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	Open Electives
1	Introduction to Internet of Things
2	Embedded Systems
3	Introduction to Artificial Intelligence

Schema of BSc. (Computer Science)

Year	Semester 1						
	Code	Subject	L	T	P	Credit	Remark
	BC101A1	Computational Methods	2	1	0	3	Major
	BC102A1	Fundamentals of Digital Systems	3	1	0	4	Major
	XXXX	Communication Skill	2	0	0	2	ability enhancement
	XXXX	UHV	3	0	0	3	Value added
	XXXX	Elective-1	3	0	0	3	Interdisciplinary/Minor
	BC103A1	Computer Programming (C)	4	0	0	4	Skill enhancement/Major
	BC101A4	Computer Programming (C) Lab	0	0	2	1	Skill enhancement/Major
	BC102A4	Digital Electronics Lab	0	0	2	1	Major
			Total			21	
	Semester 2						
	Code	Subject	L	T	P	Credit	Remark
1	**BC104A1**	Web Technology	2	1	0	3	Major
	BC105A1	Data Structure	3	1	0	4	Major
	XXXX	English Literature/Functional English/MIL/Hindi/Foreign Language (SWAYAM/NPTEL) (EL-2)	2	0	0	2	Ability enhancement
	XXXX	Constituitions of India/Environmental Sc.	1	0	0	1	Value added
	XXXX	Elective-3	3	0	0	3	Interdisciplinary/minor
	BC106A1	Python Programming	2	1	0	3	Skill enhancement/Major
	BC103A4	Web Technology lab	0	0	2	1	skill enhancement/Major
	BC104A4	Data Structure Lab	0	0	2	1	Major
	XXXX	Fitness and Yoga	0	0	4	2	value added
			Total			20	
	Summer internship/Vocational: (2 - 4 CR)		Workshop skills, Carpentry, Plumbing, Web design, Surveying, Electrical Wiring, Financial s/w, digital photography & editing, Video editing for social media, photoshop, Computer assembing and networing, Research & Technical writting etc				

Schema of BSc. (Computer Science)

Year	Semester 3						
	Code	Subject	L	T	P	Credit	Remark
	BC201A1	Computer Organization and Architecture	3	1	0	4	Major
	BC202A1	OOPs with C++	3	1	0	4	Major
	BC203A1	Computer Networks	3	1	0	4	Major
	XXXX	Behavior Management/Emotional Inteligence/Alternative English/Nepali/Sanskrit (SWAYAM, NPTEL) EL-4)	2	0	0	2	Ability enhancement
	XXXX	Minor Specialization (EL-5)	3	0	0	3	Minor
	BC201A4	OOPs with C++ Lab	0	0	2	1	Major
	BC202A4	Networking Lab	0	0	2	1	Major
	BC201A5	Project based learning I	0	0	2	1	Major
			Total			20	
	Semester 4						
	Code	Subject	L	T	P	Credit	
2	**BC204A1**	DATABASE MANAGEMENT SYSTEM	3	1	0	4	Major
	BC205A1	Introduction to Internet of Things	3	1	0	4	Major
	BC206A1	Operating Systems	3	1	0	4	Major
	XXXX	Minor specialization (EL-6)	3	0	0	3	Minor
	XXXX	Community based Participatory Research (FIELD WORK)	1	0	2	2	Ability enhancement/Summer Training
	BC203A4	Operating System Lab	0	0	2	1	Major
	BC204A4	DBMS Lab	0	0	2	1	Major
	BC202A5	Project based learning II	0	0	2	1	
			Total			20	
	Summer internship/Vocational: (2 - 4 CR)		Workshop skills, Carpentry, Plumbing, Web design, Surveying, Electrical Wiring, Financial s/w, digital photography & editing, Video editing for social media, photoshop, Computer assembing and networing, Research & Technical writting etc				

Year	Semester 5						
3	Code	Subject	L	T	P	Credit	Remark

BC301A1	Formal Language & Automata Theory	2	1	0	3	Major
BC302A1	Embedded Systems	2	1	0	3	Major
XXXX	DSE I (EL-7)	3	0	0	3	Minor
XXXX	Elective I (EL-8)	2	1	0	3	Interdisciplinary/Minor
XXXX	Minor specialization (EL-9)	2	1	0	3	Interdisciplinary/Minor
BC301A4	Embedded Systems Lab	0	0	2	1	Major
BC301A9	Summer Internship	0	0	4	2	Summer Internship
BC301A5	Project based learning III	0	0	2	1	Major
			Total		19	
	Semester 6					
Code	Subject	L	T	P	Credit	Remark
BC303A1	Design and Analysis of Algorithms	3	1	0	4	Major
BC304A1	Introduction to Artificial Intelligence	3	1	0	4	Major
XXXX	DSE II (EL-10)	3	0	0	3	Minor
XXXX	Elective II (EL-11)	3	0	0	3	Interdisciplinary/Minor
XXXX	Minor specialization (EL-12)	2	1	0	3	Interdisciplinary/Minor
BC302A4	IoT Lab	0	0	2	1	Major
BC302A5	Mini Project	0	0	4	2	Major
			Total		20	

Schema of BSc. (Computer Science)

year	Semester 7						
	Code	Subject	L	T	P	Credit	Remark
	BC401A1	IoT Gateways and Edge Computing	3	1	0	4	major
	BC402A1	Industrial IoT and Industry 4.0	2	1	0	3	major
	BC403A1	Deep Learning	2	1	0	4	major
	BC404A1	Software Engineering	3	1	0	4	minor
	XXXX	Research Methodology	3	0	0	3	minor
	XXXX	Research Ethics	2	0	0	2	
				Total		20	
4	**Semester 8**						
	Code	Subject	L	T	P	Credit	Remark
	BC405A1	Data Centre and Cloud Computing	2	1	0	4	major
	XXXX	Elective-13	3	1	0	4	major
	BC401A6	**Project/Dessertation* (1 year project)**	0	0	24	12	major
	XXXX	**Paper I (EL-14)**					major
	XXXX	**Paper II (EL-15)**					major
	XXXX	**Paper III (EL-16)**					major
				Total		20	

* In place of Project, students with honours will take 3 theory subjects of 12 credit

Schema of BSc. (Computer Science)

Pool of Dept. Specific Elective (DSE) Courses						
		Pool of First Year Elective Subjects				
Sl No.	**Code**	**Subject Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	**BC101A3**	Basic Electronics	3	0	0	3
2	**BC102A3**	Communication Systems	3	0	0	3
3	**BC103A3**	Analog Electronics	3	0	0	3
4	**BC104A3**	Microprocessor and Microcontrollers	3	0	0	3
	Pool of Second Year Elective Subjects					
1	**BC201A3**	R Programming	3	0	0	3
2	**BC202A3**	Project Management	3	0	0	3
3	**BC203A3**	E – COMMERCE	3	0	0	3
4	**BC204A3**	Principles of Programming Language	3	0	0	3
5	**BC205A3**	Sensors and Actuators for IoT	3	0	0	3

Schema of BSc. (Computer Science)

Pool of Third Year Elective Subjects						
SL No.	**Code**	**Subject Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	**BC301A3**	Wireless Sensor Networks	3	0	0	3
2	**BC302A3**	Data Science	3	0	0	3
3	**BC303A3**	Soft Computing Techniques	3	0	0	3
4	**BC304A3**	Discrete Structure	3	0	0	3
5	**BC305A3**	Numerical Analysis	3	0	0	3
6	**BC306A3**	Industrial Management	3	0	0	3
7	**BC307A3**	PHP Technology	3	0	0	3
8	**BC308A3**	Digital Marketing	3	0	0	3
9	**BC309A3**	JAVA Programming	3	0	0	3
10	**BC310A3**	Artificial Neural Network	3	0	0	3
11	**BC311A3**	Compiler Design	3	0	0	3
12	**BC312A3**	Object Oriented Anaylsis & Design	3	0	0	3
13	**BC313A3**	Machine Learning	3	0	0	3
14	**BC314A3**	Cyber Security	3	0	0	3
15	**BC315A3**	Cloud Computing	3	0	0	3
16	**BC316A3**	Block chain Technology	3	0	0	3

Schema of BSc. (Computer Science)

Pool of Fourth Year Elective Subjects						
Sl No.	**Code**	**Subject**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	**BC401A3**	NANO Electronic Devices and Materials	4	0	0	4
2	**BC402A3**	.NET Programming	4	0	0	4
3	**BC403A3**	Mobile Communication	4	0	0	4
4	**BC404A3**	Production Management	4	0	0	4
5	**BC405A3**	Acoustic Signal Processing	4	0	0	4
6	**BC406A3**	SYSTEM AND NETWORK ADMINISTRATION	4	0	0	4
7	**BC407A3**	Software Defined Networks	4	0	0	4
8	**BC408A3**	Computer Vision	4	0	0	4
9	**BC409A3**	Automation and Robotics	4	0	0	4
10	**BC410A3**	Computer Graphics	4	0	0	4
11	**BC411A3**	Information theory and Coding	4	0	0	4

Schema of BSc. (Computer Science)

Pool of Open Elective Courses (For Other Dept. Students)						
Sl No.	**Code**	**Subject**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	**BC201A2**	Introduction to Internet of Things	3	0	0	3
2	**BC302A2**	Embedded Systems	3	0	0	3
3	**BC303A2**	Introduction to Artificial Intelligence	3	0	0	3

Vision

To achieve eminence in the field of quality education and research in Computer, Communication and Artificial Intelligence.

Mission

To develop into a department of excellence capable of producing competent techno-managers who can contribute effectively to the advancement of the society.

SEMESTER 1

BC101A1 **Credit: 3 (L-2, T-1, P-0)**

COMPUTATIONAL METHODS

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective is to provide basic knowledge of the concept of quantitative techniques having their application in the field of Basic Science.

Pre-requisites: 10+2 Mathematics

Course Outcomes: After Completion of the course, students will be able to

1. Understand the importance of statistics and distribution functions.
2. Calculate Mean, Mode and Median of the given data set.
3. Apply the probability theory for data analysis.
4. Use different sampling techniques for data analysis.
5. Comprehend the correlation, convolution and regression techniques for signal analysis.

Module	Topics	Hrs	CO
Module 1: **Data Classification**	Introduction, Importance & Uses of Statistics and quantitative techniques, Methods of Presenting Statistical Information and Collection of Data, Frequency Distribution.	5	1
Module 2: **Measures of Central Tendency & Dispersion**	Measures of Central Tendency - Mean, Mode, Median. Measures of Dispersion Range - Qua Deviation, Mean deviation, Standard Deviation and Variance.	6	2
Module 3: **Probability Theory**	Probability Theory: Definition of Probability, Events, Counting rules and Computation of Probabilities, Addition, Multiplication rules, Conditional Probability, Rules of Bayes and Permutation and Combination, Probability Distribution: Introduction, Binomial Model, the Poisson Model and Normal Distribution.	10	3
Module 4: **Sampling & Forecasting**	Sampling and Sampling techniques, Forecasting: Meaning, Nature and techniques, Qualitative Techniques, Curve Fitting and method of Least Squares.	5	4
Module 5: **Correlation & Regression**	Correlation and Regression: Nature and significance of Correlation, Types of Correlation. Convolution, Importance of Convolution, Applications of Correlation and Convolution in signal analysis, Methods of Studying Correlation. Regression: Application of regression in data Science, Nature and uses of Regression Analysis, Regression Equation (Overview Only).	10	5

Text Books:

1. Probability and Statistics - Morris H. DeGroot, 4th Edition, Paperback, 7 June 2016.
2. Probability and Statistics for Engineers and Scientists - Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye, Pearson Education India, 9th Edition, Paperback – 1 January 2013.

Reference Books:

1. Probability and Statistics with Reliability, Queuing and Computer Science Applications - Kishor S. Trivedi, Print ISBN:9780471333418, Online ISBN:9781119285441.
2. Probability and Statistics - Dr. T.K.V. Iyengar, Dr. M.V.S.S.N. Prasad, S. Ranganatham & Dr. B. Krishna Gandhi, ISBN: 9789355010643, S Chand Publishing, 2022.

BC102A1 **Credit: 4 (L: 3, T:1, P: 0)**

FUNDAMENTALS OF DIGITAL SYSTEMS

Questions to be set: 05 (All Compulsory)

Objectives: In this subject, students are introduced to digital electronics and the various design methodologies of combinational logic circuits. Brief about Number systems with special emphasis on binary system are encompassed in the subject. Students are also introduced to sequential digital circuits.

Scope: In this subject, students learn how to design combinational logic circuits like adder, subtractor, code converters, multiplexers, decoders etc. Students are also taught to design sequential logic circuits such as counter, register, sequence generator, sequence detector etc.

Pre-requisites: Basics of arithmetic and physical science.

Course Outcomes:

After studying this course, students will be able to:

CO1 Relate and implement Boolean algebra in binary systems

CO2 Design combinational logic circuits

CO3 Understand basics of sequential logic circuits

CO4 Understand and Design counters

CO5 Learn the basics of memory devices and Processing unit.

