphs and their applications to model & solve various science and technology problems.
Pre-Requisites	Basic knowledge of Sets, elementary counting and matrices is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Graphs, definition and terminologies, Special graphs, Graphical degree sequences, Induced subgraph, Matrices and isomorphism of graphs, Extremal problems, Walk, Trail, Path, Circuits in graphs.	**9 Hours**
Module-2	Directed graphs and vertex degree, Eulerian digraphs, Trees and their properties, Distance in trees and graphs, Enumeration of trees, Spanning trees in graph, Minimum spanning tree, Shortest paths,	**8 Hours**
Module-3	Maximum matchings, Hall's matching conditions, Min-Max Theorem, Independent sets, covering and dominating sets, Vertex connectivity and edge connectivity, Blocks, 2-connected graphs, Connectivity of diagraphs, k-connected and k-edge-connected graphs.	**10 Hours**
Module-4	Maximum network flow, Vertex Colorings and upper bounds, Brooks' Theorem, Counting Proper colorings, Chromatic polynomials, Planar graphs, Kuratowski's theorem, Dual graphs, Euler's formula.	**8 Hours**
Module-5	Convex Embedding, Coloring of planar graph, Necessary conditions for Hamilton cycles, Sufficient conditions for Hamilton cycles, Cycles in Directed graph.	**7 Hours**
	Total	**42 Hours**

Text Books:

T1. D. B. West, ***Introduction to Graph Theory***, 2nd Edition, Pearson Education, 2000.

Reference Books:

R1. J. A. Bondy and U. S. R. Murty, ***Graduate Texts in Mathematics: Graph Theory***, 1st Edition, Springer, 2008.
R2. F. Harary, ***Graph Theory***, 2nd Edition, Narosa Publishing, 2012.

Online Resources:

1. https://nptel.ac.in/courses/111106102/
2. https://nptel.ac.in/courses/111106050/
3. https://primes.utm.edu/graph/index.html
4. https://www.tutorialspoint.com/graph_theory/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the basic concepts of graphs and their applications.
CO2	Enumerate spanning trees and find out the shortest path & shortest spanning tree in a graph.
CO3	Understand the concepts of connectivity in a graph and apply it to solve complex problems.
CO4	Understand and apply the concept of planarity in a graph.
CO5	Implement Hamilton cycle in graph and apply it to solve real life problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	1					1		2	1	1
CO2	2	3	3	1					1		3	2	1
CO3	2	3	3	1					1		3	2	1
CO4	2	3	3	1					1		3	2	1
CO5	2	3	3	1					1		3	2	1

Type	Code	Advanced Communication Skills Lab	L-T-P	Credits	Marks
HS	18MC1L08		0-0-2	1	100

Objectives	This laboratory course is designed to make students effective communicators, by addressing issues like speaking inhibitions. This is accomplished by individual and team activities based on the four skills of language (LSRW).
Pre-Requisites	Basic knowledge of English grammar and the ability to speak, read and write using the English language is required.
Teaching Scheme	Various tasks designed to facilitate communication through pair work, group/team work, individual and group presentations, discussions, role plays, listening to audios, watching videos, business writing and vocabulary enhancement.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	JAM: Just-A-Minute sessions to develop fluency in speaking using various topics of discussion.
2	Chart-work or Poster presentation on the Process of Communication.
3	Non-verbal Communication: Conducting role plays to understand the practical applications of non-verbal cues and body language.
4	Cross-cultural Communication: dealing with the nuances of this communication type through case studies, videos and discussions.
5	Listening Comprehension: Listening for specific information, ear training and for pronunciation practices.
6	Sounds of English: practice sessions on vowels, consonants and diphthongs; problem sounds and consonant clusters.
7	Transcriptions: the use of IPA symbols for transcribing words.
8	Stress and Syllable Division: Word stress, sentence stress, contrastive stress, rules of stress & syllable division through practice sessions and use of dictionaries.
9	Sentence Rhythm: through recitation of poems, read-aloud sessions and pronunciation practices.
10	Oral presentation–I: Power-point presentations on selected technical or non-technical topics of relevance.
11	Oral presentation–II: Power-point presentations on selected technical or non-technical topics of relevance.
12	Reading Comprehension: reading of various business & non-technical passages of relevance.
13	Writing Practice-I: memo and letters
14	Writing Practice-II: report writing

Text Books:

T1. M. A. Rizvi, ***Effective Technical Communication***, 2nd Edition, McGraw-Hill Education, 2017.
T2. T. Balasubramaniam, ***English Phonetics for Indian Students***, 2nd Edition, Macmillan Publishers, 2012.
T3. M. Raman and S. Sharma, ***Technical Communication: Principles and Practice***, 2nd Edition, Oxford University Press, 2011.

Reference Books:

R1. S. Samantray, ***Business Communication and Communicative English***, Sultan Chand.
R2. J. Seeley, ***The Oxford Guide to Effective Writing and Speaking***, 2nd Edition, Oxford University Press, 2005.
R3. B. K. Mitra, ***Communication Skills for Engineers***, Oxford University Press, 2011.
R4. B. K. Das, K. Samantray, R. Nayak, S. Pani, and S. Mohanty, ***An Introduction to Professional English and Soft Skills***, Cambridge University Press, 2009.

Online Resources:

1. https://nptel.ac.in/courses/109104031/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop listening comprehension and overcome their inhibitions to speak in public.
CO2	Communicate properly as an engineer in cross-cultural contexts.
CO3	Develop their English pronunciation skills through practice.
CO4	Work effectively as a team member or as a leader of the team.
CO5	Develop writing skills for effective communication in corporate environment.

Program Outcomes Relevant to the Course:

PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1						1	2	3		2	2	1	2
CO2						2	1	3		2	2	1	2
CO3						1	2	3		2		1	2
CO4						1	3	3		2	1	1	3
CO5						1	2	3		2	2	2	3

Type	Code	Computer Networks Lab	L-T-P	Credits	Marks
PC	18MC1L09		0-0-2	1	100

Objectives	The objective of this course is to implement important computer networking protocols in a high–level programming language and become acquainted with socket programming and use of GUI based computer networking tools.
Pre-Requisites	Basic knowledge of C Programming and Operating System is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Network Hardware and Software, Network Command like netstat, traceroute, ping, ifconfig, telnet, ftp etc.
2	IPv4 addressing and programming to find the IP address of a machine and Ethernet address.
3	connector devices :Router, Hub, Switch, Bridge and verification of standard Network topologies i.e. Star, Bus, Ring etc.
4	Socket Programming: TCP and UDP sockets.
5	Implement socket programming for Echo Client and Echo Server using TCP socket.
6	Simulate socket programming for Chatting between two Machines using TCP socket.
7	Socket Programming for Echo Client and Echo Server using UDP socket.
8	Socket Programming for Chatting between two Machines using UDP socket.
9	Create a socket Programming for HTTP web page upload and download.
10	Network Simulator details (NetSim/NS2).
11	Simulation of Wired and wireless LAN.
12	Simulation of different MAC Protocols: ALOHA, CSMA etc.
13	Implementation of STOP and Wait Protocol.
14	Implementation of Sliding Window Protocol.

Text Books:

T1. W. R. Stevens and S. A. Rago, ***Advanced Programming in the UNIX Environment***, 2nd Edition, Pearson India, 2017..
T2. N. B. Venkateswarlu, ***Advanced UNIX Programming***, 2nd Edition, BS Publication, 2008.

Reference Books:

R1. J. F. Kurose and K. W. Ross, ***Computer Networking - A Top-Down Approach Featuring the Internet***, 5th Edition, Pearson Education, 2009.
R2. Y. D Lin, R. H Hwang, and F.Baker, ***Computer Networks: An Open Source Approach***, 1st Edition, McGraw-Hill, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105081/
2. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
3. https://www.geeksforgeeks.org/computer-network-tutorials

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Become familiar with transmission media, connector, Hubs, Switches and installation of NIC.
CO2	Implement of client server applications with TCP/UDP Socket Programming in a standalone machine.
CO3	Implement of client server applications with TCP/UDP Socket Programming in a network.
CO4	Simulate network payload and traffic in a LAN.
CO5	Implement Flow and Error Control Protocols to solve the traffic problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2								2	1	3
CO2	1	1	2		2						2	1	3
CO3	1	1	2	2	2						2	1	3
CO4	1	1	1	2							3	1	2
CO5	1	1	1	3	3						3	1	2

Type	Code	Python Programming Lab	L-T-P	Credits	Marks
PC	18MC1L10		0-0-4	2	100

Objectives	The objective of the course is to give the students hands-on practice on Using Python programming language from fundamentals to advanced programming and solving problems using the Python programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge of Python is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Compilation and execution of simple python programs.
2	Programs using data types and operators.
3	Formulate problems using Sting handling operators and functions.
4	Programs using Input and Output statements.
5	Programs on decision making using if else, nested if else and else if ladder.
6	Implement loop-control structures using for and while loops.
7, 8	Programs using python built in data structures(List, Dictionary, tuple, set).
9	Develop programs using functions.
10	Programs using recursive function.
11	Formulate problems and write programs using modules.
12	Develop programs using random and time module.
13	Develop programs using Packages.
14, 15	Programs on creating and using Class and Object.
16, 17	Formulate problems on Inheritance and write programs.
18	Programs on Exception Handling.
19	Formulate problems on file handling and develop programs.
20	Write programs to perform file Input/Output operations.
21, 22	Programs on database Connectivity.
23	Programs on Regular expression.
24, 25	Develop programs using CGI.
26, 27, 28	Develop GUI programs using Tkinter.

Text Books:

T1. P. Barry, ***Head First Python***, 2nd Edition, O'Reilly Media, 2010.
T2. A. B. Downey, ***Think Python: How to Think Like a Computer Scientist***, 2nd Edition, O'Reilly Media, 2012.

Reference Books:

R1. J. Zelle, ***Python Programming: An Introduction to Computer Science***, 3rd Edition, Franklin, Beedle & Associates, 2016.
R2. L. Ramalho, ***Fluent Python***, 1st Edition, O'Reilly Media, 2015.
R3. A. Downey, ***Programming Python***, 4th Edition, O'Reilly Media, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105166/26
2. https://nptel.ac.in/courses/117106113/34
3. https://help.uis.cam.ac.uk/service/help-support/training/downloads/course-files/programming-student-files/python-courses/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop simple real life application in python using operators and control statements.
CO2	Use python data structure and function to develop application.
CO3	Interpret object orient concept and use it for software development.
CO4	Conveniently use file handling and database connectivity concept.
CO5	Become familiar with CGI and develop real-life web application.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1		1	1					2		2
CO2	1	2	1		1	1					2		2
CO3	1	2	1		1	1				1	3		1
CO4	1	2	1		1	2				1	2		1
CO5	2	2	1		1	1				1	3		2

Type	Code	Operating Systems Lab	L-T-P	Credits	Marks
PC	18MC1L11		0-0-2	1	100

Objectives	The objectives of this course is to introduce the students to linux programming environment & UNIX shell scripts, and practical experience of designing & implementing concepts of operating systems using C programming language.
Pre-Requisites	Knowledge of data structures, analysis of algorithms, and programming in C or C++ is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Linux OS and basic VI editor commands.
2	Linux File Structure and advanced Linux commands like grep, pipe, cut etc.
3	Introduction to UNIX Shell Script: Arithmetic Expressions, Relational & Conditional Operators.
4	UNIX Shell Script: Looping, Case structure.
5	Process Creation, process handing, process signaling through fork(), exec().
6	CPU Scheduling (Non-Pre-emptive) FCFS, SJF, Priority.
7	CPU Scheduling (Pre-emptive) SRTF, RR, Priority-based preemptive scheduling
8	Multi-Threaded application using POSIX threads.
9	Synchronization using Semaphore (Producer- Consumer, Reader-Writer).
10	Message passing: Pipe and Signals.
11	Deadlock implementation: Banker's Algorithm.
12	Implementation of different Page Replacement Algorithms.
13,14	Implementation of various Disk scheduling Algorithms.

Text Books:

T1. V. Mukhi, ***The C Odyssey: UNIX***, 1st Edition, BPB Publications, 2004.
T2. A. Silberschatz, P. B Galvin, and G Gagne, ***Operating Systems Principles***, 7th Edition, Wiley India, 2006.