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Boolean Algebra**	In class	Number System: Binary, Octal, Hexadecimal; Boolean Algebra – Theorems and Postulates; Logic Gates; Minterm and Maxterm; Forms of expression: SOP, POS; K- Map Simplification up to 4 Variables; Tabulation Method.	10	1
	Assignment			1
Module 2: **Combinational Circuits**	In class	Introduction to Combinational Circuit, Half Adder, Half Subtractor, Full Adder, Full Subtractor, Parallel Adder, Carry look ahead adder, Comparator, Parity Bit Generator and Checker, Design of Code Converter, Decoder, Encoder, Multiplexer, Demultiplexer Circuit	10	2

	Assignment			2
Module 3: **Flip-flops**	In class	Introduction to Latches and Flip Flops; Master-Slave Flip Flop, Conversion of Flip Flops;	6	3
	Assignment			3
Module 4: **Counters**	In class	Types of counters: Asynchronous and Synchronous Counter; Circuit of Asynchronous Counter; Design of Synchronous Counters: Mod 4, 10, 16, UP/DOWN etc., Ring Counter, Twisted ring counter	10	4
	Assignment			4
Module 5: **Memory devices and Processing Unit**	In class	Registers: Serial-In-Parallel Out, Parallel-in-Serial Out, Parallel-in-Parallel Out, Universal Shift Registers; Semiconductor memories: RAM and ROM – their types; Introduction to CPU and GPU	5	5
	Assignment			5

Text Books:

1. Morris Mano, Digital Logic and Computer Design, PHI .
2. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill.

Reference Books:

1. R. L. Tokheim, Digital Electronics: Principles and Applications, Tata McGraw Hill.
2. W. Gothman, Digital Electronics, PHI.
3. S. Salivahanan & S. Arizavahagan, Digital Circuits and Design.
4. Malvino Leach, Digital Principles and Application, Tata McGraw Hill.

XXXX **Credit: 2 (L: 2, T:0, P: 0)**

COMMUNICATION SKILL

No. of questions to be set: 4 each from UNIT I and UNIT II.

No. of questions to be answered: 5 (Selecting at least TWO from each UNIT)

Course Objective: To help the students to hone their oral as well as written communication skills so as to make them job and industry ready.

Pre-Requisites: No Departmental Prerequisites required.

UNIT I

Introduction to Communication Skills: Understanding Communication Skills, 7 C's of Communication, Process of Communication, Barriers to Communication, Importance of Listening, Verbal Communication- 3 V's of Communication, Non Verbal Communication.
Essay Writing: Essays related to Economics, Sociology, Technology, Psychology, Politics and Current Affairs etc.
Expansion of idea, Comprehension, Vocabulary: One Word substitution, Foreign Words Commonly used in English, Synonyms, Antonyms, Spellings.
Phonetics- Speech sounds, Syllables, Intonation.

UNIT II

Report Writing: Performance Appraisal Report, Disciplinary Report, Inspection Report, Site Survey Report, Market Survey report, Event Management Report, Project Completion Report.
Business Correspondence: Kinds of Business Letters, Enquiries and Replies, Letters to Newspapers, Circulars and Memos, Floating Tenders, Inviting Quotations, Submission of Quotation, Placing an Order, Notice, Agenda and Minutes of a Business Meeting, Job application (including Resume / Bio data), E-mail Writing.
Grammar: Tenses, Correct Usage, Sequence of Tenses, Articles, Prepositions, Punctuation, Voice, Narration.
Class Room Practice / Language Lab (Not to be included in Question Paper): Oral Communication, Extempore, Group Discussion, Power Point Presentation, Role Play.

Text Books

1. Sen, Leena. Communication Skills. (Prentice Hall).
2. Raman, Menashi & Sharma, Sangeeta. Technical Communication - Principles And Practice. (Oxford).
3. Wren, R.C. & Martin, H. English Grammar and Composition (S Chand & Co Ltd).

Reference Books

1. Mehra, Payal. Business Communication for Managers. (Pearson)
2. Miglani, Seema & Goyal, Shikha. English for Professional. (VEI)

XXXX **Credit: 3(L: 3, T:0, P: 0)**

UNIVERSAL HUMAN VALUES (UHV)

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY and ETHICAL HUMAN CONDUCT

Course Objectives:

This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

Pre-requisites: None. However, it is desired that students may have gone through UHV-I: Universal Human Values-Introduction

Course Outcome (CO):

1. Students are expected to understand self-exploration and Basic Human Aspirations.
2. To understand harmony in themselves (Human being).
3. To become more aware of their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
4. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Therefore, the course and further follow up is expected to positively impact common graduate attributes like:

1) Holistic vision of life
2) Socially responsible behaviour
3) Environmentally responsible work
4) Ethical human conduct
5) Having Competence and Capabilities for Maintaining Health and Hygiene
6) Appreciation and aspiration for excellence (merit) and gratitude for all

Module 1 –Introduction to Value Education

(9 Hrs)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education

Tutorial 1: Practice Session *PS1 Sharing about Oneself*

Lecture 3: Self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS*2 Exploring Human Consciousness*

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfil the Basic Human

Aspirations
Tutorial 3: Practice Session PS*3 Exploring Natural Acceptance*

Module 2 – **Harmony in the Human Being** **(**9 Hrs)

Lecture 7: Understanding Human being as the Co-existence of the Self and the Body
Lecture 8: Distinguishing between the Needs of the Self and the Body
Tutorial 4: Practice Session PS*4 Exploring the difference of Needs of Self and Body*

Lecture 9: The Body as an Instrument of the
Self Lecture 10: Understanding Harmony in the
Self
Tutorial 5: Practice Session PS*5 Exploring Sources of Imagination in the Self*

Lecture 11: Harmony of the Self with the Body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS*6 Exploring Harmony of Self with the Body*

Module 3 – **Harmony in the Family and Society** (9 Hrs)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction

Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS*7 Exploring the Feeling of*
Trust Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS*8 Exploring the Feeling of Respect*
Lecture 16: Other Feelings, Justice in Human-to-Human
Relationship Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS*9 Exploring Systems to fulfil Human Goal*

Module 4 – **Harmony in the Nature/Existence** (6 Hrs)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation, and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS*10 Exploring the Four Orders of Nature*

Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS*11 Exploring Co-existence in Existence*

Module 5 – **Implications of the Holistic Understanding** – **a Look at Professional Ethics**

(9 Hrs)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS*12 Exploring Ethical Human Conduct*

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS*13 Exploring Humanistic Models in Education*

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS*14 Exploring Steps of Transition towards Universal Human Order*

Content for Practice Sessions (Tutorials)

In order to connect the content of the proposals with practice (living), 14 practice sessions have been designed. The full set of practice sessions is available in the Teacher's Manual as well as the website.

Practice Sessions for Module 1 – **Introduction to Value Education**

PS1 Sharing about Oneself
PS2 Exploring Human Consciousness PS3 Exploring Natural Acceptance

Practice Sessions for Module 2 – ***Harmony in the Human***

Being PS4 Exploring the difference of Needs of Self and Body PS5 Exploring Sources of Imagination in the Self

PS6 Exploring Harmony of Self with the Body

Practice Sessions for Module 3 – **Harmony in the Family and Society**

PS7 Exploring the Feeling of Trust PS8 Exploring the Feeling of Respect PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for Module 4 – **Harmony in the Nature (Existence)**

PS10 Exploring the Four Orders of Nature PS11 Exploring Co-existence in Existence

Practice Sessions for Module 5 – **Implications of the Holistic Understanding** – **a Look at Professional Ethics**

PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Text Book

A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1

The Teacher's Manual

Teachers' Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

BC103A1 **Credit: 4 (L: 4, T:0, P: 0)**

COMPUTER PROGRAMMING (C)

No. of questions to be set: 4 each from UNIT I and UNIT II.
No. of questions to be answered: 5 (Selecting at least TWO from each UNIT)

Objectives:

1. The main aim of the course is to teach basic computer programming concepts and apply them to computer-based problem-solving methods.
2. To teach the student problem solving using C.
3. To introduce the student to data structures such as lists, stacks etc.

Prerequisites: There are no specific prerequisites for this course

Learning Outcomes:

1. Upon completion of the course, students will be able to:
2. Solve moderately difficult problems using C language.
3. Write error free code in C.
4. Debug syntax errors prompted by the C compiler.

UNIT-I

Introduction to Computer Fundamentals & Programming Language

Introduction, Basic anatomy of the computer, ALU, Memory Devices and Memory Types, I/O Devices, Number Systems & Logic Gates. Levels of Programming Language, Application Programs, System Programs, Operating Systems, editor, translator, linker, loader, Structured and Object-Oriented Programming Algorithms and Flowcharts, History of C, Basic structure of a C program, Sample programs, Programming style, Executing a C program.

Constants, variables, and data types

Character set, C tokens, Keywords and identifiers, Constants, variables, Data types, Declaration of variables, Declaration of storage class, Assigning of storage class, Defining symbolic constants, Declaring a variable as constant, Declaring a variable as volatile, Overflow and underflow of data.

Operators and expressions

Deferent categories of operators in C language, Arithmetic expressions, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expression, Operator precedence and associativity, Mathematical functions Reading a character, Writing a character, Formatted input, Formatted output

Decision making and branching & Looping

Decision making with IF statement, Simple IF statement, The IF---ELSE statement, Nesting of IF---ELSE statement, The ELSE IF ladder, The switch statement, The ? : operator, The GOTO statement. The WHILE statement, The DO statement, The FOR statement, Jumps in loops, Concise test expressions.

UNIT-II

Arrays

One-dimensional arrays, Declaration, initialization of one-dimensional array, Two-dimensional arrays, Declaration, initialization of one-dimensional array, Multidimensional arrays and Dynamic arrays, Declaring and initializing string variables, Reading strings from terminal, Writing strings to screen, Arithmetic operations on strings, Putting strings together, Comparison of two strings, String handling functions, Table of strings. Introduction to Pointers, Accessing a variable through its pointer, Chain of pointers, Pointer expressions, Pointers and arrays, Pointers and character strings, Array of pointers. Dynamic Memory allocation- malloc, calloc, free, realloc, linked list and its applications.

User defined functions & Macro

Elements of user defined functions, Definitions of functions, Return values and their types, Function calls, Function declaration, Category of functions, No arguments and no return values, Arguments but no return values, Arguments with return values, No Arguments but returns a value, Function that return multiple values, Nesting of functions, Recursion, Passing arrays to functions, Passing string to functions, Scope, Visibility and lifetime of variables, Pointers and function arguments, Functions returning pointers, Pointers to functions Preprocessor Directive – macro substitution.

Structures and unions

Defining a structure, Declaration of structure variables, Accessing structure members, Structure initialization, Copying and comparing structure variables, Operations on individual members, Arrays of structures, Arrays within structures, Structures within structures, Structures and functions, Union, Size of structures, Bit fields, Pointers and structures, Troubles with pointers.

File management in C

Defining and opening a file, Closing a file, Input/output operations on a file, Error handling during I/O operations, Random access to files, Command line arguments.

Text Books:

"Programming in ANSI C" by E. Balaguruswamy.

Reference Books:

1. "Mastering in C" by K. Venugopal.
2. "Fundamentals of C" by Gottfried.
3. "The C Programming" by Kerningham and Ritchie.
4. " Let Us C" by Y. Kanetkar.

BC101A4 **Credit: 1 (L: 0, T:0, P: 2)**

COMPUTER PROGRAMMING (C) LAB

In this lab, each student are required to develop programs based upon each unit of theory paper- Computer programming using C.

Course Objectives:

1. The main aim of the course is to teach basic computer programming concepts and apply them to computer-based problem-solving methods.
2. To teach the student problem solving using C. To introduce the students to the field of programming using C language.
3. To introduce the student to data structures such as lists, stacks etc.

Pre-Requisites: There are no specific prerequisites for this lab.

Learning Outcomes:

1. Upon completion of the course, students will be able to: Solve moderately difficult problem using C language.
2. The students will be able to enhance their analyzing and problem-solving skills and use the same for writing programs in C.
3. Write error free code in C
4. Debug syntax errors prompted by the C compiler.

List Of Experiments:

(A) Introduction to Basic Linux Commands.

(B) Write a C program to:

1. Print a message.
2. Compute arithmetic operations (+, -, *, /, %).
3. Compute Simple and Compound Interest.
4. Swap two variables with/without using a third variable.
5. Find the greatest among three numbers using
   i. If-statement.
   ii. Ternary operator
6. Find the roots of a quadratic equation.
7. Design a basic calculator using
   i. if-else
   ii. Switch case
8. Print the following pattern

```
*
**
***
****
```

9. Find the sum of the following series:
    i. 1+2+3+…….+N
    ii. $1^2+2^2+3^2$.....+N^2
10. Find the sum of digits in a number.
11. Find the reverse of a number.
12. Check whether a number of palindrome or not.
13. Find the sum of numbers in an array.
14. Find the smallest and largest number in an array.
15. Reverse an array.
16. Perform linear search an element in an array.
17. Perform Binary search an element in an array.
18. To sort an array using Bubble Sort.
19. To perform addition, subtraction and multiplication of a 2D array.
20. Perform basic operations on a String with and without using built-in function.
21. Check whether a string is a palindrome or not.
22. Add two numbers using a function.
23. Display the Fibonacci series upto nth terms using user defined functions.
24. Find factorial of a number using Recursive function.
25. Find sum of elements in an array using user defined functions by passing array to function.
26. Swap two numbers using call by reference (Pointers).
27. Sort an array using pointers using any suitable sorting algorithm.
28. Create a structure to hold student data and display it.
29. Implement Linked List using Self Referential Structures.
30. Perform basic operations in a file

(C) Introduction to the concept of Tower of Hanoi.

BC102A4 **Credit: 1 (L:0, T:0, P:2)**

DIGITAL ELECTRONICS LAB

Minimum number of experiments to be completed: 12 (covering all the modules)

Course Objective: To understand the digital components and the design of basic digital circuits.