Reference Books:

R1. A. S. Tanenbaum, ***Modern Operating Systems***, 3rd Edition, PHI Learning, 2007.
R2. P. B. Prasad, ***Operating Systems and System Programming***, 2nd Edition, SciTech Publishres, 2015.

Online Resources:

1. https://nptel.ac.in/courses/106106144/
2. https://nptel.ac.in/courses/106108101/
3. http://web.stanford.edu/~ouster/cgi-bin/cs140-spring14/lectures.php
4. https://www.cl.cam.ac.uk/teaching/1011/OpSystems/os1a-slides.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Carry out basic and advanced UNIX commands for system administration as well as write shell scripts for real life applications.
CO2	Simulate various CPU scheduling algorithms like FCFS, RR, SJF, Priority and Multilevel Queue etc.
CO3	Implement various program on process creation, inter-process communication and synchronization.
CO4	Execute Banker's algorithm for handling situations of deadlock.
CO5	Implement different page replacement algorithms like FIFO, LRU, LFU and OPTIMAL etc.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2									1
CO2	3	3	3	2							2		
CO3	3	2	2	3							2		1
CO4	3	3	3	3							2		
CO5	3	3	3	3							2		1

Type	Code	Design & Analysis of Algorithms	L-T-P	Credits	Marks
PC	18MC1T17		3-1-0	4	100

Objectives	The objective of this course are to comprehend various methods of writing algorithms under diverse categories, analyze algorithms by working out complexity, and understand the basics of P, NP, and NP Complete problems.
Pre-Requisites	Knowledge of data structures and programming using C language is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Notion of an Algorithm: fundamentals, problem solving, important problem types, analysis of algorithms; Efficiency Analysis Framework: Asymptotic notations and its properties, mathematical analysis for recursive and non-recursive algorithms; Recurrences: Solution of recurrences by substitution, recursion tree, induction method, and Master methods; Amortized Analysis.	**10 Hours**
Module-2	Brute Force: Closest-Pair, Convex-Hull problem, Traveling Salesman problem; Divide and Conquer methodology: Merge sort, Quick sort, Closest-Pair problem, Convex-Hull problems; Heap Sort - Heaps, building a Heap, the Heap sort algorithm; lower bounds for sorting.	**10 Hours**
Module-3	Priority Queue; Data structure for disjoint sets - Disjoint set operations, Linked list representation, path compression, Disjoint set forests; Dynamic programming – Computing a Binomial Coefficient, Warshall's and Floyd's algorithm (all-pair shortest path), Longest Common Subsequence.	**9 Hours**
Module-4	Greedy Technique – Huffman codes, Knapsack Problem; Elementary Graph Algorithms: Minimum Spanning Trees - Prim's algorithm, Kruskal's algorithm; Single-source shortest paths - Dijkstra's algorithm, Bellman-Ford algorithm.	**9 Hours**
Module-5	String matching algorithms – naïve string matching algorithm, Rabin-Karp algorithm, Knuth–Morris–Pratt algorithm; Flow Network – The Maximum-Flow problem, Ford-Fulkerson algorithm.	**9 Hours**
Module-6	Branch and Bound – General Strategy, 0/1 Knapsack, Traveling Salesman problem; Backtracking – General Strategy, 8 Queen's problem, Graph Coloring, Limitations of Algorithm Power, P, NP and NP Complete Problems; Approximation algorithms for NP–Hard problems – Traveling Salesman problem, Knapsack problem.	**9 Hours**
	Total	**56 Hours**

Text Books:

T1. T. H.Cormen, C. E.Leiserson, R. L.Rivest, and C. Stein, ***Introduction to Algorithms***, 3rd Edition, PHI Learning, 2014.

T2. A. Levitin, ***Introduction to the Design and Analysis of Algorithms***, 3rd Edition, Pearson Education, 2012.

Reference Books:

R1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, ***Data Structures and Algorithms***, 3rd Edition, Pearson Education, 2006.
R2. S. S. Skiena, ***The Algorithm Design Manual***, 2nd Edition, Springer, 2008.

Online Resources:

1. https://nptel.ac.in/courses/106101060/
2. https://nptel.ac.in/courses/106106131/
3. http://www.cs.virginia.edu/~robins/CS_readings.html
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Asymptotically analyze the time complexities of algorithms.
CO2	Make comparative study of comparison based sorting techniques.
CO3	Apply various algorithm design techniques such as divide-and-conquer, dynamic programming, greedy approach, backtracking, and branch-and-bound etc., to solve real life problems.
CO4	Apply advanced data structures - Heap, Disjoint-Set, and Priority Queue for solving complex problems.
CO5	Solve real life problems using graph algorithms, understand and compare various pattern matching algorithms such as Naïve, Rabin-Karp etc.
CO6	Differentiate complexity classes P, NP, NP-Complete, NP-Hard, and co-NP and design approximation algorithms for intractable problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	2							3		3
CO2	3	2	1	1							3		3
CO3	3	3	3	2							3		3
CO4	3	3	3	2							3		1
CO5	3	3	2	2							2		2
CO6	3	3	2	2							2		2

Type	Code	Database Management Systems	L-T-P	Credits	Marks
PC	18MC1T18		3-1-0	4	100

Objectives	The objective of this course is to learn principles of systematically designing and using large scale database management systems for various real-world applications.
Pre-Requisites	Basic knowledge of data structures and algorithms is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Database Systems, 3-level schema architecture, Database System Architecture; Data Models: Entity Relationship Model, Network and Object Oriented data models, Extended Entity Relationship Model, Mapping of E-R model to Relational schema.	**12 Hours**
Module-2	Query Language: Relational Algebra, Tuple & Domain Relational Calculus; Storage Strategies: File Organizations & Indexes, Ordered Indexes, B+ Tree Index Files, Hashing.	**10 Hours**
Module-3	Database Design: Functional dependency, Normalization, Normal forms: 1NF, 2NF, 3NF & BCNF, Multi-valued Dependencies, 4NF & 5NF; Query Processing and Optimization: Evaluation of Relational Algebra expressions, Query Optimization, Query Cost Estimation.	**14 Hours**
Module-4	Transaction Processing and Concurrency Control: Transaction concepts, ACID properties of transaction, Serializability; Concurrency Control Schemes: Locking and Timestamp schemes, Deadlock detection and recovery.	**10 Hours**
Module-5	Database Recovery System: Types of Database failures, Recovery techniques; Distributed Databases: Distributed database system, homogeneous distributed databases, distributed data storage, data replication and fragmentation, data transparency.	**10 Hours**
	Total	**56 Hours**

Text Books:

T1. A. Silberschatz, H. F. Korth, and S. Sudarshan, ***Database System Concepts***, 6th Edition, McGraw-Hill, 2013.
T2. R. Elmasri and S. B. Navathe, ***Fundamentals of Database Systems***, 7th Edition, Pearson Education, 2016.

Reference Books:

R1. R. Ramakrishnan and J. Gekhre, ***Database Management Systems***, 3rd Edition, McGraw-Hill, 2003.
R2. R. P. Mahapatra and G. Verma, ***Database Management Systems***, 1st Edition, Khanna Publishing, 2013.
R3. C. J. Date, ***Introduction to Database Systems***, 8th Edition, Pearson Education, 2003.

Online Resources:

1. https://nptel.ac.in/courses/106106093/
2. https://nptel.ac.in/courses/106105175/
3. https://cs145-fa18.github.io/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/lecture-notes/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Analyze the significance of database management system in an organization and explore its various functional components and design E-R model for real life problems.
CO2	Construct queries using Relational Algebra and Relational Calculus. Investigate storage architecture, and access methods using Order Indices, B+ Tree & Hashing.
CO3	Create effective database designs using different normalization techniques and devise optimal query execution strategies.
CO4	Understand transaction processing concepts and Solve the concurrent access problems by using various concurrency control mechanisms.
CO5	Explore various database recovery techniques and advance database concepts like Distributed Database. Compare between centralized and distributed databases.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	1		1				2	2		1
CO2	3	2	2	3						3	2		1
CO3	3	3	3	2		1			1	3	1		1
CO4	1	2		2			2			1	1		1
CO5	1	2		2		2	1			1	2		2

Type	Code	Java Programming	L-T-P	Credits	Marks
PC	18MC1T19		3-1-0	4	100

Objectives	The objective of the course is to expose the students to object oriented programming principles and their applications to develop programs for the real world using the Java programming language.
Pre-Requisites	Basic analytical and logical understanding with fundamental knowledge of computer programming in any language is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving and programming activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Java Overview: Introduction to Java, Java Virtual Machine, Java buzzwords, Data types, Operators, Control statements, Class fundamentals, Objects, Methods, Constructors, Overloading, Access modifiers.	**11 Hours**
Module-2	Inheritance: Basics of Inheritance, using super and final keyword, method overriding, Abstract classes, defining and importing packages, access protection, interfaces. Exception handling: Exception fundamentals, types, understanding different keywords (try, catch, finally, throw, throws), User defined exception handling.	**12 Hours**
Module-3	Input/Output: Files, stream classes, reading console input, Threads, thread model, use of Thread class and Runnable interface, thread synchronization, multithreading, inter thread communication.	**10 Hours**
Module-4	String manipulation: Basics of String handling, String class, StringBuilder, StringBuffer, StringTokenizer. Applet basics and life cycle; Event Handling: delegation event model, event classes, sources, listeners, Adapter class.	**11 Hours**
Module-5	Introduction to GUI Programming: working with windows, frames, graphics, color, and font; AWT Control fundamentals, Swing overview, Java database connectivity: JDBC overview, creating and executing queries, dynamic queries.	**12 Hours**
	Total	**56 Hours**

Text Books:

T1. H. Schildt, ***Java - The Complete Reference***, 9th Edition, McGraw-Hill, 2011.
T2. Y. D. Liang, ***Introduction to Java Programming***, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. E. Balaguruswamy, ***Programming with Java - A Primer***, 4th Edition, Tata McGraw-Hill, 2009.
R2. T. Budd, ***An Introduction to Object Oriented Programming***, 3rd Edition, Pearson, 2009.
R3. I. Horton, ***Beginning Java***, 7th Edition, Wrox Publications, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105191/
2. https://docs.oracle.com/javase/tutorial/
3. http://www.javatpoint.com/java-tutorial
4. http://www.tutorialspoint.com/java/
5. http://www.w3schools.in/java/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply object oriented principles in software design process to develop Java programs for real applications.
CO2	Employ inheritance and exception handling techniques for developing robust, reusable software.
CO3	Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.
CO4	Design applications for text processing using String class and develop user interactive applications using event handling.
CO5	Design database driven GUI applications using AWT, Swing and JDBC.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	1		1				2	3		3
CO2	3	2	2	1		1				1	3		3
CO3	3	1	2	2		1				1	3		3
CO4	3	2	3	1		1				1	3		3
CO5	3	2	3	1		1				1	3		3

Type	Code	Simulation & Modeling	L-T-P	Credits	Marks
PE	18MC2T25		3-0-0	3	100

Objectives	The objective of this course is to learn the basic concepts and steps of Statistical simulation along with some modeling problems for real life engineering, scientific, business and social science processes.
Pre-Requisites	Basic knowledge of probability and statistics is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Basic concepts of Queue, M/M/1 and M/M/s queues. Queues involving non exponential distributions; Inventory models, Deterministic Continuous review model, Deterministic Periodic review model.	**8 Hours**
Module-2	Random number generation and its application to integration, Estimation of π and other problems, Generating discrete random variable: Inverse Transform Method, Generating geometric random variable and Bernoulli Random variable, Generating Poisson and Binomial random variable, the Acceptance Rejection method, the composition Approach, Programming for Generation of discrete random variable.	**9 Hours**
Module-3	Generation of Continuous random variable: The inverse transform method, the Rejection Method, Generating normal random variable by different methods, Generating Poisson Process, Simulating a single server queueing system, A queueing system with two servers in series, A queueing system with two servers in parallel, An inventory Model, An Insurance Risk model.	**10 Hours**
Module-4	Simulation of a Repair model, Programming for simulation model, Reduction of Variance using Antithetic variables, Estimation of system reliability using antithetic variables, Application Problems, Reduction of variance using Control Variates, Application Problems, Variance by conditioning, Application Problems.	**8 Hours**
Module-5	Stratified Sampling, Reduction of variance using stratified sampling, Goodness of Fit for Discrete Data, Kolmogorov-Smirnov Test for Continuous Data, Goodness of Fit test when some parameters are unspecified, Two sample problem.	**7 Hours**
	Total	**42 Hours**

Text Books:

T1. F. S. Hillier and G. J. Lieberman, ***Introduction to Operations Research***, 8th Edition, McGraw-Hill, 2005.
T2. S. M. Ross, ***Simulation***, 5th Edition, Academic Press, 2012.