Pre-requisites: Elementary knowledge of digital number systems.

Course Outcomes (CO):

After the completion of this course, the students should be able to:

CO1 Identify and enlist the various components of combinational digital electronic circuits.

CO2 Design and verify the results of digital multiplexers and decoders.

CO3 Verify and evaluate the digital circuits that use flip-flops.

CO4 Use flip-flops to design counters.

CO5 Design sequential circuits using flip-flops and other digital components.

Module	Topics to be covered	Topics	Hrs	CO
Module 1 **Basic Combinational Circuits**	Experiment 1	Verification of ICs and familiarization if the Digital Trainer Kits.	2	1
	Experiment 2	Design (i) Half adder and (ii) Full adder (iii) Half subtractor and (iv) Full subtractor	2	1
	Experiment 3	Design (i) BCD to Excess-3 Code Converter, (ii) Excess-3 to BCD Code Converter	2	1
Module 2 **Multiplexers and Decoders**	Experiment 4	Design (i) 2-to-4-line active HIGH outputs Decoder, (ii) 1:4 Demultiplexer using logic gates	2	2
	Experiment 5	Design of an 8:1 Multiplexer using two 4:1 Multiplexers using multiplexer IC	2	2
Module 3 **Latches and Flip-Flops**	Experiment 6	Construct (i) SR Flip Flop (ii) D Flip Flop (iii) JK Flip Flop (iv) T Flip Flop using logic gates and verify them	2	3
	Experiment 7	Convert a (i) JK FF to a D FF (ii) JK FF to a T FF (iii) D FF to a JK FF (iv) D FF to a T FF	2	3

Module 4 **Counters**	Experiment 8	Design a decade asynchronous up counter.	2	4
	Experiment 9	Design a mod 16 synchronous up counter using JKFFs.	2	4
	Experiment 10	Design a mod 4 synchronous up/down counter with a control line (to control the up or down count) using DFFs	2	4
	Experiment 11	Design (i) 4 BIT ring counter, (ii) 4 BIT twisted ring counter using DFFs	2	4
Module 5 **Sequential Circuits**	Experiment 12	Using D FFs, Construct 3-BIT shift registers in (i) SISO (ii) SIPO (iii) PIPO & (iv) PISO modes	2	5
	Experiment 13	Design a circuit that produces a HIGH output if a sample data input is tested three times and found at a relatively HIGH voltage level on odd number of times and then returns to the initial condition and start the testing process again	2	5

Textbooks:

1. Digital Design, 5e, Morris Mano, Pearson.

2. William I. Fletcher, “An Engineering Approach To Digital Design”, PHI

3. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill.

Reference Books:

1. Digital Fundamentals, Global Edition, Thomas L, Floyd, Pearson.

2. Digital Integrated Circuits: A design perspective, 2e, Jan M. Rabaey, Anantha Chandrakasan, and, Borivoje Nikolic, Pearson

3. Malvino Leach, Digital Principles and Application, Tata McGraw Hill.

Semester 2

BC104A1 **Credit: 3 (L-2, T-1, P-0)**

WEB TECHNOLOGY

Questions to be set: 05 (All Compulsory)

Course Objectives: To familiarize the student with the structure and use of Internet application programming languages and with the elements of user-interface design. The focus is on client-side scripting using HTML, CSS and JavaScript.

Pre-requisites: Basic Programming concepts.

Course Outcome: After completion of this course, students will be able to

1. Understand the web fundamentals.
2. Design web pages using WordPress.
3. Design web pages using HTML.
4. Improve the design of web pages using CSS.
5. Apply the knowledge of JavaScript in web page design.

Module	Topics	Hrs	CO
Module 1: **Web Fundamentals**	Understanding the internet and Worldwide Web, History of the Web, Protocols governing the web, Web Architecture, Major issues in web solution developments.	6	1
Module 2: **Basic Web page design using WordPress**	Understanding the functionality of WordPress. Layout design, development of a website using WordPress, incorporating different design elements into your website, adding contents, Install and Activate plugins. The functionality of different plugins.	6	2
Module 3: **HTML**	Introduction to HTML, HTML Documents, Basic structure of an HTML document, creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags. Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.	8	3
Module 4: **CSS**	Introduction to Cascading Style Sheets (CSS), Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties), CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector), CSS Colour, creating page Layout and Site Designs.	8	4
Module 5: **Java Script**	Introduction, Variables, Literals, Operators, control Structures, Conditional statements, Arrays, Functions, Objects (Using	8	5

	object literals, for/in, Constructor functions, This keyword, Using Object Constructor, Adding New methods, Function overloading), Predefined Objects, Object Hierarchy, Accessing Objects, Events, Event Handlers, Multiple Windows and Frames, Document object model, JavaScript Regular Expressions, Ajax.		

Text-Books:

1. Hiren Joshi, Web Technologies and Application Development, Wiley Publication.
2. Steven M. Schafer, HTML, XHTML, and CSS Bible, 5ed, Wiley India
3. John Duckett, Beginning HTML, XHTML, CSS, and JavaScript, Wiley India

Reference Books:

1. Microsoft Commerce Solutions, Web technology, PHI.
2. Tom Negrino and Dori Smith, JavaScript for The World Wide Web.
3. Lovejoy, Essential of ASP for professionals, Pearson Education.
4. Uttam K. Roy, Web Technologies, Oxford University Press.
5. Achyut Godbole, Web Technologies, Tata McGraw Hill Publication.

BC105A1 **Credit: 4 (L-3, T-1, P-0)**

DATA STRUCTURE

Questions to be set: 05 (All Compulsory)

Course Objective: This course covers the organization of information, the implementation of common data structures such as array, lists, stacks, queues, trees, and graphs. It also explores recursion, various searching and sorting algorithms and also the close relationship between data structures and algorithms. By the end of this course, the students will be able to solve problems using appropriate data structures and writing programs for those solutions, assess the impact of choice of a data structure on program's performance and to choose appropriate data structure for a specified problem.

Pre-requisites: Basic Computer Programming

Course Outcomes (CO): On Successful Completion of the course, students will be able to

CO1 Analyze algorithms and understand basic data structures such as arrays.
CO2 Describe stack, queue and linked list operation.
CO3 Understand the knowledge of tree and graphs concepts.
CO4 Apply algorithm for solving problems like searching and sorting of data
CO5 Implement ADTs such as lists, graphs, search trees in C to solve problems

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1 **Introduction and concepts of array**	in class ****Assignment Topics**	Data and data structure concept, data structure operation, Algorithms and programs, Algorithm efficiency and analysis, definition of array, terminologies of array, 1D Array-Memory Allocation, Representation in Memory, Operations on Array, Application of Arrays. Practise programs of 1D array operation using C	7	1
Module 2 **Stack, Queue and Link Lists**	in class	Definition, Array Representation of Stacks, Operations on Stacks- Push, Pop, application of Stacks, Definition, Array Representation of Queue, Operations on Queue: Insertion, Deletion, Various Queue Structure: Circular Queue, Insertion, Deletion Operations on a Circular Queue, Definition, Single Linked List- Representation in Memory, Operations on a Single Linked List, Circular Linked List	8	2

Module 3 **Trees and Graphs**	in class	Definition, Binary Trees, Representing Binary Trees, Terminologies, Binary Search Tree, Searching, Inserting and Deleting in a Binary Search tree. Insertion, deletion with examples of Height balanced binary tree – AVL tree, Basic Terminologies, Adjacency Matrix Representation and Adjacency List Representation of Graphs, Graph Traversals: BFS and DFS. Definition of a Spanning Tree.	8	3
Module 4 **Sorting and searching**	in class	Sorting: Bubble, Insertion, merge, Heap sort and quick sort, Radix sort. Searching: Linear, Binary search, Comparison of different methods.	7	4
Module 5 **Solving ADT Problems using C**	in class ****Assignment Topics**	Basic algorithms and programs to solve ADT problems using C language. Practice programs related to ADT operations	6	5

Text Books:

1. D. Samanta, *Classic Data Structures*, PHI.
2. Reema Thareja, *Data Structures Using C*, Oxford University Press.

Reference Books:

1. Horowitz & Sahni, *Fundamentals of Data Structures*, Galgotia.
2. Tannenbaum, Augustine & Longsu, *Data Structures using C and C++*, Prentice Hall
3. J.P. Trembly, and P.G Sorenson, *An Introduction to Data Structures with Applications*, McGraw Hill.
4. S. Lipschutz, *Data Structures*, Schaum Series.

BC106A1 **Credit: 3 (L-2, T-1, P-0)**

PYTHON PROGRAMMING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course covers the fundamentals of Python programming. This course covers from the fundamental concepts of Python such as variables, operators, lists, tuples, and objects to topics like files and exception handling. The completion of this course will enable the students to write programs in Python language to solve their problems of interest.

Pre-requisites: Knowledge of basics programming.

Course Outcomes (CO):

After studying this course, students will be able to:

1. Understand the concept of structure, data types and variables using Python Programming Language

2. Apply the concept of list, tuples, functions and dictionaries in Python Programs

3. Understand and use classes and objects in Python.

4. Read and write files in Python.

5. Use exception handling in Python applications for error handling.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
1. **Overview & Introduction**	In class	Introduction, Features, Lexical Structure, Data Type, Variables, Numbers, Strings, Expression and Operators, Numeric Operations, Conditional Statements, Looping, Control flow Statements.	7	1
2. **List, Tuples, Functions & Dictionaries**	In Class	Introduction to List and Tuple, Accessing List and Tuple, Operations, working with List and Tuple Build-in Function and Methods, optional arguments, default values, Passing functions as arguments, Working with dictionaries, properties and Methods.	8	2
3. **Classes and Objects in Python**	In Class	Defining Class, Creating Object, Built-in class Attributes, Inheritance, Overloading and Overriding, Data Hiding	7	3
4. **Read and Write Files**	In Class	File Objects, File Built-in Function, File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments, File System, File Execution, Persistent Storage Modules.	7	4
5. **Error and Exception Handling**	In Class	Exceptions in Python, Detecting and Handling Exceptions, Exceptions as Strings, Raising Exceptions, Assertions, Standard Exceptions	7	5

Text Book

1. Lutz, Mark, Learning Python, O Rielly.
2. Chun, J Welsey, Core Python Programming, Pearson.

Reference Books:

1. Ljubomir Perkovic, Introduction to Computing Using Python: An Application Development Focus, John Wiley & Sons.
2. Barry, Paul, Head First Python, O Rielly.
3. Guttag John V, Introduction to Computation and Programming Using Python with Application to Understand Data, PHI.
4. Taneja Sheetal, Python Programming : A modular approach, Pearson.

BC103A4 **Credit: 1 (L-0, T-0, P-2)**

WEB TECHNOLOGIES LAB

Course Objectives: Demonstrate the role of languages like HTML, Javascript, PHP, Servlets, JSP in the workings of the web and web applications.

<table>
<tr><th>Experiment No.</th><th>Title</th></tr>
<tr><td>1.</td><td>Familiarization of WordPress:</td></tr>
<tr><td>2.</td><td>Hosting webpage using local server</td></tr>
<tr><td>3.</td><td>Design a page having suitable background colour and text colour with title “My First Web Page” using all the attributes of the Font tag.</td></tr>
<tr><td>4.</td><td>Create a HTML document giving details of your [Name, Age], [Address, Phone] and [Register
Number, Class] aligned in proper order using alignment attributes of Paragraph tag.</td></tr>
<tr><td>5.</td><td>Write HTML code to design a page containing some text in a paragraph by giving suitable heading style.</td></tr>
<tr><td>6.</td><td>Create a page to show different character formatting (B, I, U, SUB, SUP) tags.
$viz: \quad log_b m^p = p\, log_b m$</td></tr>
<tr><td>7.</td><td>Write HTML code to create a Web Page that contains an Image at its centre.</td></tr>
<tr><td>8.</td><td>Create a web page with an appropriate image towards the left hand side of the page, when user clicks on the image another web page should open.</td></tr>
<tr><td>9.</td><td>Create web Pages using Anchor tag with its attributes for external
links.</td></tr>
<tr><td>10.</td><td>Create a web page for internal links; when the user clicks on different links on the web page it should go to the appropriate locations/sections in the same page.</td></tr>
<tr><td>11.</td><td>Write a HTML code to create a web page with pink color background and display moving message in red color.</td></tr>
<tr><td>12.</td><td>Create a web page, showing an ordered list of all second semester/ third semester courses.</td></tr>
<tr><td>13.</td><td>Create a web page, showing an unordered list of names of all the Diploma Programmes (Branches) in your institution.</td></tr>
<tr><td>14.</td><td>Create a HTML document containing a nested list showing a content page of any book.</td></tr>
<tr><td>15.</td><td>Create the following table in HTML with Dummy Data:
<table>
<tr><th>Reg. Number</th><th>Student Name</th><th>Year/Semester</th><th>Date of Admission</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>16.</td><td>Create a web page which divides the page in two equal frames and place the audio and video clips in frame-1 and frame-2 respectively.</td></tr>
</table>