Reference Books:

R1. A. M. Law and W. D. Kelton, ***Simulation Modelling and Analysis***, 4th Edition, McGraw-Hill Higher Education, 2005.
R2. H. A. Taha, ***Operations Research***, 8th Edition, Pearson Education, 2006.

Online Resources:

1. https://nptel.ac.in/courses/110106062/
2. https://onlinecourses.nptel.ac.in/noc17_me35/preview
3. https://fac.ksu.edu.sa/sites/default/files/index.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the queue and inventory model and solve related problems.
CO2	Generate discrete random variable for different inputs.
CO3	Generate continuous random variable and simulate queues and inventory models.
CO4	Understand and apply the variance reduction methods in simulation.
CO5	Test the goodness of a simulation by analyzing the simulated data.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	1					2		3	2	1
CO2	3	3	3	1					2		2	1	1
CO3	3	3	3	1					2		3	2	1
CO4	3	3	3	1					2		3	2	1
CO5	3	3	3	1					2		3	2	1

Type	Code	Optimization Techniques	L-T-P	Credits	Marks
PE	18MC2T26		3-0-0	3	100

Objectives	The objective of this course is to learn the methods to optimize processes and algorithms for their best use, methods that solve large-scale industrial optimization problems, and implement the solution processes.
Pre-Requisites	Basic concepts of multivariable functions, maxima & minima, matrices, probability theory, and understanding of algorithmic computations is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Optimization, Linear Programming Problem: Formulation, Graphical Solution, Basic and Non basic variables, Feasible solution, Basic feasible solution, optimal solution, non degenerate and degenerate basic feasible solution, Simplex method, Solution by Big M method, Two phase method, Special case in Simplex method.	**9 Hours**
Module-2	Duality theory, solution of Duality Problem, Dual simplex method, Generalized Simplex Algorithm, Transportation Problem model and methods for starting solutions, Optimality in a transportation problem, Variations in Transportation Problems, Assignment Problem and its solution, Transshipment Problem.	**8 Hours**
Module-3	Queuing model, its components, notations and terminologies, Role of Exponential distribution, Birth and death process, Generalized Poisson Queuing Model, Single Server Models, Multi Server Model.	**8 Hours**
Module-4	Decision under uncertainty, Decision under Risk, Decision problems based on uncertainty and risk, Decision Trees, Game theory, Two Person Zero Sum game: Games with Saddle point, Two Person Zero sum game: Games without Saddle point, Solution by graphical method.	**8 Hours**
Module-5	Scheduling a project with CPM, Problem based on CPM, Scheduling a project with PERT, Problem based on PERT, Time-cost trade-offs, Dynamic Programming: Forward and Backward Recursion, Knapsack/cargo loading model, Solution of Dynamic programming problem using Bellman's Optimality principle.	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. H. A. Taha, ***Operations Research***, 8th Edition, Pearson Education, 2006.
T2. A. M. Natarajan, P. Balasubramani, and A. Tamilarasi, ***Operations Research***, 2nd Edition, Pearson Education, 2009.

Reference Books:

R1. F. S. Hiller, G. J. Lieberman, ***Introduction to Operartion Research***, 10th Edition, McGraw-Hill Education, 2010.
R2. K. Swarup, ***Operations Research***, 1st Edition, S. Chand & Sons, 2014.
R3. J. K. Sharma, ***Operations Research - Theory and Application***, 5th Edition, Macmillan India Ltd., 2012.

Online Resources:

1. https://nptel.ac.in/courses/111105039/
2. https://nptel.ac.in/courses/105108127/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply simplex method to solve a linear programming problem.
CO2	Model and solve transportation and assignment problem.
CO3	Understand a queue and solve related problems.
CO4	Understand the concepts of Game Theory and able to take decisions.
CO5	Analyze a project by PERT and CPM methods.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2					2		2	1	1
CO2	3	3	3	2					2		2	1	1
CO3	3	3	3	2					2		3	2	1
CO4	3	3	3	2					2		3	2	1
CO5	3	3	3	2					2		3	2	1

Type	Code	Stochastic Process	L-T-P	Credits	Marks
PE	18MC2T27		3-0-0	3	100

Objectives	The objective of this course is to understand the non-deterministic & time dependent nature of real life processes, model them as stochastic processes and obtain desired solutions.
Pre-Requisites	Basic knowledge of probability theory and matrices is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Revisit to Basics of Probability; Conditional distribution and conditional expectation (Discrete Case), Conditional distribution and conditional expectation (Continuous Case), Computing Expectation and Variance by conditioning, Computing Probabilities by Conditioning.	**8 Hours**
Module-2	Stochastic Processes, Markov Chain: introduction and definition, Chapman- Kolmogorov Equations, Classification of states, Limiting Probabilities, Some application Problems, Mean time spent in transient state, Branching Processes, Time reversible Markov chains.	**11 Hours**
Module-3	Markov Decision Process, Hidden Markov chain, Exponential distribution and its Properties, Counting Process & Definition of Poisson Process, Inter arrival and waiting time distribution, Properties of Poisson Process, Non homogeneous Poisson Process.	**8 Hours**
Module-4	Continuous Time Markov chain, Birth & Death Process, The transition Probability function, Limiting Probabilities, Time reversibility, Uniformization, Computing the Transition Probabilities.	**7 Hours**
Module-5	Terms and notations in Queueing Theory, steady state probabilities, A single server exponential queueing system (M/M/1), M/M/1 system with finite capacity, An application problem, The system M/G/1, Multiserver queues.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. S. M. Ross, ***Introduction to Probability Models***, 9th Edition, Academic Press, 2006.

Reference Books:

R1. J. Medhi, ***Stochastic Processes***, 3rd Revised Edition, New Age Science, 2009.
R2. F. S. Hiller and G. J. Lieberman, ***Introduction to Operation Research***, 10th Edition, McGraw-Hill Education, 2017.

Online Resources:

1. https://swayam.gov.in/course/4495-stochastic-processes
2. http://web2.uwindsor.ca/math/hlynka/stochOnline.html

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Solve probability problems by conditioning.
CO2	Understand the concepts of Markov chain and apply it to real life problem to model.
CO3	Understand various Markovian processes.
CO4	Compute the transition probabilities in case of continuous time Markov models.
CO5	Apply the concept of queue to solve real life problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	1					1		2	1	1
CO2	3	3	3	1					1		2	1	1
CO3	3	3	3	1					1		2	1	1
CO4	3	3	3	1					1		2	1	1
CO5	3	3	3	1					1		3	2	1

Type	Code	Design & Analysis of Algorithms Lab	L-T-P	Credits	Marks
PC	18MC1L12		0-0-2	1	100

Objectives	The objective of this course is To implement various algorithms under different categories, analyze algorithms & their complexities, and implement approximation algorithms for NP hard problems.
Pre-Requisites	Basic knowledge of C Programming and Data Structures is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Design C programs using structure to implement insertion, deletion, BST.
2	Sort a given set of elements using the Quick-sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted.
3	Implement Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted.
4	Implement Heap Sort algorithm to sort a given set of elements and determine the time required to sort the elements.
5	Obtain the Topological ordering of vertices in a given digraph.
6	Implement 0/1 Knapsack problem using Dynamic Programming.
7	Implement BFS algorithm in a diagraph and check whether a given graph is connected or not using DFS method.
8	Implement Dijkstra's algorithm to find the shortest path in weighted connected graph.
9	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
10	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
11	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this Algorithm.
12	Implement N Queen's problem using Back Tracking.
13, 14	Design an algorithm to find the optimal solution for the TSP and then solve the same problem using any approximation algorithm and determine the error in the approximation.

Text Books:

T1. T. H.Cormen, C. E.Leiserson, R. L.Rivest, and C. Stein, ***Introduction to Algorithms***, 3rd Edition, PHI Learning, 2014.

T2. A. Levitin, ***Introduction to the Design and Analysis of Algorithms***, 3rd Edition, Pearson Education, 2012.

Reference Books:

R1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, ***Data Structures and Algorithms***, 3rd Edition, Pearson Education, 2006.
R2. D. E. Knuth, ***The Art of Computer Programming - Volumes 1 & 3***, Pearson Education, 2009.
R3. S. S. Skiena, ***The Algorithm Design Manual***, 2nd Edition, Springer, 2008.

Online Resources:

1. https://nptel.ac.in/courses/106101060/
2. https://nptel.ac.in/courses/106106131/
3. http://www.cs.virginia.edu/~robins/CS_readings.html
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Design C programs using structure to implement insertion, deletion, searching of a BST.
CO2	Implement comparison-based sorting algorithms and computing the time required.
CO3	Construct C programs for algorithms based on Divide & Conquer, Dynamic Programming and Greedy techniques.
CO4	Design C program for Graph traversal algorithms.
CO5	Implement N-Queen using Backtracking.
CO6	Implement a scheme to find the solution of Travelling Salesman Problem.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	1	2						3		3
CO2	3	3	3	3							3		2
CO3	3	2	3	3	3						3		3
CO4	3	3	2	2	2						3		3
CO5	3	3	3	3	3						3		2
CO6	2	2	2	1							2		2

Type	Code	Database Management Systems Lab	L-T-P	Credits	Marks
PC	18MC1L13		0-0-4	2	100

Objectives	The objective of this lab course is to provide a hands-on practice on database design, creation, data storage, and data manipulation including advanced database programming concepts to groom the students into well-informed database programmers and data-driven application developers.
Pre-Requisites	Basic analytical skills and knowledge of programming language are required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Oracle databases, simple queries for data retrieval.
2	Data retrieval based on conditions and sorting the query results.
3	Using single-row functions in SQL queries for data retrieval.
4	Applying grouping and aggregation functions.
5	Writing complex queries using sub-queries.
6	Create, alter, and manipulate design of tables.
7	Data manipulation using various DML statements.
8	Imposing various constraints on tables for maintaining data integrity.
9, 10	Retrieve data from multiple tables using various types of JOIN operations.
11	Create, alter, and manage Views from single & multiple base tables.
12	Create and use other data base objects like sequence, indexes, and synonyms.
13	Controlling user access to database using DCL queries.
14	Write SQL queries to perform set operations on tables.
14	Perform different advanced operations like ROLLUP and CUBE.
16	Write SQL queries by using co-related sub-queries.
17	Introduction to PL/SQL, identifiers, literals, and keywords.
18	Write PL/SQL block by using conditional statements and expressions.
19	Using different types of Loops in a PL/SQL block.
20	Implement Exception Handling in a PL/SQL block.
21	Write PL/SQL block with use of numeric & string data types.
22	Write PL/SQL block with use of other miscellaneous data types.
23	Write PL/SQL block to retrieve data using CURSORs.
24	Introduction to Stored Procedures, Write PL/SQL block using procedures.
25	Develop functions with in/out parameters and using them in a PL/SQL block.

Cont'd...

Experiment-#	Assignment/Experiment
26	Write PL/SQL block using package and trigger.
27, 28	Develop a given mini project for real-world application.

Text Books:

T1. K. Loney, ***Oracle Database 11g - The Complete Reference (Oracle Press)***, 1st Edition, McGraw-Hill Education, 2009.

Reference Books:

R1. I. Bayross, ***Teach Yourself SQL/PL SQL Using Oracle 8i and 9i with SQLJ***, BPB Publications, 2010.
R2. S. Feuerstein, ***Oracle PL/SQL Programming***, 6th Edition, O'Reilly, 2014.

Online Resources:

1. https://docs.oracle.com/cd/E11882_01/server.112/e40402.pdf
2. https://docs.oracle.com/cd/B28359_01/server.111/b28286/toc.htm
3. https://www.tutorialspoint.com/oracle_sql/index.asp
4. https://www.javatpoint.com/oracle-tutorial

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Construct queries using SQL and retrieve data from a database using single row function, aggregate function and sub-queries.
CO2	Create tables and specify constraints on tables using DDL statements.
CO3	Create other database objects like views, sequences and indices.
CO4	Write PL/SQL programs including control structures, loops, and exception handing for real-world applications.
CO5	Develop solutions using Procedures, Functions, Parameters, Packages, and Triggers for real time requirements.

Program Outcomes Relevant to the Course:

PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1		2		2	2					1	2		1
CO2		2		2	2					1	2		1
CO3			2	2	2					1	2		1
CO4		2		2	2					1	2		1
CO5		2		1	2					1	2		1

Type	Code	Java Programming Lab	L-T-P	Credits	Marks
PC	18MC1L14		0-0-4	2	100

Objectives	The objective of this lab course is to provide a hands-on practice on application of object oriented programming principles using the Java programming language to enable the students develop applications for real world.
Pre-Requisites	Basic analytical & logical understanding with fundamental knowledge of computer programming are required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	The Java platform, compilation & execution process of a java program.
2	Overview of Eclipse IDE.
3	Use of class, Use of Control statement, Data Types, Operators.
4	A closer look at methods and class concept, object and constructor concept.
5	OOPS features.
6	Inheritance Basics, More use of constructor, method overriding, use of final.
7	Object class, Practical use of Abstract class.
8	Wrapper class, Autoboxing and Unboxing.
9	Interface use for achieving multiple inheritance, implementation of package concept.
10	Use of Scanner class for console input, Command line argument.
11	Exception handing fundamentals, java built-in exceptions.
12	Use of own Exception subclass.
13	Java thread life cycle model and implementation approach, Thread priority.
14	Implementation of synchronization.
15	I/O Basics, Byte stream and Character streams.
16	Reading and Writing files.
17	Applet Life cycle implementation.
18	Text processing using java predefined String, StringBuilder and StringBuffer class.
19	Inner and Anonymous class.
20	Java Collection Framework.
21	GUI basics and Window fundamentals, Working with different Component, Container.
22	Use of Layout Managers.
23	Event Handling for interactive GUI application.

Cont'd...

Experiment-#	Assignment/Experiment
24	Use of Adapter concept in Event Handling.
25	Java Database connectivity using JDBC steps and use of different drive types.
26	GUI Based Project using OOPS Concept - Design.
27	GUI Based Project using OOPS Concept – Implementation.
28	Project presentation, viva-voce and evaluation.

Text Books:

T1. H. Schildt, ***Java - The Complete Reference***, 9th Edition, McGraw-Hill, 2011.
T2. Y. D. Liang, ***Introduction to Java Programming***, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. E. Balaguruswamy, ***Programming with Java - A Primer***, 4th Edition, Tata McGraw-Hill, 2009.
R2. T. Budd, ***An Introduction to Object Oriented Programming***, 3rd Edition, Pearson, 2009.
R3. I. Horton, ***Beginning Java***, 7th Edition, Wrox Publications, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105191/
2. https://docs.oracle.com/javase/tutorial/
3. http://www.javatpoint.com/java-tutorial
4. http://www.tutorialspoint.com/java/
5. http://www.w3schools.in/java/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply object oriented principles in software design process to develop Java programs.
CO2	Employ inheritance and exception handling for developing robust, reusable software.
CO3	Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.
CO4	Design applications for text processing using String class and develop user interactive applications using event handling.
CO5	Design database driven GUI applications using AWT, Swing and JDBC.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

P.T.O

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	1		1				2	3		3
CO2	2	2	2	1		1				1	3		3
CO3	1	1	2	2		1				2	3		3
CO4	3	2	3	1		1				2	3		3
CO5	3	2	3	1		1				2	3		3

Type	Code	Personality Development & Soft Skills Lab	L-T-P	Credits	Marks
HS	18MC1L15		0-0-2	1	100

Objectives	The objective of this course is to help students work on their personality development through an understanding of Soft skills, participate in Group Discussions (GD), present their views in public, perform well in Personal Interviews, and become successful in a corporate scenario.
Pre-Requisites	Basic knowledge of English grammar and the ability to speak, read and write using the English language is required.
Teaching Scheme	Ample tasks designed to facilitate communication through pair work, group/team work, individual and group presentations, discussions, role plays, listening to audios, watching videos, business writing and vocabulary enhancement.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Group Discussions (GD)
2	Mock GD 1.
3	Mock GD 2.
4	Mock GD 3.
5	Interview skills: Preparing for interviews through mock interview session.
6	Writing a good and effective C.V. and SWOC presentation.
7	Assertiveness and EI: Theory inputs and activities.
8	Conducting Mock Interviews.
9	Team work activity: building blocks of a team - discussion & activity.
10	Panel Discussion.
11	Verbal Ability – I: synonyms, antonyms, homonyms, one word substitutes.
12	Verbal Ability – II: jumbled paragraphs, error corrections.
13	Summarizing and note making: techniques and important tips.
14	Personality assessment: conducting an MBTI (Myers Bigiggs Type Indicator) test, self-assessment and discussion.

Text Books:

T1. M. A. Rizvi, ***Effective Technical Communication***, 2nd Edition, McGraw-Hill Education, 2017.
T2. T. Balasubramaniam, ***English Phonetics for Indian Students***, 2nd Edition, Macmillan Publishers, 2012.
T3. M. Raman and S. Sharma, ***Technical Communication: Principles and Practice***, 2nd Edition, Oxford University Press, 2011.

Reference Books:

R1. S. Samantray, ***Business Communication and Communicative English***, Sultan Chand.
R2. J. Seeley, ***The Oxford Guide to Effective Writing and Speaking***, 2nd Edition, Oxford University Press, 2005.
R3. B. K. Mitra, ***Communication Skills for Engineers***, Oxford University Press, 2011.
R4. B. K. Das, K. Samantray, R. Nayak, S. Pani, and S. Mohanty, ***An Introduction to Professional English and Soft Skills***, Cambridge University Press, 2009.

Online Resources:

1. https://nptel.ac.in/courses/109104107/
2. https://nptel.ac.in/courses/109104031/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Participate effectively in Group Discussions.
CO2	Work on their own personality through self-assessment by SWOC and MBTI.
CO3	Perform well in Personal Interviews.
CO4	Develop Vocabulary Skills.
CO5	Work effectively both as a team leader and a team member.

Program Outcomes Relevant to the Course:

PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1						1	2	3		2	1	1	3
CO2						1	2	3		2		1	1
CO3						1		3		2			3
CO4						2	3	3		2	2	2	2
CO5						1	3	3		2	1	1	3

Part III

3rd Year MCA

Curriculum Structure

Semester V									
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY									
PC	18MC1T20	Web Technologies & Enterprise Java	3	0	0	3	0	0
PC	18MC1T21	Software Engineering & UML	3	0	0	3	0	0
PE	18MC2T**	Professional Elective - III	3	0	0	3	0	0
PE	18MC2T**	Professional Elective - IV	3	0	0	3	0	0
PE	18MC2T**	Professional Elective - V	3	0	0	3	0	0
PRACTICAL									
PC	18MC1L17	Web Technologies & Enterprise Java Lab	0	0	4	0	0	2
PC	18MC1L18	Software Engineering & UML Lab	0	0	2	0	0	1
PJ	18MC6L19	Minor In-House Project	0	0	4	0	0	2
		SUB-TOTAL	**15**	**0**	**10**	**15**	**0**	**5**
		TOTAL	**25**			**20**		

List of Electives

Code	Elective # and Subjects
	Professional Elective - III
18MC2T28	Data Warehousing & Data Mining
18MC2T29	Artificial Intelligence
18MC2T30	Mobile Computing
18MC2T31	E-Commerce & Knowledge Management
	Professional Elective - IV
18MC2T32	Machine Learning
18MC2T33	Mobile Application Development
18MC2T34	Embedded Systems
18MC2T35	Software Testing
	Professional Elective - V
18MC2T36	Cloud Computing
18MC2T37	Cryptography & Internet Security
18MC2T38	Internet of Things
18MC2T39	Soft Computing

Semester VI								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
PRACTICAL								
PJ	18MC6L20	Industrial Training & Major Project	0	0	40	0	0	20
		SUB-TOTAL	**0**	**0**	**40**	**0**	**0**	**20**
		TOTAL	**40**			**20**		

Type	Code	Web Technologies & Enterprise Java	L-T-P	Credits	Marks
PC	18MC1T20		3-0-0	3	100

Objectives	The objective of this course is to impart in-depth understanding of web technologies necessary for business application design and development with primary focus on enterprise Java.
Pre-Requisites	Analytical and logical understanding with fundamental knowledge of object oriented programming is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Internet and Web Technology: Introduction and overview, Internetworking concept and architectural model, Protocol layering, Client Server model, the World Wide Web; Web Programming: Web generation, Web browsers, Web servers, URLs, URN, URI; Basics of HTML & XHTML Programming: Document structure, Images, Hyperlinks, Lists, Tables, Forms, Frames, CSS.	**10 Hours**
Module-2	Basic JavaScript Programming: DOM, Loops, Function and Arrays; XML: Data Interoperability, Document structure, DTD, Namespaces, XML Schema, Parsing XML documents.	**8 Hours**
Module-3	Enterprise Java Programming: Overview, Java EE platform, API, Web Applications; Java Servlet Technology: Lifecycle of a Servlet, Servlet API, Servlet Packages, Types of Servlets, Stateless and Stateful protocols, Session tracking.	**8 Hours**
Module-4	JSP Technology: Architecture & Anatomy of JSP Page, JSP life cycle, Bean, JSP with MVC Architecture, Dynamic web page creation, Scripting elements, Session tracking.	**8 Hours**
Module-5	JSTL, Database access, EJB, Component Architecture, Java Server Faces (JSF) Technology, Facelets, AJAX.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. I. Bayross, ***Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP***, 4th Revised Edition, BPB Publications, 2005.
T2. E. Jendrock, D. Carson, I. Evans, D. Gollapudi, K. Haase, and C. Srivastha, ***The Java EE6 Tutorial - Volume I***, 4th Edition, Pearson India, 2010.

Reference Books:

R1. R. Moseley and M. T. Savaliya, ***Developing Web Applications***, 2nd Edition, Wiley India, 2008.
R2. Kongent Learning Solutions Inc., ***Java Server Programming - Java EE6 (J2EE 1.6) Black Book***, Dreamtech Press, 2010.

Online Resources:

1. https://www.w3.org/ - World Wide Consortium
2. https://www.tutorialspoint.com/ - Tutorials Point
3. https://www.coursera.org/courses?languages=en&query=web%20development
4. https://www.simplilearn.com - Web Development Simplilearn

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe & explain Web Technologies and protocols used on the Internet.
CO2	Design a web page using appropriate elements and attributes in XHTML.
CO3	Develop interactive web pages using JavaScript with client side programming.
CO4	Build database driven web applications using java server side programming.
CO5	Design complex web applications using MVC architecture.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	1		1				2	1		
CO2	1	2	2	1		1				2	1		
CO3	3	1	2	2		1				2	1	1	1
CO4	3	2	2	1		1				2	2	1	1
CO5	3	2	3	1		1				2	2	1	1

Type	Code	Software Engineering & UML	L-T-P	Credits	Marks
PC	18MC1T21		3-0-0	3	100

Objectives	The objective of this course is to provide fundamentals of software engineering, software development life cycle & project management, object-oriented software design, development, testing and quality assurance.
Pre-Requisites	Knowledge of computers, logical & analytical ability, exposure to procedural and object oriented programming languages is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Software Engineering: Evolution and Emergence of Software Engineering; Software Life Cycle Models: Classical Waterfall Model, Iterative Waterfall Model, V-Model, Prototyping Model, Incremental Development Model, Evolutionary Model, RAD model, Agile development models & Spiral model.	**8 Hours**
Module-2	Software Project Management: Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, COCOMO model, Halstead's Software Science, Scheduling, Staffing, Risk Management; Requirements Analysis & Specification: Requirements Gathering and Analysis, SRS, Formal System Specification.	**8 Hours**
Module-3	Software Design: Overview of the Design Process, Cohesion and Coupling, Layered Arrangement of Modules, Approaches to Software Design; FOD: SA/SD Methodology, DFD, Structured Design and Detailed Design.	**8 Hours**
Module-4	Object Modelling Using UML: Object-Orientation Concepts, Unified Modelling Language (UML); UML Models: Use Case Model, Class Diagram, Interaction Diagrams, Activity Diagram, State Chart Diagram, Package, Component and Deployment Diagrams; Object-Oriented Software Development: OOAD Methodology.	**8 Hours**
Module-5	Coding & Code Review; Testing: Basic Concepts, Black-box and White-box Testing, Debugging, Integration Testing, Testing Object-Oriented Programs, Integration Testing, System Testing; Software Reliability, Software Quality, QMS, SEI CMM, Six Sigma; CASE, Software Maintenance, Emerging Trends.	**10 Hours**
	Total	**42 Hours**

Text Books:

T1. R. Mall, ***Fundamentals of Software Engineering***, 4th Edition, PHI Learning, 2014.
T2. C. Larman, ***Applying UML and Patterns***, 3rd Edition, Pearson Education, 2015.