	<table><tr><td>FRAME-1</td><td>FRAME-2</td></tr></table>
17.	Create a web page which should generate following output: <table><tr><td rowspan="2">FRAME-1</td><td>FRAME-2</td></tr><tr><td>FRAME-3</td></tr></table>
18.	Create a web page using Embedded CSS and multimedia.
19.	Use tables to provide layout to your HTML page describing your college infrastructure.
20.	Use and tags to provide a layout to the above page instead of a table layout.
21.	Use frames such that page is divided into 3 frames 20% on left to show contents of pages, 60% in center to show body of page, remaining on right to show remarks.
22.	Embed Audio and Video into your HTML web page.
23.	Create a webpage with HTML describing your department use paragraph and list tags.
24.	Apply various colors to suitably distinguish key words, also apply font styling like italics, underline and two other fonts to words you find appropriate, also use header tags.
25.	Create links on the words e.g. ―Wi-Fi and ―LAN to link them to Wikipedia pages.
26.	Insert an image and create a link such that clicking on image takes user to other page.
27.	Change the background color of the page; At the bottom create a link to take user to the top of the page.
28.	Design the following static web pages required for an online book store web site. i. HOME PAGE: The static home page must contain three frames. ii. LOGIN PAGE iii. CATOLOGUE PAGE: The catalogue page should contain the details of all the books available in the web site in a table. REGISTRATION PAGE
29.	Develop static pages (using only HTML) of an online book store, the pages should resemble some standard website, the website should consist the following pages, home page, registration and user login, user profile page, books catalog, shopping cart, payment by credit card, order confirmation.
30.	Create a table to show your class time table.
31.	Write an HTML page that contains a selection box with a list of 5 countries, when the user selects a country, its capital should be printed next to the list; Add CSS to customize the properties of the font of the capital (color, bold and font size)

32.	Write a program in html to design a Bio-Data.
33.	Write a program in html to create a webpage with four frames (Picture, table, list, and hyperlink).
34.	Write a program in html to show all character elements in html.
35.	Write a program in html to create a webpage to show the block level elements and text level elements.
36.	Write a program in html to create a webpage to show various confectionary items using ordered list and unordered list.
37.	Write a program in html to create a webpage to show different hobbies.
38.	Write a program in html to show India map.
39.	Write an HTML page that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next in the list.
40.	Write an HTML page including any required JavaScript that takes a number from text field in the range of 0 to 999 and shows it in words. It should not accept four and above digits, alphabets and special characters.
41.	Write JavaScript to validate the following fields of the Registration page. i. First Name (Name should contains alphabets and the length should not be less than 6 characters). ii. Password (Password should not be less than 6 characters length). iii. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) iv. Mobile Number (Phone number should contain 10 digits only). v. Last Name and Address (should not be Empty).
42.	Develop and demonstrate JavaScript with POP-UP boxes and functions for the following problems: i. Input: Click on Display Date button using onclick( ) function Output: Display date in the textbox ii. Input: A number n obtained using prompt Output: Factorial of n number using alert iii. Input: A number n obtained using prompt Output: A multiplication table of numbers from 1 to 10 of n using alert iv. Input: A number n obtained using prompt and add another number using confirm. Output: Sum of the entire n numbers using alert

BC104A4 **Credit: 1 (L-0, T-0, P-2)**

DATA STRUCTURE LAB

Course Objective: The course is designed to develop skills to design and analyze simple linear and non-linear data structures. It strengthens the ability to the students to identify and apply the suitable data structure for the given real world problem. It enables them to gain knowledge in practical applications of data structures.

Pre-requisites: Computer Programming

Course Outcomes (CO): On Successful Completion of the course, students will be able to

CO1 Understand the concept of data structures and apply algorithm for solving problems like Sorting, searching, insertion and deletion of data.
CO2 Understand linear data structures for processing of ordered or unordered data.
CO3 Explore various operations on dynamic data structures like single linked list
CO4 Explore the concept of non-linear data structures such as trees and graphs.
CO5 Understand the operations of binary search tree like tree traversals and counting the number of nodes in the binary search tree

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1 **Introduction to Sorting and searching**	in class	Write programs for implementing the following searching techniques to arrange a list of integers in ascending order. a. Linear search b. Binary search c. Bubble sort d. Insertion sort	3	1
Module 2 **Stack and Queue**	in class	Write programs to for the following: a. Design and implement Stack and its operations using List. b. Design and implement Queue and its operations using List. c. Uses Stack operations to convert infix expression into postfix expression. d. Uses Stack operations for evaluating the postfix expression	3	2
Module 3 **Linked Lists**	in class	Write programs for the following operations on Single Linked List. a. Creation b. insertion	3	3

		c. deletion d. traversal		
Module 4 **Non-linear Data Structure**	in class	Write programs to implement the following graph traversal algorithms: a. Depth first search. b. Breadth first search.	2	4
Module 5 **Binary Search Tree**	in class	Write programs to perform the following: a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre-order, post-order andin-order. c. Count the number of nodes in the binary search tree.	3	5

Text Books:

1. Reema Thareja, *Data Structures Using C*, Oxford University Press.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, *The C Programming Language*, Prentice Hall of India.
2. Byron Gottfried, *Schaum's Outline of Programming with C*, McGraw-Hill.
3. J.P. Trembly, and P.G Sorenson, *An Introduction to Data Structures with Applications*, McGraw Hill.

Semester 3

BC201A1 **Credit: 4 (L-3, T-1, P-0)**

COMPUTER ORGANIZATION AND ARCHITECTURE

Questions to be set: 05 (All Compulsory)

Course Outcomes: After Completion of the course, students will be able:

1. To demonstrate an understanding of the organization of a computer system.
2. To identify instruction sets, processor structure and its functions.
3. To have knowledge on memory system and I/O organization.
4. To explain the working of a control unit and its operations.
5. To discover parallelism and features of parallel processing and superscalar operations.

Pre-requisites: Basic of Digital Systems.

Module	Topics	Hrs	CO
Module 1: **Introduction: Overview of Computers**	Historical background, Classification of computers. Basic Structure, Fundamental Units, Basic Operational Concepts, Bus Structure, RISC and CISC processors, Introduction to RISC V processor, SHAKTI Processor, VIKRAM Processor, ARM Processors.	8	1
Module 2: **Computer Arithmetic and Processor Basics**	Addition and Subtraction, Multiplication Algorithms (Booth's Algorithm), Division Algorithms, Floating point number representation, Floating point arithmetic and unit operations, Pipelined ALU. Processor architecture and organization, Processor operation, Register set, Stack organization, Interrupts and subroutine.	8	2
Module 3: **Memory System and I/O Organization**	Memory classification, memory characteristics and hierarchy, Cache memory, main memory Secondary memory, Virtual memory. Basic I/O structure of computers, Asynchronous data communication, Serial and parallel communication, Programmed I/O Interrupt driven I/O, Interrupt controller, DMA controller, Device drivers, Standard I/O buses (USB, SCSI, IEEE488), Bus arbitration, I/O processor.	8	3
Module 4: **Microprogramming and Micro Architecture Control Unit Operation**	Need of data flow control, data paths, control signal requirements, microinstructions, instruction cycles, hardwired control, programmed control, sequencing and execution of microinstructions, utilizing system clock. Control Unit, Micro-operations, control of the processor, hardware implementation.	6	4
Module 5: **Pipelining, Parallel Processing and Superscalar Operation**	Pipeline strategy, pipeline performance, Pipeline Hazards, Data hazards, Control hazards, Structural hazards, Control and data paths. Flynn's classification, Network topologies, Program parallelism, shared variables and critical section, cache coherence, superscalar operation.	6	5

Text Books:

1. Computer Architecture & Organization, William Stallings, 2008, Pearson Education.

Reference Books:

1. Computer Architecture & Organization, Nicholas Carter & Raj Kamal, 2009, McGraw Hill.
2. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 1996, McGraw Hill.

BC202A1 **Credit: 4 (L-3, T-1, P-0)**

OOPS WITH C++

Course Objectives:
This course is designed so that the student should be able to define the objects and classes. This course contains the basic features of Object-Oriented Programming using C++. This course is aimed for providing a complete knowledge of different functions, techniques and algorithms used in C++ to address different practical problems. This creates interests and motivations in students and in other way, this course will fetch a large scope of job and research opportunities in India as well abroad.

Pre-requisites: Basics of programming

Course Outcomes (CO): After completion of the course, students will be able to:

1. Understand the basic concept of Object-oriented programming.

2. Understand the basic features and syntaxes of C++.

3. Write programs using the different concepts of object oriented programming.

4. Understand file handling and input output operation.

5. Apply the concept of OOPs to solve some practical problems.

Module	Topics	Hrs	CO
Module 1: **Overview of OOPs**	Procedure-Oriented programming, Object-oriented programming, benefits, features, and Application of OOP. Simple C++ program, Tokens, Keywords, constants, Basic data types, User defined data types and Derived data types, Function prototyping, Call by reference, analyzing simple programs.	8	1
Module 2: **Concepts of OOPs in C++**	Classes, Class scope, Nested classes, Member functions, Nesting of member functions and basic Object-Oriented features (encapsulation), overloading, namespace and using structure and union, Array of objects, Member functions, Friend function, Pointers to members, Constructors, Copy Constructors, Destructors.	8	2
Module 3: **Inheritance, Polymorphism**	Generalization / Specialization of Object Modelling in C++ Pointer, Virtual Functions, Static and Dynamic Binding, pointers to objects, this pointer, pointers to derived class, Abstract class, Friend function, Virtual functions, Method Overloading, Method Overriding	7	3
Module 4: **Type Casting, Exceptions,**	C++ cast operators; C++ Exceptions & standard exception classes, Function and Class templates and using STL like containers.	7	4

Templates & STL			
Module 5: **File handling**	Classes for file stream operations, Accessing files, Sequential I/O operations, Random access, Command- line arguments, Exception handling (throw, try, and catch).	6	5

Text Books:

1. E Balagurusamy, Object-Oriented Programming in C++, 6e , McGraw Hill Education, 2016.

2. Bjarne Stroustrup, The C++ Programming Language, 4e, Pearson education, edition,2013.

3. Robert Lafore, Object-oriented programming in C++, 4e , Sams Publishing, 2001.

Reference Books:

1. Cay Horstmann, Computing Concepts with C++ Essentials, 2e, John Wiley & Sons, 1997.

2. John Hubband, Programming with C++,2e., Schaum's outline series, McGraw Hill, 2017

BC203A1 **Credit: 4 (L-3, T-1, P-0)**

COMPUTER NETWORKS

Questions to be set: 05 (All Compulsory)

Course Outcomes: After Completion of the course, students will be able to:

1. Understand the fundamentals principles of a computer network.
2. Understand the concepts of layered architecture and the role of Physical Layer and Link Layer.
3. Visualize the protocols in a Link layer.
4. Comprehend the routing procedures in Network Layer.
5. Relate the various protocols in a Transport Layer

Pre-requisites: Digital System

Module	Topics	Hrs	CO
Module 1: **Overview of Computer Communication**	Introduction to Data Communications, Network types. Data Flow, Concepts of Communication in Computer Networks, Layered Architecture, OSI, TCP/IP, Network Addressing.	6	1
Module 2: **Introduction to Physical and Link Layers**	Data and Signal Fundamentals, Analog and Digital Signals, Transmission Impairments, Transmission Media- Guided and Unguided Guided Media: Twisted Pair, Coaxial, and Fiber Optics Cables, Radio Waves, Microwaves, and Infra-red. Data link layer design Issue, Roles and Responsibilities of Data Link Layer, Error Detection and correction – Single Parity bit, Cyclic Redundancy Check (CRC), Framing.	8	2
Module 3: **Link Layer Methodologies and Protocols**	Elementary Data link Protocol: Stop-and-Wait ARQ, Sliding Window, Go-Back-N, Selective Repeat, Circuit-Switched, Packet Switched- Datagram, and Virtual Circuit Networks, Message Switching.Random Access: Aloha (Pure and Slotted), CSMA, CSMA/CD, CSMA/CA.	8	3
Module 4: **Network layer Protocols**	Network design issue, Routing algorithm- Introduction, Optimality principle, Shortest path, Flooding, Distance vector routing, Link State Routing.	8	4
Module 5: **Transport layer Protocols**	Transport services, Element of transport protocols, TCP connection management, transmission policy, congestion control, UDP.	6	5

Text Books:

1. Behrouz A. Forouzan, Data Communications and Networking, Tata McGraw Hill.
2. A. S. Tanenbaum, Computer Networks, Pearson Education Asia.

Reference Books:

1. Bharat Bhushan Agarwal, Sumit P. Tayal, Computer Network, University Science Press.
2. William Stallings, Data and Computer Communications, PHI.
3. L. L. Peterson & B.S. Davie, Computer Networks: A System Approach, Elsevier.
4. Alberto Leon-Garcia, Indra Widjaja, Communication Networks, Tata McGraw Hill

BC201A4 **Credit: 1 (L-0, T-0, P-2)**

OBJECT ORIENTED PROGRAMMING WITH C++ LAB

Course Objectives: To give the students ideas on object oriented programming language. In this subject, students are introduced with topics like class, linked list, stack, pointers etc. After completion of this subject, students are able to develop some system with the knowledge of object oriented programming, able to debug and fix the errors.

Pre-requisites: The basic knowledge of computer fundamentals and experience with a procedural programming language (e.g. C Programming) are expected.

Course Outcomes (CO):

After studying this course, students will be able to:

1. Understand the concept of data types, Loops, array and sorting using C++.

2. Apply the concept of function and pointer.

3. Understand and use procedural based programming.

4. Apply the concept of classes, objects, inheritances and polymorphism in C++.

5. Apply the concept of Linked list using C++

Module	Experiment No.	Experiment Name	Hrs	CO
1. **Data types, Loops, array and sorting using C++.**	1	Programs with range of different built in data types, loops.	6	1
	2	Programs with one dimensional array, two dimensional arrays.		
	3	Program with sorting techniques: Bubble sort, Insertion sort, Selection sort.		
2. **Function and pointer.**	4	Programs with string manipulating functions.	6	2
	5	Programs with Pointer.		
	6	Programs with Functions: Call by value and call by reference.		
3. **Procedural based programming**	7	Programs with structure and union.	4	3
	8	Programs to maintain employee record using structure.		
4. **Classes, objects, inheritances and polymorphism in C++.**	9	Programs with Class and objects, Array of objects.	6	4
	10	Programs with different types of inheritances.		
	11	Programs with Polymorphism, Abstract class, runtime polymorphism.		
5.	12	Programs with linked list using C++.	4	5

/Linked list	13	Program with Linked List: insertion and deletion of nodes.		

BC202A4 **Credit: 1 (L-0, T-0, P-2)**

NETWORKING LAB

Course Objectives: To give the students the ideas on networking devices, instruments, coding.

Pre-requisites: The basic knowledge of Computer Networks.

Course outcomes:

On the completion of this laboratory course, the students will be able to:

1. Choose suitable tools to model a network.

2 Use the network simulator for learning and practice of networking algorithms.

3. Illustrate the operations of network protocols and algorithms using C programming.

4. Simulate the network with different configurations to measure the performance parameters.

5. Implement the data link and routing protocols using C programming.

List of Experiments:

1. Implement a point to point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth.

2. Implement a four node point to point network with links n0-n2, nl-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between nl-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP.

3. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.

4. Implement Ethernet LAN using n nodes and assign multiple traffic to the nodes and obtain congestion window for different sources/ destinations.

5. Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.

6. Implementation of Link staterouting algorithm..

PART-B: Implement the following in C/C++

1. Write a program for a HLDC frame toperform the following.

i) Bit stuffing

iil) Character stuffing.

2 Write a program for distance vector algorithm to find suitable path for transmission.

3. Implement Dijkstra 's algorithm to compute the shortest routing path.

4. For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases

a Without error

b. With error

5. Implementation of Stop and Wait Protocol and Sliding Window Protocol

6. Write a program for congestion control using leaky bucket algorithm.

Semester 4

BC204A1 **Credit: 4 (L-3, T-1, P-0)**

DATABASE MANAGEMENT SYSTEM

No. of questions to be set: 1 from each CO
No. of questions to be answered: Five

Objectives: This course provides students with in-depth knowledge of database management systems. It covers the basics of relational database concepts, architecture, models, schemas, database dependencies and normal forms, and database design guidelines. It also includes the basics of SQL, transaction processing, and concurrency control. Upon successfully completing this course, students will have the skills to analyze business requirements, produce a viable model, and implement a database to meet such requirements.

Pre-requisites: Data Structures and Programming Concepts.

Course outcomes:

On completion of the course the student will be able to:

1. Define fundamental elements of a relational database management system
2. Describe the data models.
3. Interpret the basic concepts of the relational data model, and Map the Entity-relationship model.
4. Connect database using SQL
5. Understand the concept of transactions

Module	Topic	Hrs	CO
1 **Introduction to Databases and Transactions**	What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management	4	1
2 **Data Models**	The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction.	4	2
3 **Database Design, ER-Diagram, Unified Modeling Language & Relational database model**	Database design and ER Model:overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF), Data Flow Diagram. Relational algebra: introduction, Selection, and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison.	12	3

	Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.		
4 **Constraints, Views and SQL**	What is constraints, types of constrains, Integrity constraints, Views: Introduction to views, data independence, security, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers.	12	4
5 **Transaction management and Concurrency control**	Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	4	5

Books:

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill , Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning.
2. Elmasri and Navathe, Fundamentals of Database Systems, Addison Wesley.
3. Korth and S.Sudarshan, Database System Concepts, McGraw Hill.

BC205A1 **Credit: 4 (L-3, T-1, P-0)**

BC201A2 **Credit: 3 (L-3, T-0, P-0)**

Introduction to Internet of Things

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is focused to give a vision and introduction to IoT Technology. This course will provide the knowledge of IoT Gateway, Cloud and its access. It also highlights the basic architecture of BIG DATA solution, Radio Frequency Identification system, Near-field Communication system in relevance to the IoT market perspective. The students will be able to grow the expertise in data and knowledge management methodologies after pursuing this course. The course is dedicated towards the realization of 'Connected Society': Smart Cities and Smart World. The future Industry trends is highly inclined with the aspect of the outcomes of this course. So, after completion of this course, the students will be able to get a huge scope of jobs in this domain

Pre-requisites: Knowledge of basic signals and communication.

Course Outcomes(CO):

CO1: The students should be able to explain the basic features and requirements of IoT.
CO2: The students should be able to establish the need of Big Data solution strategy in corporate.
CO3: The students should be able to explain various short range communication protocols used for different IoT applications.
CO4: The students should be able to explain various long and medium range communication protocols used for different IoT applications.
CO5: The students should be able to elucidate how IoT can be deployed in different application scenarios.
** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **IoT basics**	in class	Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels. IoT system components, IoT Devices, IoT Gateways, Cloud Access, Cloud Components.	10	1
Module 2: **Big Data**	in class	What is Big Data (BD). Modern Corporate's need of BD Strategy. Main components of Big Data Solution. Basic Architecture of BD Solution. Introducing Hadoop.	8	2
	****Assignment Topics**	Case study		2
Module 3: **Short-Range Wireless Communication**	in class	Introduction to: Near-field communication (NFC); Radiofrequency identification (RFID) Thread – Network protocol based on the IEEE 802.15.4 standard, similar to ZigBee, Bluetooth low energy (BLE); Z-Wave; Body area Networks – BAN, Light-Fidelity (Li-Fi);	12	3

	****Assignment Topics**	Use cases		3
Module 4: **5G based IoT Under Medium and LongRange Wireless**	in class	Overview on 6LoWPAN, Low Power Wide Area Networks (LPWANS), Overview On 5G IOT, Low-power Consumption, Enhanced Coverage, Ultra-reliable Low-latency Communications, Massive Number of Devices. IoT Networking Protocols: MQTT, CoAP	10	4
	****Assignment Topics**	AMQP, XMPP		4
Module 5: **Towards 'connected Society': Smart Cities and Smart World**	in class	Smart Home, Connected Vehicle, Smart Agriculture, Smart Healthcare, Smart Grid	8	5
	****Assignment Topics**	Case study		5

Text Books:

1. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases**,** 1/e, CRC Press, Taylor & Francis Group, 2017.

2. Vijay Madisetti, ArshdeepBahga, Internet of Things A Hands-On- Approach**,**2014, ISBN:9780996025515.

3. Hongjian Sun, Chao Wang, Bashar I. Ahmad**,** From Internet of Things to Smart Cities: Enabling Technologies**,** CRC Press, Taylor & Francis Group, 2018.

Reference Books:

1. Adrian McEwen, Designing the Internet of Things, Wiley Publishers, 2013, ISBN: 978-1-118-43062-0.

2. Daniel Kellmereit, The Silent Intelligence: The Internet of Things. 2013, ISBN 0989973700.

3. NB-IoT : Enabling New Business Opportunities- Building A Better Connected World, Huawei.

4. http://bookgedebook.tk/downloads/nb-iot-enabling-new-business-opportunities-huawei.pdf.

5. Mishra S., Bhutia S.D., Akhtar N., Dhar S., "Cloud-Based Multilayer Telemedicine Architecture: A Case Study" in: Advances in Communication, Devices and Networking. Lecture Notes in Electrical Engineering, vol 537. Springer, Singapore, Bera R., Sarkar S., Singh O., Saikia H. (eds) (2019)

BC206A1 **Credit: 4 (L-3, T-1, P-0)**

OPERATING SYSTEMS

No. of questions to be set: 4 each from Unit – I and Unit – II
No. of questions to be answered: Any Five selecting at least TWO from each UNIT

Objectives: The principles and concepts that govern the design of modern computer operating systems are studied. Managing computing resources such as the memory, the processor and the Input/output devices are covered. Basics of CPU scheduling, process coordination, deadlock and memory management techniques are also discussed. After this course the students will be able to understand the interface between the hardware, software and user-machine interface.

Pre-requisites: Programming language concepts.

Module	Topic	Hrs	CO
1 **Introduction**	Basic Concepts, Simple Batch Systems, Multi-programmed Batched Systems, Time-Sharing Systems.	6	1
2 **Processes and Threads**	Process Concept, Process Scheduling, Operation on Processes, Cooperating Processes, Inter-process Communication.	7	2
3 **CPU Scheduling**	Scheduling Criteria, Scheduling algorithms, Multiple process scheduling.	6	3
4 **Process Synchronization & Deadlocks**	The Critical-Section Problem, Basics of Semaphores. Deadlock Characterization, Methods of Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection & Recovery from Deadlock.	10	4
5 **Memory Management**	Logical versus Physical Address Space, Swapping, Paging.	7	5

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, John Wiley & Sons. Inc.
2. Andrew S. Tanenbaum, Modern Operating Systems, PHI

Reference Books:

1. H.M.Diatel, An Introduction to Operating System, John Wiley.

2. William Stallings, Operating Systems: Internals and Design Principles, Pearson Publication. D.M. Dhamdhare, Operating System, Tata McGraw Hill.

BC203A4 **Credit: 1 (L-0, T-0, P-2)**

OPERATING SYSTEMS LAB

Objectives: At least 12 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied/programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper BC206A1 – Operating Systems and associated prerequisites.

Course Outcomes (CO): At the end of the course, the student should be able to

CO-1: Compare the performance of various CPU Scheduling Algorithms
CO-2: Implement Deadlock avoidance, Detection Algorithms and Semaphores
CO-3: Create processes and implement IPC
CO-4: Analyze the performance of the various Page Replacement Algorithms
CO-5: Implement File Organization and File Allocation Strategies

LIST OF EXPERIMENTS

1. Basics of UNIX commands
2. Write programs using the following system calls of UNIX operating system fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Write C programs to simulate UNIX commands like cp, ls, grep, etc.
4. Shell Programming
5. Write C programs to implement the various CPU Scheduling Algorithms
6. Implementation of Semaphores
7. Implementation of Shared memory and IPC
8. Bankers Algorithm for Deadlock Avoidance
9. Implementation of Deadlock Detection Algorithm
10. Write C program to implement Threading & Synchronization Applications
11. Implementation of the following Memory Allocation Methods for fixed partition: a) First Fit b) Worst Fit c) Best Fit
12. Implementation of Paging Technique of Memory Management
13. Implementation of the following Page Replacement Algorithms: a) FIFO b) LRU c) LFU
14. Implementation of the various File Organization Techniques
15. Implementation of the following File Allocation Strategies: a) Sequential b) Indexed c) Linked

BC204A4 **Credit: 1 (L-0, T-0, P-2)**

DATABASE MANAGEMENT SYSTEM LAB

Course outcomes:

On completion of the course, the student will be able to:

1. Create and manipulate SQL database
2. Create and manipulate SQL table
3. Understand SQL clause
4. Understand SQL Join
5. Understand the concept of transactions

Module	Experiment No.	Experiment Name	Hrs	CO
SQL Database	1.	Write a query to a) CREATE database b) SELECT database c) SHOW database d) DROP database e) COPY database	2	1
SQL Table	2.	Write a query to a) CREATE TABLE b) ALTER TABLE c) RENAME TABLE d) TRUNCATE TABLE e) DROP TABLE f) COPY TABLE	2	2
SQL Database & Table	3.	Write a query to a) ADD/DELETE columns b) SHOW columns c) RENAME column d) VIEWS e) Table locking	2	1 & 2
	4.	Write a query to a) CREATE constraint b) INSERT record c) UPDATE record d) DELETE record e) SELECT record	2	
SQL Clause	5.	Write a query using the following clauses a) WHERE b) DISTINCT c) FROM	2	3

	6.	Write a query using the following clauses a) ORDER BY b) GROUP BY c) HAVING	2	
SQL Transactions	7.	Write a query using the following flow functions a) IF() b) IFNULL() c) NULLIF() d) CASE	2	5
	8.	Write a query using the following conditions a) AND b) OR c) AND OR d) LIKE e) IN	2	
	9.	Write a query using the following conditions a) NOT b) NOT NULL c) IS NULL d) IS NOT NULL e) BETWEEN	2	
	10.	Write a query to use aggregate functions a) COUNT() b) SUM() c) AVG() d) MIN() e) MAX() f) FIRST() g) LAST()	2	
SQL Join	11.	Write a query to perform Join a) Left Join b) Right join	2	4
	12.	Write a query to perform Join a) Cross join b) Self Join c) Inner Join	2	

Semester 5

BC301A1 **Credit: 3 (L-2, T-1, P-0)**

FORMAL LANGUAGES AND AUTOMATA THEORY

Objective: The central objective of the course is to provide learners with a detailed understanding of the mathematical models of the machines and their evolution through requirement generation and advancement in languages.

Pre-requisites: Computer Programming concepts and Discrete Structures for Computer Science.

Course Outcomes (CO): By the completion of the course, the students will be able to

CO-1: Define a system and recognize the behavior of a system and minimize a system and compare different systems.

CO-2: Convert Finite Automata to regular expression.

CO3: Check equivalence between regular linear grammar and FA.

CO4: Minimize context free grammar and to check equivalence of CFL and PDA.

CO5: Design Turing Machine.