Reference Books:

R1. I. Somerville, ***Software Engineering***, 9th Edition, Pearson Education, 2013.
R2. R. S. Pressman, ***Software Engineering - A Practitioner's Approach***, 7th Edition, McGraw Hill Education, 2010.

Online Resources:

1. https://nptel.ac.in/courses/106105182/: by Prof. Rajib Mall, IIT Kharagpur.
2. https://nptel.ac.in/courses/106101061/: by Prof. N. L. Sharda, IIT Bombay.
3. https://www.tutorialspoint.com/software_engineering/software_engineering_tutorial.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe fundamentals of software engineering and life cycle models.
CO2	Conduct requirements analysis, estimation, planning, scheduling, and other software project management activities.
CO3	Create high-level & detail-level design of a software using various design methodologies.
CO4	Visualize object oriented approach for software design using Unified Modeling Language.
CO5	Code, review, test and maintain software products confirming to quality standards.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	1	1		2		1	2	1		1	1	3
CO2	3	2	2		2		3	3	2		3	1	3
CO3	2	3	2		2		2	2	2		3	2	3
CO4	2	3	3		2		2	2	2		3	1	3
CO5	2	3	3		3		1	2	1		2	3	2

Type	Code	Data Warehousing & Data Mining	L-T-P	Credits	Marks
PE	18MC2T28		3-0-0	3	100

Objectives	The objective of this course is to study the fundamentals of data warehousing and various data mining algorithms for analysis of large, complex, information-rich data sets to discover useful knowledge from the data.
Pre-Requisites	Basic knowledge of probability and statistics is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Data warehousing: Introduction, Difference between operational databases and data warehouses, Three tier architecture of data warehouse, data marts, data staging area, metadata.	**8 Hours**
Module-2	Data Mining Basics: Introduction, application areas in data mining, KDD process; Getting to know your data: Data Objects and attributes types; Data pre-processing, Data cleaning, data integration, data transformation and reduction.	**6 Hours**
Module-3	Mining frequent Patterns, Associations and Correlations: Introduction, Market Basket Analysis, Frequent Item-set Generation using Apriori algorithm, Rule generation; Alternative Methods for Generating Frequent Item sets using FP-Growth Algorithm, Evaluation of Association Patterns; From association analysis to correlation analysis.	**8 Hours**
Module-4	Classification: Introduction, Naïve Bayesian Classifiers, Decision Trees Induction, Nearest Neighbor Classifiers, Neural network - multilayer perceptron model; Classification model evaluation techniques, Techniques to improve classification accuracy: Bagging, Boosting, handling the class imbalance problem.	**14 Hours**
Module-5	Clustering: Overview, K-Means, K-Medoid, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph-based Clustering, Scalable Clustering Algorithms.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. J. Han, M. Kamber, and J. Pei, ***Data Mining Concepts and Techniques***, 3rd Edition, Elsevier, 2011.
T2. R. Thareja, ***Data Warehousing***, 4th Edition, Oxford University Press, 2009.

Reference Books:

R1. A. Berson and S. J. Smith, ***Data Warehousing, Data Mining & OLAP***, 10th Edition, McGraw Hill Education, 2007.
R2. P-N. Tan, M. Steinbach, and V. Kumar, ***Introduction to Data Mining***, 1st Edition, Pearson Education, 2016.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105174/: by Prof. P. Mitra, IIT Kharagpur
2. https://www.cse.iitb.ac.in/infolab/Data/Talks/datamining-intro-IEP.ppt: by Prof. S. Sudarshan. IIT Bombay
3. https://grid.cs.gsu.edu/~cscyqz/courses/dm/dmlectures.html: Lecture notes by GSU
4. http://infolab.stanford.edu/~ullman/mining/2003.html: Notes by Stanford University

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain the requirement of a data warehouse and its components.
CO2	Describe the basic concepts of data mining and perform data pre-processing.
CO3	Perform frequent pattern mining to determine associations and correlations.
CO4	Classify data sets into different classes using various classification algorithms.
CO5	Apply different clustering algorithms to discover distinct groups in data.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1							1	3	1	1
CO2	3	3	1							1	3	1	1
CO3	3	3	2	1						1	3	1	1
CO4	3	3	2	1						1	3	1	1
CO5	3	3	2	1						1	3	1	1

Type	Code	Artificial Intelligence	L-T-P	Credits	Marks
PE	18MC2T29		3-0-0	3	100

Objectives	The objective of the course is to present an insight of Artificial Intelligence (AI) concepts, principles and approaches used to develop intelligent agents for various computer applications.
Pre-Requisites	Knowledge of computer programming, data structures & algorithms, discrete mathematics and probability theory are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Artificial Intelligence: Introduction, Intelligent Agents - Agents and Environment, Good Behavior, Nature of Environments, Structure of Agents; Problem Solving: Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Searching with Partial Information.	**8 Hours**
Module-2	Informed Search and Exploration: Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms & Optimization Problems; Constraint Satisfaction Problems (CSPs): Introduction, Backtracking Search for CSPs, Local Search for CSPs; Adversarial Search: Games, Optimal Decisions in Games, Alpha-Beta Pruning.	**9 Hours**
Module-3	Knowledge & Reasoning: Knowledge-Based Agents, The Wumpus World; Logic: Propositional Logic & Reasoning Patterns; First-Order Logic: Syntax and Semantics, Using FOL, Knowledge Engineering in FOL; Inference in FOL: Propositional vs. FOL, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories & Objects, Semantic Networks, Frames.	**9 Hours**
Module-4	Planning: The Planning Problem, Planning with State-Space Search, Partial-Order Planning, Planning Graphs; Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability Notations, Bayes' Rule and its use; Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks.	**8 Hours**
Module-5	Learning: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees; Statistical Learning Methods: Instance Based Learning, Neural Networks; Reinforcement Learning: Passive and Active Reinforcement Learning; Communication: Communication as Action, A Formal Grammar for a Fragment of English, Syntactic & Semantic Analysis; Expert Systems: Introduction, Architecture, Representations.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. S. J. Russell and P. Norvig, ***Artificial Intelligence - A Modern Approach***, 3rd Edition, Pearson Education, 2016.
T2. D. W. Patterson, ***Introduction to Artificial Intelligence & Expert Systems***, Pearson Education, 2015.

Reference Books:

R1. E. Rich, K. Knight, and S. B. Nair, ***Artificial Intelligence***, 3rd Edition, McGraw Hill, 2017.
R2. G. F. Luger, ***Artificial Intelligence***, 5th Edition, Pearson Education, 2009.
R3. M. Negnevitsky, ***Artificial Intelligence: A Guide to Intelligent Systems***, 2nd Edition, Pearson Education, 2008.
R4. N. J. Nilson, ***Principles of Artificial Intelligence***, 1st Edition, Narosa, 2002.
R5. E. Charniak and D. McDermott, ***Introduction to Artificial Intelligence***, 1st Edition, Addison-Wesley, 1985.

Online Resources:

1. https://nptel.ac.in/courses/106105077/: by Prof. S. Sarkar & Prof. A. Basu, IIT Kharagpur
2. https://nptel.ac.in/courses/106105079/: by Prof. P. Mitra, IIT Kharagpur
3. https://nptel.ac.in/courses/106106140/: by Prof. D. Khemani, IIT Madras

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explore agents and working environments with utilization of uninformed techniques in state space search.
CO2	Apply search techniques for Game playing and solving constraint satisfaction problems.
CO3	Interpret logic & inference rules for decision making & knowledge representation.
CO4	Apply planning and reasoning to handle uncertainty in real life problems.
CO5	Use learning to solve complex real-life problems and design of expert systems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3						1	2	1	1
CO2	2	3	2	3						1	3	1	2
CO3	3	2	2	3						1	3	1	1
CO4	3	2	2	2		1				1	3	1	1
CO5	2	2	2	2		2				1	3	1	2

Type	Code	Mobile Computing	L-T-P	Credits	Marks
PE	18MC2T30		3-0-0	3	100

Objectives	The objective of the course is to study the concepts and technologies for transmission of various types of data over wireless mediums and introduce computing on mobile devices.
Pre-Requisites	Fundamental knowledge of networking and signal transmission are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Personal Communication System (PCS), Evolution of Wireless Technologies, Signals and Frequency, Cellular system – Structure, Cluster, Frequency Reuse and Splitting, MAC mechanisms - SDMA, TDMA, CDMA, GSM Technology - Architecture, Channels & Bands, GSM Architecture, Mobility Management, Handover Detection and Management; GPRS - Architecture, Interfaces, Network Protocols.	**8 Hours**
Module-2	WLAN IEEE 802.11 System Architecture, Ad-Hoc and Infrastructural Mode, MAC Frame format, Bluetooth - Introduction, Piconet, Scatternet, Protocol stack, Profile; WAP - Architecture and Components, WAP Gateway and Protocol stack; WML Script - Variables, Control structure and Functions, IMT 2000 standards, WCDMA and CDMA 2000.	**9 Hours**
Module-3	MobileIP - Goals, Requirements, Entities, Agent Advertisement and Discovery, Registration, IP packet Delivery, Tunneling and Encapsulation; IPv6, DHCP, ICMP, Routing, Introduction to Wireless Local Loop (WLL), Wireless Enterprise Networks.	**9 Hours**
Module-4	Satellite Network Technology - Global Mobile Satellite system (HEO, LEO, MEO), Satellite system architecture, satellite constellation for satellite phone, Case studies: Iridium, GLOBALSTAR, GLONASS; Virtual Private Network - Features and Goals, Remote Access VPN, Site to Site VPN, VPN Protocol and Requirements, Security Issues in Mobile Computing, Algorithms and Implementation.	**8 Hours**
Module-5	VoIP and Real Time protocols, Multimedia content delivery in Mobile Network, Mobile OS - Android, iOS, Application development for Mobile platforms, Android Studio and Java Programming Language, 3-tier Architecture for Mobile Computing, Design and computing through Internet, Internet of Things, Current trends and Research.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. J. Schiller, ***Mobile Communication***, 2nd Edition, Pearson Education, 2004.
T2. A. K. Talukder, H. Ahmed, and R. Yavagal, ***Mobile Computing***, 2nd Edition, McGraw Hill, 2017.
T3. Y-B. Lin, I. Chlamtac, ***Wireless and Mobile Network Architectures***, 1st Edition, Wiley, 2008.

Reference Books:

R1. V. K. Garg, ***Wireless Communication and Networks***, 2nd Edition, Pearson Education, 2003.
R2. U. Hansmann, L. Merk, M. Nicklous, and T. Stober, ***Principles of Mobile Computing***, 2nd Edition, Springer, 2006.