Module	Topics	Hrs	CO
Module 1: **Introduction**	Mathematical preliminaries: Sets, Logic, Functions, Relations, Languages Definitions: Language, Grammar, Automata, Relation between language, Grammar and automata, Importance of automata theory.	4	1
Module 2: **Finite Automata**	Informal introduction: Drawing examples from everyday life to bring out the essence of finite automata, Finiteness and its importance in automata theory. Deterministic finite automata: Definition, Processing strings, Transition functions, Language of a DFA, Nondeterministic finite automata: Non-determinism, Definition, Extended transition functions, Language of a NFA, Equivalence of DFA and NFA, Kleene's theorem, Epsilon transitions, Applications of Finite automata in text search.	10	2
Module 3: **Regular expressions and regular languages**	Memory required to recognize a language, Regular expressions, Regular expression to finite automata, Finite automata to regular expression, Algebraic laws for regular expressions, Applications of regular expressions, Criterion for regularity, Regular languages. Pigeonhole principle, Pumping lemma for regular languages, Closure properties, Testing membership of regular languages, Equivalence of automata.	10	3

Module 4: **Pushdown automata and context free languages**	Definition, Leftmost and rightmost grammars, Parse trees, Ambiguity: Ambiguous grammar, Removing ambiguity. Normal forms, Applications of context free grammars: Parsers. Definition of pushdown automata, Representing pushdown automata, Acceptance by pushdown automata: By final state, By empty stack, Deterministic pushdown automata, Equivalence of pushdown automata and context free grammars, Pumping lemma for context free languages, Closure properties of context free languages, Testing membership of context free, Decision problems for context free languages.	11	4
Module 5: **Turing machines, Recursively enumerable languages, Undecidability & Language learning**	Definition, Language of a turing machine, Programming turing machines, The church-turing thesis, A simple programming language, Extensions of the basic turing machine. Recursively enumerable languages, Definition, Enumeration, Chomsky hierarchy, The halting problem, the post correspondence problem, Time and space complexity of turing machines, Complexity classes, Learning framework, Inductive inference, Grammar induction.	13	5

Text Books:

1. John. E. , Rajeev Motwani, Jeffry.Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. John Martin , "Introduction to Languages and the Theory of Computation", Tata McGraw Hill.

Reference Books:

1. Peter Linz, "An Introduction to Formal Languages and Automata", Narosa.
2. James. L. Hein, "Discrete Structures, Logic and Computability", Narosa.
3. Partha Niyogi, "The Computational Nature of Language Learning and Evolution", PHI.
   Zvi Kohavi and Niraj K. Jha, "Switching and Finite Automata theory", Tata McGraw Hill.

BC302A1/BC302A2 **Credit: 3 (L-2, T-1, P-0)**

EMBEDDED SYSTEMS

No. of questions to be set: 1 from each CO
No. of questions to be answered: Five

Objectives: The objective of this course is to impart a solid understanding of the role of embedded systems and embedded systems design and development. This course delves into the processes of Real-Time Embedded Systems to provide the basic foundation in embedded systems.

Pre-requisites: Concepts of Digital Systems and Computer organization & architecture.

Course outcomes:

On completion of the course, the student will be able to:

1. describe the basics of design, modelling, development of embedded systems

2. develop the hardware for embedded system applications based on the processors

3. simulate and synthesize the embedded system by using the Embedded system and Linux operating system.

4. apply various real-time algorithms and implement the RTOS development tools in building real-time embedded systems.

5. design various advanced embedded systems.

Module	Topic	Hrs	CO
1 **Introduction to Embedded System**	Introduction. Definition, Categories of embedded systems, components, requirements of embedded systems, Challenges and issues in embedded system.	4	1
2 **Concept of different Processors**	Design with 8051, Basic knowledge in ARM, PIC and Digital Signal Processor, Architecture of embedded memory, Basic structure and applications of Latch, Buffer, Crystal, reset circuit, Watch dog timer, Display unit and key pad.	6	2
3 **Embedded Programming**	Embedded programming in C for relay, stepper motor, opto-coupler, serial port, timer, interrupt, project study in C for LCD, Keyboard interfacing, elevator. Concepts of Linux Programming, I/O programming, Process and memory management programming, cell programming.	10	3
4 **Real time operating System**	Introduction, Basic features, description of Layer model and Kernel operations for general operating system and real time operating system, concept of Task, Process and Thread, Task Scheduling, Task synchronization, Device driver, inter process communication.	10	4

5 **Embedded Software Development**	Embedded software development process, Conversion of ALP and high level language into ROM image, ICE, IDE, Linking and locating software, Contact less Smart card, SoC for cell phone, Internet of Things, Artificial Intelligence	6	5

Books:

1. Raj Kamal, Embedded system: Architecture, programming and Design ,3e, McGraw Hill Education, 2017.
2. Shibu K V, An introduction to Embedded system, 2e, McGraw Hill Education India Private Limited, 2017.
3. Mazidi, Muhammad Ali, the 8051 microcontroller and embedded systems Using Assembly and C, Pearson, 2018.

BC301A4 **Credit: 1 (L-0, T-0, P-2)**

EMBEDDED SYSTEMS LAB

Course Outcomes

After completion of the course, the students should be able to:
1. Design various combinational circuits using the Dataflow style of modeling.
2. Implement various combinational circuits using Structural style of modeling.
3. Implement various combinational circuits using behavioral style of modeling
4. Design various sequential circuits using the Dataflow style of modeling.
5. Design various sequential circuits using the behavioral style of modeling.

Module	Experiment No.	Experiment Name	Hrs	CO
	1.	Design and write VHDL code for basic gates	2	
	2.	Design and Write VHDL code for full adder using half adder	2	
	3.	Design and Write VHDL code for 4:1 Mux using dataflow modeling	2	
	4.	Design and Write VHDL code for 4:1 Mux using behavioral modeling	2	
	5.	Design and Write VHDL code for 3:8-line decoder using case statement	2	
	6.	Design and Write VHDL code for 4-2-line encoder	2	
	7.	Design and Write VHDL code for 3-bit comparator using a 1-bit comparator and basic gates	2	
	8.	Design and Write VHDL code for 4-bit parallel adder using structural modeling	2	
	9.	Design and Write VHDL code for SR flip flop	2	
	10.	Design and Write VHDL code for D flip flop	2	
	11.	Design and Write VHDL code for J-K flip flop	2	
	12.	Design and Write VHDL code for T flip flop	2	

Semester 6

BC303A1 **Credit: 4 (L-3, T-1, P-0)**

DESIGN AND ANALYSIS OF ALGORITHMS

Questions to be set: 05 (All Compulsory)

Objective: This course builds upon preliminary knowledge delivered in Data Structures. The main objectives of the course are to provide thorough knowledge and understanding of different algorithm analysis techniques, design strategies and their applications. Special purpose machines, some critical problems and innovative techniques are used in solving them.

Pre-requisites: Data Structures and Programming concepts

Course Outcomes (CO): On successful completion of course, the learners will be able to

1. To define and gain the overall view of Algorithm and understand the designing analyzing it.
2. Describe, apply, and analyze the complexity of certain divide and conquer methods.
3. To apply sorting algorithm, greedy and dynamic programming algorithms.
4. Identify and analyze criteria and specifications appropriate to new problems and choose the appropriate algorithmic design technique for their solution.
5. Explain and apply backtracking and branch and bound techniques to deal with some hard problems.

Module	Topics to be covered	Topics	Hrs	CO
Module 1 **Introduction to Algorithm and Mathematical preliminaries**	In class Topics	Definition, Aim of the subject, Designing algorithms and Analyzing algorithms: An introduction. Asymptotic notations and common functions. Example: Insertion sort	7	1
	Assignment Topics			
Module 2 **Recurrences and divide and conquer**	In class Topics	The basics of divide & conquer method, Solving recurrences: Substitution method, Recursion tree method, Master method: Proof of master method. Finding maximum and minimum, Strassen's matrix multiplication, Binary search.	7	2
	Assignment Topics			
Module 3 **Sorting algorithms and their analysis Greedy method**	In class Topics	Quick sort, Heap sort, Counting sort, Radix sort, Bucket sort. Basics of greedy method, Huffman codes, Activity selection, Greedy method vs. dynamic programming.	9	3
	Assignment Topics			

Module 4 **Dynamic programming and Graph algorithms**	In class Topics	Basics of dynamic programming, Matrix chain multiplication, longest common subsequence, Traveling salesperson problem. Basics terminologies, Representation of graphs, Breadth first search, Depth first search, Minimum spanning tree-Kruskal's algorithm, Prim's algorithm, Single source shortest path: Dijkstra's algorithm, All pair shortest path-Floyd and Wars hall's algorithm.	11	4
	Assignment Topics			
Module 5 **Applications**	In class Topics	Sorting networks, Solving systems of linear equations, Fast Fourier transforms: Description only, String matching.	6	5
	Assignment Topics			

Text Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms", PHI.
2. D. Samanta, "Classic Data Structures", PHI.

Reference Books:

1. A. Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education.
2. S. Basse, A. Van Gelder, "Computer Algorithms-Introduction to Design and Analysis", Pearson.
3. Alfred V. Aho, John E. Hop croft, Jeffrey D. Ullman, "Data Structures and Algorithms", Addison Wesley.
4. M. A. Weiss, "Data Structure and Algorithm Analysis in C", Pearson Education.

BC304A1 **Credit: 4 (L-3, T-1, P-0)**

BC303A2 **Credit: 3 (L-3, T-0, P-0)**

Introduction to Artificial Intelligence

Questions to be set: 05 (All Compulsory)

Course Objectives: To develop semantic-based and context-aware systems to acquire, organize process, share and use the knowledge embedded in multimedia content. Research will aim to maximize automation of the complete knowledge lifecycle and achieve semantic interoperability between Web resources and services.

Pre-requisites: Statistics, linear algebra, matrix, calculus, probability, programming languages and data modelling.

Course Outcomes (CO): After Completion of the Course, students will be able to:

CO1: Explain basic concept of Artificial Intelligence.
CO2: Explain the search algorithm in Artificial Intelligence.
CO3: Develop the concept about the logic and object
CO4: Explain the concept of agent
CO5: Explain and examine different AI based applications.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to AI**	in class	AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation	6	1
Module 2: **Search Algorithm**	in class	Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions	8	2
	****Assignment Topics**	Case study		2
Module 3: **Introduction to logic and object**	in class	Knowledge Representation First Order Predicate Logic – Prolog Programming Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories –Reasoning with Default Information	8	3

	****Assignment Topics**	Use cases		3
Module 4: **Introduction to Agent**	in class	Software Agents Architecture for Intelligent Agents – Agent communication–Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	7	4
	****Assignment Topics**	Case study		4
Module 5: **AI Application**	in class	Applications AI applications – Language Models – Information Retrieval-Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware –Perception – Planning – Moving	7	5
	****Assignment Topics**	Case study		5

Text Books:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Artificial Intelligence: A Modern Approach, 4th Edition, Stuart Russell, Peter Norvig University of California at Berkeley, Pearson education, 2020.

Reference Books:

1. I. Bratko, ―Prolog: Programming for Artificial Intelligence, Fourth Edition, Addison-Wesley Educational Publishers Inc., 2011.

BC302A4 **Credit: 1 (L-0, T-0, P-2)**

IoT LAB

Minimum number of Experiments to be completed: 12 (Covering all the Modules).

Course Objectives: The Main objective of this Lab manual is to have hands on experience of testing, developing and configuring different IoT modules for a complete knowledge in the field of IoT.

Pre-requisites: Knowledge of basics programming and the knowledge of microprosser/microcontroller programming

Course Outcomes (CO):

1. Use of microprocessor and microcontroller based embedded platforms in IOT.
2. Experimentation on different sensor and actuators used in IoT.
3. Make use of Cloud platform to upload and analyse any sensor data
4. Use of Devices, Gateways and Data Management in IoT.
5. Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

Module	Experiment No.	Experiment Name	Hrs	CO
Introduction to IoT Hardware	1.	Introduction to Arduino UNO: IDE installation processor specification, pin detail I/O, and basic programming.	2	1
	2.	Introduction to NODE MCU: hardware specifications, I/O programming. Wireless module configuration.	2	
	3.	Introduction and interfacing different wireless devices with Arduino/NODE MCU (Bluetooth, ZigBEE, LoRa, Wifi)	2	
IoT Sensor, actuators and interfacing	4.	Introduction and standalone exploration of IR sensor. LDR, DHT11, Pressure sensor and Gas Sensor.	2	2
	5.	Standalone exploration of solenoid valve, Stepper motor, Servo motor, Solenoid Relay	2	
IoT Cloud server and data	6.	Introduction to different IoT cloud server (Think speak, IFTTT) server configuration and real time data analysis.	2	3

	7.	Alarm notification and controlling using IoT server.	2	
Development of IoT using SOC	8.	Introduction to Raspberry pi: Features, NOOBS Installation, and basic operation	2	4
	9.	I/O programming using python programming language	2	
	10.	Camera interfacing and image processing using ESP 32 CAM	2	
Project Work	11.	Project work 1 on complete IoT Device Development.	2	5
	12.	Project work on complete IoT Server configuration and controlling.	2	5

Semester 7

BC401A1 **Credit: 4 (L-3, T-1, P-0)**

IoT GATEWAYS AND EDGE COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objectives: Integrated Smart Gateways with Edge computing are becoming essential ingredients for the smart proliferation of IoT services. Students will be able to design such Smart Gateway system with the completion of this course.