Online Resources:

1. http://alphace.ac.in/downloads/notes/cse/10cs831.pdf
2. https://www.tutorialspoint.com/mobile_computing/mobile_computing_overview.htm

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain current technological implementation in GSM network.
CO2	Assess the capabilities of GSM and wireless technologies in network design and operation.
CO3	Evaluate network protocols, routing algorithms, connectivity methods and characteristics.
CO4	Describe wireless network topologies, wireless connectivity and characteristics, and the significance of security & Internet communications.
CO5	Apply appropriate wireless technologies in commercial & enterprise applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3			2	2					1	3		3
CO2	1	2		2	3					1	3		3
CO3	1		3	3	2					1	3		3
CO4	3	2	2		3					1	3	1	3
CO5	1	3	2	1	3					1	3	2	3

Type	Code	E-Commerce & Knowledge Management	L-T-P	Credits	Marks
PE	18MC2T31		3-0-0	3	100

Objectives	The objective of this course is to introduce the fundamentals of e-commerce and its impact, infrastructure, business strategies, revenue models, building web presence, hardware and software technologies for e-commerce and knowledge management.
Pre-Requisites	Basic knowledge of Internet Web Technology, World Wide Web, Databases and Client-Server technologies is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to E-Commerce: E-Commerce and E-Business, Introduction to Business Models and Revenue Models, Business Processes, Impacts, Advantages and Disadvantages of E-Commerce, International Nature of E-Commerce; Technology Infrastructure: The Internet and the World Wide Web, Internet Protocols, Markup Languages, Intranets and Extranets; The Environment of E-Commerce: Legal, Ethical, and Tax Issues.	**8 Hours**
Module-2	Revenue Models in detail, Revenue Models in Transition, Revenue Strategy Issues, Creating an Effective Web Presence, Web Site Usability, Connecting with Customers; Marketing on the Web: Web Marketing Strategies, Communicating with Different Market Segments, Beyond Market Segmentation: Customer Behavior and Relationship Intensity, Advertising On The Web, E-Mail Marketing, Technology-Enabled CRM, Creating and Maintaining Brands on the Web, Search Engine Positioning and Domain Names.	**10 Hours**
Module-3	Business-to-Business Activities: Purchasing, Logistics, and Support Activities, Electronic Data Interchange, Supply Chain Management Using Internet Technologies, Electronic Marketplaces and Portals, Social Networking, Mobile Commerce, and Online Auctions.	**8 Hours**
Module-4	Web Server Hardware and Software: Web Server Basics, Software for Web Servers, E-Mail, Web Server Hardware.	**8 Hours**
Module-5	Electronic Commerce Software: Web Hosting, Basic and advanced Functions of Electronic Commerce Software, Electronic Commerce Software for Small, Midsize and Large Companies, Knowledge Management, Knowledge Management technologies and Software.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. G. P. Schneider, ***Electronic Commerce***, 9th Edition, Cengage Learning, 2010.

Reference Books:

R1. R. Kalakota, A. B. Whinston, ***Frontiers of Electronic Commerce***, 1st Edition, Addision Wesley, 2002.
R2. C. V. S Murthy, ***E-commerce: Concepts, Models & Strategies***, 1st Edition, Himalaya Publishing, 2018.

Online Resources:

1. https://nptel.ac.in/courses/110105083/: by Prof. M. Jenamani, IIT Kharagpur.
2. https://warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/oklc3/papers/id240.pdf: by R. McLean and N. M. Blackie, University of Salford, UK.
3. https://www.researchgate.net/publication/240790062_Knowledge_Management_in_an_E-commerce_System: by Oklahoma State University, USA

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the fundamentals of e-commerce and its relevance to society.
CO2	Explain various e-commerce revenue models and online marketing strategies.
CO3	Discuss B2B activities, Electronic Data Interchange, Supply Chain Management, Mobile Commerce and e-Logistics.
CO4	Explain technical aspects of e-commerce with respect to Hardware and Software components.
CO5	Compare available e-commerce solutions and knowledge management technologies.

Program Outcomes Relevant to the Course:

PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1			2		2	3			2		2	1	
CO2			2		1	2			2		2	2	1
CO3			1		3	2			3		2	1	1
CO4			2		3	1			2		2	2	1
CO5			2		3	2			2		2	1	

Type	Code	Machine Learning	L-T-P	Credits	Marks
PE	18MC2T32		3-0-0	3	100

Objectives	The objective of this course is to introduce fundamental concepts and methods for machine learning along with analysis of large data sets.
Pre-Requisites	Basic knowledge of probability and statistics is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Overview of supervised learning, K-nearest neighbour, Multiple linear regression, Shrinkage methods (Ridge regression, Lasso regression), Subset selection, Linear Discriminant Analysis, Logistic regression.	**9 Hours**
Module-2	Bias, Variance, and model complexity, Cross-validation, Bootstrap methods, Regression and classification trees, Boosting methods, AdaBoost and Random forest.	**8 Hours**
Module-3	Generative model for discrete data (Bayesian concept learning, Naïve Bayes classifier), SVM for classification, Reproducing Kernels, SVM for regression.	**8 Hours**
Module-4	Clustering (K-means, spectral clustering), Feature Extraction (Principal Component Analysis (PCA), kernel based PCA, Independent Component Analysis (IDA), Non-negative matrix factorization).	**9 Hours**
Module-5	Introduction to Reinforcement learning, Single State Case: K-Armed Bandit, Elements of Reinforcement Learning, Model-Based Learning (Value Iteration, Policy Iteration).	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. T. Hastie, R. Tibshirani, and J. Friedman, ***The Elements of Statistical Learning - Data Mining, Inference, and Prediction***, 2nd Edition, Springer, 2009.
T2. S. Haykin, ***Neural Networks and Learning Machines***, 3rd Edition, Pearson Education, 2009.
T3. E. Alpaydin, ***Introduction to Machine Learning***, 2nd Edition, Prentice Hall of India, 2010.

Reference Books:

R1. Y. G. James, D. Witten, T. Hastie, and R. Tibshirani, ***An Introduction to Statistical Learning with Applications in R***, 1st Edition, Springer, 2013.
R2. T. M. Mitchell, ***Machine Learning***, 1st Edition, McGraw Hill Education, 2013.
R3. C. M. Bishop, ***Pattern Recognition and Machine Learning***, 1st Edition, Springer, 2006.

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Online Resources:

1. https://nptel.ac.in/courses/106/105/106105152/: by Prof. S. Sarkar, IIT Kharagpur.
2. https://nptel.ac.in/courses/106/106/106106139/: by Prof. B. Ravindran, IIT Madras.
3. https://nptel.ac.in/courses/106/106/106106202/: by Prof. C. G. Jansson, IIT Madras.

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply supervised learning to solve related real-life problems.
CO2	Analyze a problem and select the most suitable supervised model for the same.
CO3	Apply classification & regression models such as SVM and decision models.
CO4	Preform clustering of given data with extraction of important features.
CO5	Apply the concepts of reinforcement learning to solve relevant real-life problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	1						1	3	1	2
CO2	3	2	3	1						1	3	1	3
CO3	3	3	3	2						1	3	1	3
CO4	3	2	2	2						1	3	1	3
CO5	2	3	2	2						1	3	1	3

Type	Code	Mobile Application Development	L-T-P	Credits	Marks
PE	18MC2T33		3-0-0	3	100

Objectives	The objective of this course is to learn about design and development of mobile applications with focus on Android operating system.
Pre-Requisites	Knowledge of Java programming language & IDE tools is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with design and programming activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to mobile applications – Embedded systems, Market and business drives for mobile applications, Publishing and delivery of mobile applications, Requirements gathering and validation for mobile applications.	**6 Hours**
Module-2	Basic Design - Introduction, Basics of embedded systems design, Embedded OS, Design constraints for mobile applications (hardware and software); Architecting mobile applications: User interfaces for mobile applications, Touch events and gestures; Achieving quality constraints: performance, usability, security, availability and modifiability.	**8 Hours**
Module-3	Introduction to Android OS, Android Studio, Establishing the development environment, Android architecture, Activities and views, Interacting with UI, Persisting data using SQLite, Packaging and deployment, Design patterns for mobile applications.	**10 Hours**
Module-4	Designing applications with multimedia and web access capabilities, Integration with GPS and social media applications, Accessing applications hosted in the cloud, Interaction with server side applications, Using Google Maps.	**10 Hours**
Module-5	Working with Bluetooth and WiFi, Threads and Thread Handlers – Introduction to Threads, Worker threads; Working with Graphics and Animation, Using the Drawable and ShapeDrawable objects, Hardware Acceleration.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. R. Meier, ***Professional Android^{TM}4 Application Development***, 3rd Edition, John Wiley & Sons. 2012.

T2. P. Kothari, ***Android Application Development Black Book***, 3rd Edition, Kogent Learning Solutions, DreamTech Press, 2014.

Reference Books:

R1. C. Collins, M. Galpin, and M. Käppler, ***Android in Practice***, 1st Edition, DreamTech Press, 2012.

R2. A. Pradhan, A. V. Despande, ***Composing Mobile Apps (Learn, Explore, Apply) using Android^{TM}***, 1st Edition, Wiley, 2014.
R3. J. McWherter and S. Gowell, ***Professional Mobile Application Development***, 1st Edition, Wrox (John Wiley & Sons), 2012.

Online Resources:
1. https://developer.android.com/guide: Android Developers' Guide by *Google*

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain mobile applications and platforms from technical and business point of views.
CO2	Design simple mobile applications considering performance, usability, and security.
CO3	Use IDE tools to create mobile applications on Android platform.
CO4	Develop feature-rich mobile applications and integrate them with other useful services.
CO5	Implement various advanced UI and connectivity features in mobile applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3						1	3		3
CO2	2	3	2	3						1	3	1	2
CO3	3	2	2	3						1	3	1	3
CO4	3	2	2	2		1				1	3	1	2
CO5	2	2	2	2		2				1	3	1	2

Type	Code	Embedded Systems	L-T-P	Credits	Marks
PE	18MC2T34		3-0-0	3	100

Objectives	The objective of this course is to study basic concepts, architecture, and design of embedded systems along with advanced topics like ARM architecture, real-time operating systems, low power embedded systems design and hardware-software co-simulation & partitioning.
Pre-Requisites	Fundamentals of operating system, basic knowledge on computer organization and architecture are essential for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with design and programming activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Hardware Concepts: Generation of evolution, purpose, components, application and characteristics of embedded systems, Overview of processors and hardware units in embedded system, Embedded software in a system, Design metrics, Embedded system design flow.	**7 Hours**
Module-2	ARM: ARM microcontroller, Brief history of ARM, ARM pipeline, Instruction Set Architecture (ISA), THUMB instructions.	**8 Hours**
Module-3	Interfacing: Serial Peripheral Interface (SPI), IIC, RS-232C, RS-422, RS-485, USB architecture and USB connectors, CAN, Bluetooth, ISA and PCI.	**8 Hours**
Module-4	Real-Time Operating systems: Concepts of Real-time task scheduling, Types of real-time tasks and their characteristics, Task scheduling, Clock-driven scheduling, Hybrid scheduler, Event-driven scheduling, EDF, RMA, Resource sharing using PIP, HLP and PCP, Features of real-time operating system, Commercial RTOSs like PSOS, VRTX, Windows CE.	**10 Hours**
Module-5	Modeling Techniques: Common computation model, Sequential program model, FSM, Language subset approach, State chart, SDL, Petri-Nets, PRES and UML; Hardware-software co-simulation: Designs, approaches and co-simulation environments; Hardware-software partitioning: K-L partitioning; Low power embedded system design: Dynamic power dissipation, Static power dissipation, algorithmic and control logic power minimization.	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. S. Chattopadhyay, ***Embedded System Design***, 2nd Edition, PHI, 2010.
T2. F. Vahid and T. Givargis, ***Embedded Systems Design - A Unified Hardware / Software Introduction***, 1st Edition, Wiley, 2006.
T3. R. Mall, ***Real-Time Systems***, 2nd Edition, Pearson Education, 2010.

P.T.O

Reference Books:

R1. R. Kamal, ***Embedded System Architecture, Programming and Design***, 3rd Edition, McGraw Hill, 2017.
R2. P. Marwedel, ***Embedded System Design***, 1st Edition, Springer, 2006.