Pre-requisites: Basics of Computer Networks

Course Outcomes (CO):

CO1: The students should be able to explain different IoT networking protocols.

CO2: The students should be able to explain Gateways for IoT networking.

CO3: The students should be able to explain different IoT short and long-range communication protocols.

CO4: The students should be able to explain the edge and fog computing paradigms.

CO5: The students should be able to explain how the concept of edge and fog computing is applied in different IoT applications.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Overview of Computer Networking**	in class	TCP/IP protocol, CoAP, XMPP, Web Socket, AMQP, MQTT, WebRTC, PuSH in IoT networking, Routers, Switches and Hubs in IoT networking, Architectural Considerations in Smart Object Networking.		1
	**Assignment Topics			
Module 2: **Introduction to Gateways**	In class	Introduction to Wi-Fi, Network topologies, Network Protocols. Smart IoT Gateways: Processor, Operating System, Memory, Hard Drive, Antennas, Power Supply, Wireless LAN Card, LTE/5G Mobile broadband Card. Bluetooth, 802.15.4, ZigBee, Wireless Hart, Thread, Z- WaVe.		2
	**Assignment Topics			
Module 3: **Short Range and Long Range Wireless Communication**	In class	Unlicensed spectrum offerings: LoRa, SigFox; Licensed spectrum specialties: NB-IoT, CAT-M1, Hybrid networks.		3
	**Assignment Topics			

Module 4: **New Computing Paradigms**	in class	Addressing the Challenges in Federating Edge Resources, Integrating IoT-Fog-Cloud Infrastructures System Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds.		4
	**Assignment Topics			
Module 5: **Applications**	in class	Exploiting Fog Computing in Health Monitoring, Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking, Fog Computing Model for Evolving Smart Transportation Application		5
	**Assignment Topics			

Text Books:

1. Gerardus Blokdyk, "IoT Gateways The Ultimate Step-By-Step Guide", STARCooks , 2018.

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking", Pearson, Seventh Edition, 2017.
2. https://www.dell.com/en-us/work/shop/gateways-embedded-computing/dell-edge-gateway-5100/spd/dell-edge-gateway-5100/xctoi5100us.
3. Keysight TechnologiesThe Menu at the IoT Café: A Guide to IoT Wireless Technologies; http://literature.cdn.keysight.com/litweb/pdf/5992-2412EN.pdf
4. Rajkumar Buyya and Satish Narayana Srirama, "Fog and Edge Computing Principles and Paradigms ", Wiley Series On Parallel and Distributed Computing, John Wiley & Sons, Inc, 2019

BC402A1 **Credit:3 (L-2, T-1, P-0)**

IIoT AND INDUSTRY 4.0

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is focussed on giving a vision and introduction to Industrial IoT Technology. This course will provide the knowledge of Pathways, Gateways and IoT Nodes, Cloud and its access. It also highlights the basic architecture of BIG DATA solution, 5G based Cellular, Satellite and Fiber Communication system in relevance to the IoT market perspective. The students will be able to develop their expertise in data and knowledge management methodologies after pursuing this course. The course is dedicated towards the realization of 'Connected Society' Smart Factories, Smart Health Care, Retail and Logistics, Oil and Gas Industry, Smart Cities, Smart Grid. The future Industry trends is highly inclined with the aspect of the outcomes of this course. So, after completion of this course, the students will be able to get a huge scope of jobs in this domain.

Pre-requisites: Basic knowledge of internet.

Course Outcomes (CO):

CO1: The students should be able to explain the basic features and requirements of Industry 4.0

CO2: The students should be able to establish the need of robotics in industry 4.0

CO3: The students should be able to explain various communication protocols used for different IIoT applications.

CO4: The students should be able to recognize the importance of data analytics and data security in IIoT

CO5: The students should be able to elucidate how extended realities (XR) are effective to enhance the performance of industrial production.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Industrial IoT and Industry 4.0**	in class	Introduction to Industrial IoT : Introduction, Evolution of Industrial IoT, Key Opportunities and Benefits, Industrial Internet System, Smart Business Models, Cyber Physical Systems, IIoT Reference Architecture. Defining Industry 4.0, Why Industry 4.0 and Why Now?, Technology drivers for industry 4, The Value Chain, Lean Production Systems, Benefits to Business, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, Industry 4.0 Reference Architecture, SCADA in IIoT		1

	****Assignment Topics**	**Industrial IoT Use Cases:** Smart Factories, smart agriculture, Smart Health Care, Retail and Logistics, Oil and Gas Industry, Smart Cities, Smart Grid. 5G Industrial IoT Use-Cases using Live OTA 5G NR Network		1
Module 2: **Advances in Robotics in the Era of Industry 4.0**	in class	Recent Technological Components of Robots, Industrial Robotic Applications, Internet of Robotic Things, Cloud Robotics, Sets Up Smart Manufacturing Line, Cloud computing in IIoT		2
	****Assignment Topics**	iRobot Factory-cognitive manufacturing,		2
Module 3: **Communication Protocols and Networks**	in class	Wireless Communication Systems:Review of IEEE 802.15.4, Bluetooth Low Energy, ZigBee and ZigBee IP, Z wave,RFID, NFC, 5G-NR, mmWave Communication. IioTNetworking: -Industrial Ethernet- MODBUS-TCP, EtherCat, Etherner/IP, Profinet, TSN, Fieldbus- MODBUS-RTU, Profibus, CC-Link, InterBus, DeviceNet. IIoT Network Protocols: LPWAN, LoRaWAN, SIGFOX		3
	****Assignment Topics**	Pathways and Gateways for connection of IoT Industrial End Nodes to Cloud:-IOT end Nodes, IoT Gateways, Connection through: i) Fiber and ADSL ii) Cellular Base Station iii) Satellite.Realization of IOT gateways through PATHWAVE based integrated software.		3
Module 4: **Data Analytics and Security in Industry 4.0**	in class	**Big data in Industry** 4.0,IIoT Data characteristics, challenges, IIoT Analytics-machine learning, Deep learning, Batch Processing, complex event processing (CEP), Processing and Analytics, supervisory control and management, **Security** Threats and Vulnerability, Industrial Challenges, Evolution of Cyber attacks, Cyber attack Solution, Strategic principles in cyber security, Security Measures.		4
	****Assignment Topics**	MIDAS (M2M Platform),Big data driven smart manufacturing.		4
Module 5: **Augmented Reality, Virtual Reality and Additive**	in class	Role of AI in Industry 4.0, Introduction to AR and VR, AR Hardware and Software, Industrial Application of AR, Additive Manufacturing Technologies, Advantages and Disadvantages,		5

Manufracturing in the Age of Industry 4.0	****Assignment Topics**	Impact of extended reality (XR) Technologies in society.		5

Text-Books:

1. Alp Ustundag, EmreCevikcan, Industry 4.0: Managing the Digital Industrial Transformation, Springer Series in Advance Manufracturing, Switzerland, 2018.

2. Alasdin Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, Bnagken, DOI 10.1007/978-1-4842-2047-4, Thailand, 2016.

Reference Books:

1. Li Da Xu et. al, "Internet of Things in Industries: A Survey", IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS, VOL. 10, NO. 4, NOVEMBER 2014

BC403A1 **Credit: 4 (L-3, T-1, P-0)**

DEEP LEARNING

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of the course is to introduce various neural networks widely used in various machine learning algorithms for object detection and other applications.

Scope: The student will learn various types of neural networks including the convolutional and deep learning methods and use them in machine learning applications.

Pre-requisites: Linear Algebra

Course Outcomes (CO): After Completion of the course, students will be able to:

1. Understand the basic concept of neural networks
2. Understand various advanced neural networks and regularization methods.
3. Understand convolutional neural networks and their applications in machine learning.
4. Understand various Deep learning networks and Boltzman machines.
5. Understand and implement neural networks in real world problems.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Neural Networks**	in class	History of Deep Learning, Neural Network Basics: Multi-layer perceptron, Back propagation algorithm, training procedures, Shallow Neural Networks: Review, Gradient descent, and Activation Function	8	1
	****Assignment Topics**	Types of Activation Function		1
Module 2: **Deep Neural Network**	in class	Deep Feed Forward Networks: Forward and Backward Propagation, Hidden units, architecture design, Dimensionality reduction, learning time. Regularization for Deep Learning: Parameter Norm Penalties, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise-Robustness, Bagging and Other Ensemble Methods, Dropout,	8	2
	****Assignment Topics**	Adversarial Training		2
Module 3: **CNN**	in class	Convolutional Networks: convolution operation, pooling Object detection and Face recognition Sequence Modeling: Recurrent and Recursive Networks, Stacked Auto Encoders: Under complete, Regularized, sparse, de-noising, Monte Carlo Methods. Markov Models, Hidden Markov	8	3

		models: evaluation problem, finding the state sequence		
	****Assignment Topics**	HMM as graphical model.		3
Module 4: **Deep Generative Models**	in class	Deep Generative Models: Boltzmann Machines-the physics, randomness, impact on cognitive learning. Deep Boltzmann Machines	8	4
	****Assignment Topics**	Applications of Deep Generative Models		4
Module 5: **Application of Deep Learning**	in class	Case Studies in: Large Scale Deep Learning, Computer Vision, Speech Recognition, Economics, Fraud detection	8	5
	****Assignment Topics**	Case study on Crime detection using Deep Learning		5

Text Books:

1. Deep Learning By Ian Goodfellow, Yoshua Bengio and Aaron Courville.
2. Deep Learning Tutorial By LISA Lab, University of Montreal.

Reference Books:

1. Deep Learning: Methods and Applications By Li Deng and Dong Yu.

BC404A1 **Credit: 4 (L-3, T-1, P-0)**

SOFTWARE ENGINEERING

Questions to be set: 05 (All Compulsory)

Objective: This course will offer a wide perspective on software development covering the full life cycle of software development. This would be inclusive of requirements analysis, technical design, estimating, programming style, testing, quality measures and management issues. Current software engineering theory and practices with special emphasizes on the methodologies, techniques and tools are also taught.

Pre-requisites: Algorithm concept and Database Management System.

Course Outcomes (CO): At the end of the course, the student will be able to

1. Describe principles, concepts and practice of software engineering and apply its techniques and tools.
2. Author a software requirements and specifications for a software system. Understand the distributed system architectures and application architectures.
3. Understand the differences between real-time and non-real time systems. Demonstrate proficiency in rapid software development techniques and cost estimation.
4. Author a software testing plan.
5. Manage a project including planning, scheduling, and risk assessment/ management.

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction Software life cycle**	In class Topics	The software engineering discipline-evaluation and impact, Programs vs. software products, Importance of software engineering, Emergence of software engineering, Notable changes in software development practice, Computer system engineering. Life Cycle Models: Classical waterfall model, Iterative waterfall model, Prototype model, Evolutionary model, Spiral model, Comparison of different life cycle models.	8	1
	Assignment Topics			
Module 2: **Software project management; Requirements analysis and specification: Software design**	In class Topics	Responsibilities of project manager, Project planning, Metrics for project size estimation, Project estimation techniques, Empirical estimation techniques, COCOMO: A heuristic estimation techniques, Halstead's software science: An analytical technique, Staffing level estimation, Scheduling, Organization and team structure, Staffing, Risk management, Software configuration management, Miscellaneous plans. Requirements gathering and analysis, Software requirement specification (SRS), Formal system	10	2

		development techniques, Axiomatic specification, Algebraic specification. Cohesion and coupling, neat arrangement, Software design approaches, Object oriented vs. function oriented design		
	Assignment Topics			
Module 3: **Function-oriented software design and User interface design**	In class Topics	Overview of SA/SD methodology, Structured analysis, Data flow diagram, Extending DFD technique to real life systems, Structured design, detailed design, Design review. Characteristics of a good user interface, Basics concepts, Types of user interfaces, Component-based GUI development, User interface design methodology, GUI design methodology, Task and object modeling, Interaction design and rough layout, User interface inspection.	8	3
	Assignment Topics			
Module 4: **Coding and testing Software reliability and quality management**	In class Topics	Coding, Code review, Testing, Testing in the large vs. testing in the small, Unit testing, Black-box testing, Debugging, Program analysis tools, Integration testing, System testing, some general issues associated with testing. Software reliability, Statistical testing, Software quality management system, ISO 9000, SEI capability maturity model, Personal software process (PSP), Six sigma.	8	4
	Assignment Topics			
Module 5: **Computer aided software engineering Software maintenance Software reuse**	In class Topics	Case and its scope, Case environment, Case support in software life cycle, other characteristics of case tools, Towards second generation case tool, Architecture of a case environment. Characteristics of software maintenance, Software reverse engineering, Software maintenance processes model, Estimation maintenance cost. Basics issues in any reuse program, A reuse approach, Reuse at organization level.	6	5
	Assignment Topics			

Text Book:

1. Rajib Mall, “Fundamentals of Software Engineering”, PHI.
2. Richard Fairley, “Software Engineering Concepts”, Tata McGraw Hill.

Reference Books:

1. Jalote Pankaj, “An integrated approach to Software Engineering”, Narosa.
2. Pressman R, “Software Engineering- Practioner Approach”, McGraw Hill.
3. Somerville, “Software Engineering”, Pearson
4. Budgen, “Software Design”, Pearson

Semester 8

BC405A1 **Credit: 4 (L-3, T-1, P-0)**

DATA CENTRE AND CLOUD COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objectives: In the near future, all the activities of the 'Things' will be monitored and controlled from the cloud and data center. Students will be able to learn and use the knowledgefrom this course, in designing computational algorithms and system.