Online Resources:

1. https://nptel.ac.in/courses/108/105/108105057/: by Prof. R. Mall *et. al.*, IIT Kharagpur.
2. https://nptel.ac.in/courses/106/105/106105159/: by Prof. A. Basu, IIT Kharagpur.
3. https://examupdates.in/embedded-systems-pdf/
4. http://www.eeherald.com/section/design-guide/esmod1.html

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe embedded systems, identify the features of processors, and functioning of hardware units and embedded software.
CO2	Analyze the ARM instruction set and its special features.
CO3	Identify and visualize device drivers used in embedded system and their interfacing.
CO4	Understand principles of real-time operating systems and compare various real-time task scheduling algorithms.
CO5	Explain embedded system modeling techniques, hardware-software partitioning and low power embedded system design.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2		2					2	2		1
CO2	2	2	2		2					2	3		2
CO3	3	2	2	2	2					2	1		2
CO4	2	3	2	2	2						2		2
CO5	3	1	3	2	2					1	2		2

Type	Code	Software Testing	L-T-P	Credits	Marks
PE	18MC2T35		3-0-0	3	100

Objectives	The objective of this course is to introduce the fundamental concepts, processes, and systematic methodologies of Software Testing and their implications on different stages of software development & maintenance.
Pre-Requisites	Basic programming knowledge, understanding of databases / data modeling and adequate knowledge of software engineering are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with examples and case-study activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction: Testing as an Engineering Activity, Role of Process in Software Quality, Testing as a Process, TMM Overview, Basic Definitions, Software Testing Principles - The Tester's Role, Origins of Defects, Defect Classes, The Defect Repository and Test Design Defect Examples, Developer/Tester Support for Developing a Defect Repository.	**8 Hours**
Module-2	Test Case Design: Testing Design Strategies, The Smarter Tester, Test-Case Design Strategies, Using Black-Box Approach to Test-Case Design, Random Testing, Equivalence Class Partitioning, Boundary Value Analysis, Other Black Box Test Design Approaches, Decision Tables, Requirements based Testing, Positive and Negative Testing, Compatibility Testing, User Documentation Testing, Domain Testing, Using the White Box Approach to Test Design, Test Adequacy Criteria, Coverage and Control Flow Graphs, Covering Code Logic, Paths Testing, Data Flow and White Box Test Design, Loop Testing, Mutation Testing, Evaluating Test Adequacy Criteria.	**11 Hours**
Module-3	Levels of Testing: The Need for Levels of Testing, Unit Test - Functions, Procedures, Classes, and Methods as Units, The Need for Preparation, Unit Test Planning, Designing the Unit Tests, The Class as a Testable Unit, The Test Harness, Running the Unit Tests and Recording Results; Integration Test - Goals, Integration Strategies for Procedures, Functions, and Classes, Designing Integration Tests, Integration Test Planning; System Test - Functional Testing, Performance Testing, Stress Testing, Configuration Testing, Security Testing, Recovery Testing, Regression Testing, Alpha, Beta, and Acceptance Tests.	**11 Hours**

Cont'd...

Module-#	Topics	Hours
Module-4	Test Management: People Issues in Testing, Organization structures for Testing Teams (Single Product and Multi-Product Companies), Testing Services Organization, Test Planning, Test Plan Components, Test Management, Test Process, Test Reporting, Software test automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation.	**6 Hours**
Module-5	Control, Monitoring, and Quality Assurance: Measurements and Milestones (Testing Status, Tester Productivity, Testing Costs, Errors, Faults & Failures, Test Effectiveness), Criteria for Test Completion, Types of Reviews, Review Metrics; Quality Control, Operational Profiles and Usage Models, Support for Quality Control, Statistical Testing, Software Reliability, Measurements for Software Reliability, Reliability, Quality Control, and Stop-Test Decisions, Applying Reliability Models, Internationalization Testing, Ad-hoc Testing, Testing OO-systems, Usability and Accessibility Testing.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. I. Burnstein, ***Practical Software Testing***, 1st Edition, Springer, 2003.
T2. S. Desikan and G. Ramesh, ***Software Testing - Principles and Practices***, 1st Edition, Pearson Education, 2006.

Reference Books:

R1. A. P. Mathur, ***Foundations of Software Testing***, 2nd Edition, Pearson Education, 2008.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105150/: by Prof. R. Mall, IIT Kharagpur
2. https://nptel.ac.in/courses/106101163/: by Prof. M. D'Souza, IIIT Bangalore.
3. https://www.softwaretestingmaterial.com/manual-testing-tutorial/
4. https://www.guru99.com/software-testing.html

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the relevance of testing as an engineering activity and realize the defects that are inherent to software applications.
CO2	Explain different testing strategies and select appropriate strategy for software testing.
CO3	Analyze different levels of testing in the perspective of product requirements and delivery.
CO4	Develop understanding of the test management procedures & create test plans for test automation.
CO5	Practice quality aspects, standards & models required to deliver software of assured quality.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

Cont'd...

PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3			2	1		1	2		1	2		2
CO2	3			2	3		2	2		1	1	1	3
CO3	2			2	3		3	1		1	2		2
CO4	1			2	3		3	3		2	2		3
CO5	1			2	1		3	3		1	2		3

Type	Code	Cloud Computing	L-T-P	Credits	Marks
PE	18MC2T36		3-0-0	3	100

Objectives	The objective of this course is to study the fundamental concepts of cloud computing along with a broad coverage of the cloud platforms, security issues, and performance of applications on the cloud.
Pre-Requisites	Knowledge of computer networking, client-server concepts, internet & web technologies are essential for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with examples and case-study activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Client/Server systems, Thin & Thick Clients, Centralized Computing, Parallel & Distributed Computing, Amdahl's Law, P2P Computing, Cluster Computing, Grid Computing, Utility Computing, Autonomic Computing, Hosting, Data Center, Convergence of Technologies, Cloud Computing, NIST definition, Characteristics, Service Models, Deployment Models, Cloud Service Examples, Cloud-based Services & Applications.	**9 Hours**
Module-2	Cloud Concepts & Technologies: Virtualization, Load Balancing, Scalability & Elasticity, Deployment, Replication, Monitoring, Software Defined Networking (SDN), Network Function Virtualization, MapReduce, Identity & Access Management, Service Level Agreements (SLA), Billing.	**9 Hours**
Module-3	Cloud Services & Platforms: Compute Services, Storage Services, Database Services, Application Services, Content Delivery Services, Analytics Services, Deployment & management Services, Identity & Access Management Services, Open Source Private Cloud Software - CloudStack, Eucalyptus, OpenStack.	**8 Hours**
Module-4	Cloud Application Design: Considerations for scalability, reliability, availability, security, maintenance and upgradation, performance; Reference Architecture for Cloud Applications, Cloud Application Design Methodologies, Data Storage Approaches; Cloud Application Benchmarking & Tuning, Workload Characteristics, Application Performance Metrics, Benchmarking Tools, Deployment Prototyping, Load Testing & Bottleneck Detection.	**9 Hours**
Module-5	Cloud Security: Introduction, Security Issues in the Cloud, Components of Security, Attacks & classes of Threats, CSA Security Architecture, Authentication, Authorization, Identity & Access Management, Infrastructure Security, Data Security, Key Management, Auditing & Compliance.	**7 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Bahga and V. Madisetti, ***Cloud Computing : A Hands-On Approach***, 1st Edition, Orient Blackswan, 2014.
T2. K. Hwang, G. C. Fox, and J. J. Dongarra, ***Distributed and Cloud Computing - From Parallel Processing to the Internet of Things***, 1st Edition, Elsevier, 2012.
T3. T. Mather, S. K. Swamy, and S. Latif, ***Cloud Security and Privacy : An Enterprise Perspective on Risks and Compliance***, 1st Edition, O'Reilly Media, 2009.

Reference Books:

R1. A. T. Velte, T. J. Velte, and R. Elsenpeter, ***Cloud Computing : A Practical Approach***, 1st Edition, McGraw Hill Education, 2017.
R2. B. Sosinsky, ***Cloud Computing Bible***, 1st Edition, Wiley-India, 2011.
R3. T. Erl, Z. Mahmood, and R. Puttini, ***Cloud Computing : Concepts, Technology & Architecture***, 1st Edition, Pearson India Education, 2014.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105167/: by Prof. S. K. Ghosh, IIT Kharagpur.
2. https://nptel.ac.in/courses/106/104/106104182/: by Prof. R. Misra, IIT Kanpur.
3. https://www.coursera.org/learn/cloud-computing: Prof. Indranil Gupta, Department of Computer Science, University of Illinois at Urbana-Champaign.
4. http://web.mit.edu/6.897/www/readings.html: by Prof. Hari Balakrishnan, MIT

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe computing paradigms and explain standard cloud computing models.
CO2	Explain key concepts along with the enabling technologies of cloud computing.
CO3	Appreciate various types of cloud computing services and user-access management.
CO4	Visualize design principles and methodologies for developing applications on the cloud.
CO5	Assess the importance of security & privacy of data in cloud environment.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2		1		1			1	1		1		1
CO2	2		1		2			1	1	1	1		1
CO3	2		3		2			1	1	1	1		2
CO4	2		3		2			1	2	1	2		2
CO5	2		3		2			1	1	1	2	2	1

Type	Code	Cryptography & Internet Security	L-T-P	Credits	Marks
PE	18MC2T37		3-0-0	3	100

Objectives	The objective of this course is to study different security goals and mechanisms with primary focus on cryptography techniques used to protect from various security threats in computer networks and Internet.
Pre-Requisites	Knowledge of computer networks and internet technologies are required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Computer Security Concepts, Security Attacks, Security Services and Mechanisms, Symmetric Cipher model, Cryptography & Cryptanalysis, Substitution Techniques: Caesar cipher, Monoalphabetic cipher, Playfair cipher, Hill Cipher, Polyalphabetic ciphers: Vignere cipher, Vernam cipher, Transposition cipher.	**8 Hours**
Module-2	Integer and Modular Arithmetic, Euclidean and Extended Euclidean Algorithms, Concept of groups, rings, and fields, Difference between GF(p) and GF(2m), Block cipher principles, Data Encryption Standard (DES), Advanced Encryption Standard (AES)	**9 Hours**
Module-3	Fermat's and Euler's Theorem, Chinese Reminder Theorem, Integer factorization, Discrete Logarithms, Public Key Cryptography: RSA, ElGamal , Diffie-Hellman Key Exchange, Elliptic Curve Cryptography : Introduction to elliptic curve, arithmetic, application,	**9 Hours**
Module-4	Message Integrity and Authentication, Cryptographic Hash Functions: MD5, SHA family, Digital Signature and applications-ElGamal.	**7 Hours**
Module-5	Key Distribution, Certificate Authority, X.509, Kerberos, E-mail security: PGP, S/MIME, Security at the Transport Layer: SSL/TLS, Security at Network Layer: IPSec, Malicious Software, Firewall, Intrusion Detection	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. W. Stallings, ***Cryptography and Network Security : Principle and Practice***, 7th Edition, Pearson Education, 2017.

Reference Books:

R1. B. A. Forouzan and D. Mukhopadhaya, ***Cryptography and Network Security***, 2nd Edition, McGraw Hill, 2010.
R2. C. P. Pfleeger, S. L. Pfleeger, and J. Margulies, ***Security in Computing***, 5th Edition,PHI, 2015.
R3. C. Kaufman, R. Perlman, and M. Speciner, ***Network Security : Private Communication in a Public World***, 2nd Edition, PHI, 2002.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105031/: by Dr. D. Mukhopadhyay, IIT Kharagpur
2. https://nptel.ac.in/courses/106/105/106105162/: by Prof. S. Mukhopadhyay, IIT Kharagpur

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the security objectives and security threats that affect our sensitive data.
CO2	Acquire a mathematical foundation of cryptography through modular arithmetic, number theory, integer factorization, and discrete logarithms.
CO3	Analyze and compare traditional and modern symmetric key cryptography algorithms.
CO4	Explain public key cryptography algorithms and their applications and use of hash functions in message integrity and authentication.
CO5	Apply cryptography techniques for securing data on the Internet and realize the need of firewall & IDS technology.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1	1							3		3
CO2	3	3	1	1							3		3
CO3	3	3	3	2		2					3		2
CO4	3	3	3	2		2					3		3
CO5	1	3	3	3		2					3		3

Type	Code	Internet of Things	L-T-P	Credits	Marks
PE	18MC2T38		3-0-0	3	100

Objectives	The objective of this course is to study different security goals and mechanisms with primary focus on cryptography techniques used to protect from various security threats in computer networks and Internet.
Pre-Requisites	Basic knowledge of computer networks, sensor network, micro-processor and micro-controllers is required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as needed, sessions are planned to be interactive with examples, programming, and idea generation activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to IoT: Definition, Characteristic, Components of IoT, Design of IoT systems, Technology and systems implementing IoT, Levels of IoT, Sensors, Actuators, Power Supply.	**8 Hours**
Module-2	IoT Network Model: OSI reference model, Layers in IoT; Protocols: MAC based Protocols, IP based Protocols, Simple Network Management Protocol (SNMP), NetConf, Yang.	**10 Hours**
Module-3	M2M: IoT vs M2M, Software Defined Networking, Network Function Virtualization; IoT Platform Design: IoT Design Methodology, Resource Management in IoT, Data Synchronization.	**9 Hours**
Module-4	Devices: Zigbee, Bluetooth, Wi-fi, RFID, Cloud Computing, Big Data.	**9 Hours**
Module-5	Case Studies: IoT in Smart Home, Smart Grid, Agriculture, Healthcare, Smart Industry, Environment, Smart Cities.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Bahga, V. Madisetti, ***Internet of Things : A Hands-on Approach***, 1st Edition, University Press, 2018.
T2. O. Hersent, D. Boswarthick, and O. Elloumi, ***The Internet of Things : Key Applications and Protocols***, Student Edition, Wiley, 2016.

Reference Books:

R1. D. Uckelmann, M. Harrison, and F. Michahelles, ***Architecting the Internet of Things***, 1st Edition, Springer, 2011.
R2. R. Buyya and A. V. Dastjerdi, ***Internet of Things : Principles and Paradigms***, 1st Edition, Elsevier, 2016.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105166/: by Prof. S. Misra, IIT Kharagpur
2. https://nptel.ac.in/courses/108/108/108108098/: by Prof. T. V. Prabhakar, IISc Bangalore

P.T.O

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe basic concepts of IoT, its architecture and system design.
CO2	Visualize the communication mechanisms between sensors and systems using various protocols and network models.
CO3	Explain IoT with respect to machine to machine and design IoT systems with data synchronization and resource manipulation.
CO4	Describe advanced IoT concepts applied in various devices prevalent in the market.
CO5	Envisage and compare real-world applications of IoT in different domains.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3		1			1			1	2	3	1	3
CO2	2		3			2			2	2	2	1	3
CO3	3		3			2			2	2	2	1	3
CO4	2		3			2			2	2	2	1	2
CO5	3		3			2			2	3	3	1	3

Type	Code	Soft Computing	L-T-P	Credits	Marks
PE	18MC2T39		3-0-0	3	100

Objectives	The objective of this course is to study the fundamentals of non-traditional computing techniques and approaches to solve complex real-life problems with approximate models. The course will also cover different aspects of hybridization along with some case studies.
Pre-Requisites	Knowledge of linear algebra, algorithm design, and data structures is required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as needed, sessions are planned to be interactive with examples, problem solving and programming activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Fuzzy Logic: Basic definition and terminology of fuzzy set, set theoretic operations, T-norm, T-conorm, Membership function formulation and parameterization, Extension Principle, Fuzzy relations, Linguistic variables, fuzzy if-then rules, Compositional rule of inference, fuzzy reasoning, fuzzy inference systems, Mamdani fuzzy models, Defuzzification, Sugeno fuzzy models, Tsukamoto fuzzy models.	**10 Hours**
Module-2	Genetic Algorithm: Introduction to Genetic Algorithm, Working cycle of a GA, Binary Coded GA, GA-parameter setting, Constraint Handling GA, Advantages and disadvantages of GA, Some specialized GA – Real Coded GA.	**8 Hours**
Module-3	Neural Network-I: Introduction, Models of a neuron, Network Architecture, Knowledge Representation; Learning Process, Error correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, Learning with a teacher, Learning without a teacher; Single layered learning – Least Mean Square Algorithm, Perceptron, Perceptron Convergence algorithm.	**10 Hours**
Module-4	Neural Network-II: Multilayer perceptron – Back-propagation algorithm, XOR Problem, Heuristics for Back-Propagation algorithm; Self-organizing maps – Two basic feature mapping models, SOM algorithm.	**8 Hours**
Module-5	Hybrid Systems: Combination of Genetic Algorithms with Fuzzy Logic or Neural Networks, Combination of Neural Network and Fuzzy Logic.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. J. Shing, R. Jang, C. T. Sun, and E. Mizutani, ***Neuro Fuzzy And Soft Computing - A Computational Approach to Learning and Machine Intelligence***, 3rd Edition, Pearson Education, 2008.

T2. D. K. Pratihar, ***Soft Computing***, 2nd Edition, Narosa Publishing House, 2009.

T3. S. Haykin, ***Neural Network - A Comprehensive Foundation***, 2nd Edition, Pearson Education, 2006.

Reference Books:

R1. T. Munakata, ***Fundamentals of the New Artificial Intelligence - Neural, Evolutionary, Fuzzy and More***, 2nd Edition, Springer, 2014.
R2. F. O. Karray and C. De Silva, ***Soft Computing and Intelligent System Design - Theory, Tools and Applications***, 1st Edition, Pearson Education, 2009.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105173/: by Prof. D. Samanta, IIT Kharagpur.
2. http://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html: by Prof. D. Samanta, IIT Kharagpur.

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply fuzzy logic and fuzzy inference system concepts to design automation systems for real life problems.
CO2	Apply the concepts of genetic algorithm to solve engineering optimization problems.
CO3	Use the concepts of ANNs to solve real life engineering and societal problems.
CO4	Appreciate the use of advanced ANN concepts and self-organizing maps to solve a variety of engineering problems.
CO5	Envisage the need of hybridization, and to develop hybrid models for solving complex problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	3					3	3	1	2
CO2	3	3	3	2	3					2	3	1	2
CO3	3	3	3	2	3					2	3	1	2
CO4	3	3	3	2	3					2	3	2	3
CO5	3	3	3	2	3					3	3	1	3

Type	Code	Web Technologies & Enterprise Java Lab	L-T-P	Credits	Marks
PC	18MC1L17		0-0-4	2	100

Objectives	The objective of this lab course is to apply web design principles to develop static and interactive web pages, use server side programming to develop dynamic web applications, and deploy applications on server environment.
Pre-Requisites	Basic analytical and logical understanding with fundamental knowledge of object oriented programming is required. Topics taught in the theory class are essential to do the programming assignments.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Familiarity with Browser Features and Inspect Tool.
2	Hypertext skeleton structure and HTML Elements.
3	HTML Form Elements, Frames, IFrames
4	Box Layout Design.
5	Use of CSS for user interface design.
6	Java Script data types, DOM reference.
7	Form elements and Form validation.
8	Web Server Installation, Web Server folder structure and Web Container.
9	Request response Life cycle.
10	Servlet life cycle implementation.
11	Types of Servlet and deployment procedure to web server.
12	Practical use case of RequestDispatcher and sendRedirect for request flow in web application.
13	Session Tracking mechanism.
14	Servlet Chain using Session.
15	Use of JSP implicit objects.
16	JSP Elements.
17	Use of Session using JSP.
18	Use of Bean in JSP.
19	MVC Framework.
20	Implementation of MVC Architecture using Servlet, JSP and Bean.
21	Database connectivity using Servlet.
22	Database connectivity using JSP.
23	Component Architecture and Java server Faces.

Cont'd...

Experiment-#	Assignment/Experiment
24	Use of Facelet.
25	Implementation of Ajax.
26	Database driven Web Application-Design.
27	Database driven Web Application-Development.
28	Database driven Web Application-Implementation.

Text Books:

T1. I. Bayross, ***Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP***, 4th Revised Edition, BPB Publications, 2005.
T2. E. Jendrock, D. Carson, I. Evans, D. Gollapudi, K. Haase, and C. Srivastha, ***The Java EE6 Tutorial - Volume I***, 4th Edition, Pearson India, 2010.

Reference Books:

R1. R. Moseley and M. T. Savaliya, ***Developing Web Applications***, 2nd Edition, Wiley India, 2008.
R2. Kongent Learning Solutions Inc., ***Java Server Programming - Java EE6 (J2EE 1.6) Black Book***, Dreamtech Press, 2010.

Online Resources:

1. https://www.w3.org/ - World Wide Consortium
2. https://www.tutorialspoint.com/ - Tutorials Point
3. https://www.coursera.org/courses?languages=en&query=web%20development
4. https://www.simplilearn.com - Web Development Simplilearn

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Design Web pages using HTML and use browser inspect features to examine source code.
CO2	Design layout with cascading style sheets and develop suitable user interfaces.
CO3	Build interactive web pages using JavaScript (client side programming) and DOM.
CO4	Build web applications using server side programming, Servlet and JSP.
CO5	Develop database driven web application using MVC architecture.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

P.T.O

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	3	1		1				2	1		
CO2	1	2	2	1		1				2	1		
CO3	3	1	2	2		1				2	1	1	1
CO4	3	2	2	1		1				2	2	1	1
CO5	3	2	3	1		1				2	2	1	1

Type	Code	Software Engineering & UML Lab	L-T-P	Credits	Marks
PC	18MC1L18		0-0-2	1	100

Objectives	The objective of this lab course is to apply software engineering principles for development of a software product starting with creation of SRS, function and object oriented design using UML and CASE tools, coding and testing.
Pre-Requisites	Basic analytical and logical ability with fundamental knowledge of procedural & object oriented programming is required. Topics taught in the theory class are essential to do the assignments.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of design, modelling, programming, and testing assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to the complete objectives of the course & CASE tool. Assignment of case study projects to student groups.
2	Requirement Analysis of the assigned case study project.
3	Requirement Specification of the assigned case study project.
4	Function Oriented Design Phase: Creation of structure chart and Level-0 DFD.
5	Function Oriented Design Phase: Creation of DFD Level-1, 2 etc.
6	Object Oriented Design Phase: Creation of Use Case UML model.
7	Object Oriented Design Phase: Creation of Class UML diagram.
8	Object Oriented Design Phase: Creation of Activity and Sequence UML diagrams.
9	Object Oriented Design Phase: Creation of Collaboration, Statechart UML diagrams.
10	Object Oriented Design Phase: Creation of Component and Deployment UML diagrams.
11	Development of User Interface of the case study project.
12	Development and Unit testing of the case study project using programming language of choice (Java, C++, .NET etc.) - Part 1.
13	Development and Unit testing of the case study project using programming language of choice (Java, C++, .NET etc.) - Part 2.
14	Testing of the case study project (Integration, System test).

Text Books:

T1. R. Mall, ***Fundamentals of Software Engineering***, 4th Edition, PHI Learning, 2014.
T2. C. Larman, ***Applying UML and Patterns***, 3rd Edition, Pearson Education, 2015.

P.T.O

Reference Books:

R1. I. Somerville, ***Software Engineering***, 9th Edition, Pearson Education, 2013.
R2. R. S. Pressman, ***Software Engineering - A Practitioner's Approach***, 7th Edition, McGraw Hill Education, 2010.

Online Resources:

1. https://nptel.ac.in/courses/106105182/: by Prof. Rajib Mall, IIT Kharagpur.
2. https://nptel.ac.in/courses/106101061/: by Prof. N. L. Sharda, IIT Bombay.
3. https://training-course-material.com/training/UML_Analysis_and_Design: by NobleProg on UML models
4. https://www.visual-paradigm.com/tutorials/data-flow-diagram-dfd.jsp: by Visual Paradigm on DFDs
5. https://www.tutorialspoint.com/software_engineering/software_engineering_tutorial.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Perform requirement analysis and prepare SRS document for a software product.
CO2	Design a software using FOD methodology and create the Structure Charts & DFDs.
CO3	Design a software using OOD methodology and create UML models using a CASE tool.
CO4	Develop the design of User Interfaces of a software using principles of a good design.
CO5	Develop a software using a high-level programming language or tool and test the product.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1		2		2	3			3	1	3
CO2	2	3	2		2		2	3			3	2	3
CO3	2	3	2		3		2	3			3	2	3
CO4	2	3	2		3		2	3			3	2	3
CO5	2	3	3		3		2	1			3	2	3