Pre-requisites: Basic knowledge of clouds and gateways.

Course Outcomes (CO):

CO1: The students should be able to explain the cloud computing requirements and challenges.

CO2: The students should be able to explain Cloud based IoT platform design methodology.

CO3: The students should be able to explain storage hierarchy for cloud computing.

CO4: The students should be able to explain the role of Data centre cloud computing.

CO5: The students should be able to explain the basic concept of cloud server.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Cloud Computing**	in class	Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management. Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks		1
	**Assignment Topics			
Module 2: **Migrating into a Cloud**	In class	Introduction, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud , IoT platforms design methodology, IoT Physical devices and endpoints. IoT Systems: Logical design using Python, IoT physical servers and cloud offerings (Cloud computing for IoT), Conclusions		2
	**Assignment Topics			
Module 3: **Cloud storage basics**	In class	Storage hierarchy. Hard disk drive (HDD) fundamentals, HDD evolution, storage SLA and RAID architecture, RAID techniques, RAID configurations, storage LUN, LUN capacity expansion, Storage topologies and connections, direct attached storage (DAS), storage area network (SAN), storage protocols.		3

	**Assignment Topics	Applications: Massively Multiplayer Online Game Hosting on Cloud Resources Building Content Delivery Networks Using Clouds.		
Module 4: **Introduction to Data Centre network (DCN)**	in class	Basic understanding of a data center, Data Center Architecture, Data Center Performance, Scalability, Latency and throughput, data center capacity planning, data center space, how to estimate cost of space key network terms and components, network hardware, Hub, Switch, Bridge, Router, Gateway, Data center network topology.		4
	**Assignment Topics			
Module 5: **Cloud infrastructure servers**	in class	CISC, RISC, Rack-mounted, and Blade servers Cloud servers, a client/server architecture, X86 SERVER, Core, multicore, processor, and CPU, N-way servers, Multithreading and processes, Hyperthreading, server pci cards, server storage, server network, server motherboard, Rack-mounted servers and vendors.		5
	**Assignment Topics	Blade servers, rack vs. Blade server, RISC server, CISC vs. RISC, ORACLE/SUN SPARC servers, ORACLE/SUN m-series RISC servers, ORACLE/SUN t-series RISC servers, SPARC logical domain and virtual machine (VM).		

Text Books:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski , "CLOUD COMPUTING Principles and Paradigms" , John Wiley & Sons, Inc, 2011.

Reference Books:

1. Caesar Wu, Rajkumar Buyya , " Cloud Data Centers and Cost Modeling", Elsevier Inc.,2015.

2. Kai Hwang, Min Chen, "Big-Data Analytics for Cloud, IoT and Cognitive Computing", John Wiley & Sons Ltd, 2017.

Electives

Electives for First Year

BC101A3 **Credit: 3 (L: 3, T:0, P: 0)**

BASIC ELECTRONICS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides the student with the fundamental skills to understand the basics of semiconductor and components like diode and Bipolar Junction Transistor. It will give some idea about the usages and role of electronics in our daily lives. Students will learn basics of digital electronics in this course. Students will be introduced with the basics of a communication system.

Pre-requisites: Basics of semiconductor Physics

Course Outcomes (CO):

After studying this course, students will be able to:

CO1 Appreciate the significance of electronics in different areas

CO2 Apply the concept of diodes in rectifiers, voltage regulators and in some other applications

CO3 Understand the operation of a transistor and its biasing techniques

CO4 Compile the different building blocks in digital electronics using logic gates and implement simple logic function using logic gates

CO5 Understand the functioning of a communication system

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Electronics**	In class	Electronics in our daily life, Role of electronics in smart city, Application of electronics in computers, Introduction to special purpose diodes: Photo diode, Tunnel diode, Varactor diode, Light Emitting Diode, Schottky diode	6	1
	Assignment			1
Module 2: **Semiconductor Diodes and Applications**	In class	p-n junction diode, Characteristics and Parameters, Diode approximations, Half-wave rectifier, Full-wave rectifier – Centre tap rectifier, Bridge rectifier, Zener diode as voltage regulator	8	2
	Assignment			2
Module 3: **Introduction to Bipolar Junction Transistor**	In class	Operation of Bipolar Junction Transistors, Regions of operation of Transistor configurations - Common Base, Common Emitter and Common Collector Characteristics, BJT Biasing - Operating point, DC Load line, ac load line, Fixed bias, Base Resistor bias, Collector to Base bias, Voltage divider Bias	8	3

	Assignment			3
Module 4: **Introduction to Digital Electronics**	In class	Analog versus Digital electronics, Binary System for digital electronics, Introduction to basic and composite logic gates, realization of a Boolean expression using logic gates, examples of small digital circuits - adder, comparator etc., Introduction to IC technologies	8	4
	Assignment			4
Module 5: **Basics of Communication System**	In class	Application of electronics in Communication Systems, 1G to 6G, Introduction to IoT, Basics of internet	6	5
	Assignment			5

TEXTBOOKS:

1. Millman and Halkias, Integrated devices & Circuits (2e), PHI, 2017
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices & Circuit Theory (11e), PHI 2012
3. Malvino and Leach, Digital Principles & applications (7e), TMH 2010
4. George Kennedy, Bernad Davis., Electronic Communication Systems, (4e), TMH, 2004
5. Garcia, Widjaja, Communication Networks, McGraw Hill 2006

REFERENCE BOOKS:

1. Electronics Devices and Circuits-II by A. P. Godre& U. A. Bakshi
2. Electronics Devices and Circuit by G. K. Mithal
3. Raj Pandya, Mobile and Personal Communication Services and Systems, Wiley-IEEE Press, 1999

BC102A3 **Credit: 3 (L-3, T-0, P-0)**

COMMUNICATION SYSTEMS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course is designed to teach the analysis and design of analog communication systems. Topics include amplitude modulation, angle modulation and pulse modulation techniques, their generation as well as demodulation. Analysis of random signals and the comparison of receivers based on their noise performances is also included. This course is designed give a brief idea about Digital Communication & its related fundamentals. The course entitles major portions namely Digital Sources, Transmitters, Receivers, Nyquist Sampling theory, Quantization & Companding in PCM, Concept of PSK, FSK, DPSK and Information theory & Coding

Pre-requisites: Fourier series and Fourier Transforms, probability and random process, and Signals and Systems

Course Outcomes (CO):

CO1: Students should be able to explain the basic concepts of amplitude modulation and demodulation techniques.

CO2: Students should be able to analyze continuous angle (frequency and phase) modulation techniques, Evaluate the performance of analog communication systems in presence of noise.

CO3: Students should be able to explain the basic concepts of digital modulation.

CO4: Students should be able to analyze various types of multiplexing.

CO5: Students should be able to analyze various types of digital modulation technique

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Analog Communication & Amplitude Modulation**	in class	Types and reasons for modulation. Transmitters, transmission channels and receivers. Amplitude Modulation (AM) Time & Frequency domain expression, Single tone AM, Demodulation of AM signals-envelope detectors. Double side band suppressed carries (DSB) modulation, Continuous wave linear modulators, Square law modulators, Ring modulators. Generation of SSB using a side band filter, indirect generation of SSB. Vestigial side band modulation (VSB).	8	1
Module 2: **Frequency modulation & Representation of random signals and noise**	in class	Frequency Modulation (FM) and Phase Modulation (PM), Overview of Instantaneous frequency and instantaneous phase, FM and PM, Transmission bandwidth for FM, Carson's rule, narrowband and wide band FM and PM signals. Generation of FM using Armstrong method,	7	

in communication system		Demodulation of FM and PM signals, the limiter discriminator, PLL		
	****Assignment Topics**	Signal to noise ratio for AM & SSB, comparison of DSB, SSB and AM. Signal to noise ratio for FM		2
Module 3: **Introduction to Digital Communication**	in class	Basic block diagram of Digital communication systems, Analog to digital conversion technique: Sampling, Quantizing and Encoding, Nyquist sampling theory, Spectrum of a sampled signal, Aliasing, Effects of aliasing, Reconstruction of sampled signals, Antialiasing filter, Interpolation filter. Waveform coding Techniques Pulse code modulation (PCM), Block diagram, Transmitter and Receiver.	8	3
	****Assignment Topics**	Overview of Wireless Channel: AWGN, Rayleigh, Rician, Optimum detection of a pulse in additive white noise.		3
Module 4: **Quantizer & Multiplexing**	in class	Quantizer, Types of quantizer, Working principle of quantizer, Bandwidth of PCM, Quantization Noise in PCM, Signal to Quantization Noise Ratio, Effect of noise in PCM. Application of PCM. The Differential PCM (DPCM), Adaptive DPCM, delta modulation. Necessity of non-uniform quantizing, Companding, μ-law and A-law. Multiplexing(M) and Multiplexing Access (MA) Techniques: FDM/CDM/SDM and comparison of TDM and TDMA, CDM and CDMA, FDM and FDMA.	7	4
	****Assignment Topics**			4
Module 5: **Digital modulation techniques**	in class	Base band digital data transmission, Types of Line codes: Unipolar and bipolar NRZ and RZ format, Alternate Mark Inversion (AMI) format, Split phase Manchester code format, Polar quaternary NRZ format. Generation and detection of ASK, FSK, PSK, DPSK, QPSK, QAM and MSK; Signal space representation, Bandwidth requirement.	6	5
	****Assignment Topics**	Probability of error calculation of BPSK and QPSK, concept of BER and throughput, Channel coding techniques.		5

Text Books:

1. S. Haykin, An Introduction to Analog and Digital communications,4e, Willey Eastern. New York, 1989.
2. B.P.Lathi, Communication systems, Oxford series, 4e, 2009

Reference Books:

1. C.W. Couch II. “Digital and Analog Communication Systems” 2e, Macmillan publishing company, New York, 1987.
2. Taub ,D.L.Shelling , Principles of Communication Systems, 2e, McGraw Hill Book Co., 2005.
3. Edward A. Lee, David G Messerschmitt, Digital Communication, 2e., Kluwer Academic Press, 2005.
4. Sanjay Sharma, Communication Systems (Analog and Digital), 5e., S.K. Kataria & Sons, 2013.
5. P. Chakrabarty, Analog and Digital Communication Systems, 1e., reprint 2013, Dhanpat Rai & Co.

BC103A3 **Credit: 3 (L-3, T-0, P-0)**

ANALOG ELECTRONICS

Questions to be set: 05 (All Compulsory)

Course Objectives: To enrich the knowledge of the students with a sound understanding of analog electronic circuit, this will help them in the further course of their studies. It exposes the students to various types of analog electronic circuit which will help them to relate this with the other courses which they have in their future semesters, as well as its importance from industrial point of view.

Pre-requisites: Basic idea on Electrical and Electronic Circuits. Engineering Physics.

Course Outcomes (CO):

After successful completion of this course, students will be able to:

CO1: Explain and design different types of feedback amplifiers and Oscillator

CO2: Explain and design different types of power amplifiers

CO3: Explain the working principle of Operational Amplifier and implement the linear and non-linear applications of Operational Amplifier

CO4: Analyze and design different types of filter circuits using OPAMPs

CO5: Explain and design Multivibrators and Special functional circuits

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Feedback Amplifiers & Oscillator**	in class	Basic principles and types of feedback, feedback topology, derivation of expression for gain, effect of negative feedback in gain, stability, distortion and bandwidth of an amplifier, Barkhaushen criterion, Different oscillator circuits: Wien-Bridge, Hartley, and Crystal.	7	1
	****Assignment Topics**	Derivation of expression for frequency of RC Phase Shift and Colpitt Oscillator.		1
Module 2: **Power Amplifiers**	in class	Class A, B, AB, C, Push-Pull Amplifiers, Tuned Amplifiers.	6	2
	****Assignment Topics**	Derivation of Conversion Efficiency of class A, B power amplifier.		2
Module 3: **Operational Amplifiers and its applications**	in class	Characteristics of an ideal operational amplifier and its block diagram, Differential amplifiers and its characteristics-CMRR, Slew-Rate, Offset Voltage and Current, Gain-Bandwidth Product, Open & Closed loop operation, inverting and non-inverting amplifier, voltage follower, Summing amplifier,	11	3

		Differentiator, Integrator, Comparator, Precision rectifiers, Sample and Hold circuits.		
	****Assignment Topics**	Schmitt trigger, Instrumentation amplifier.		3
Module 4: **Active Filters**	in class	Design and analysis of first and second order low pass, high pass, band pass, , Gain-Frequency Curve.	6	4
	****Assignment Topics**	Band reject filters and Notch filters		4
Module 5: **Multivibrators and Special Functional Circuits**	in class	Implementation of Multivibrators using Transistor and 555 Timer, Introduction of VCO and PLL.	6	5
	****Assignment Topics**	A-to-D Converter, D-to-A Converter.		5

Text Books:

1. Robert L. Boylestad, Louis Nashelsky, *Electronic devices and circuit theory*, Pearson Education, 11th Edition, 2013.

2. Jacob Millman, Christos Halkias, Chetan Parikh, *Integrated Electronics*, McGraw Hill Education, 2nd Edition, Paperback, 2009.

3. RamakantGayakwad, *Opamps& Linear Integrated Circuits*, PHI, 4th Edition, 2004.

4. V S KanchanaBhaaskaran , Salivahanan, *Linear Integrated Circuits*, Tata Mcgraw Hill Education Private Limited 2nd Edition, 2008.

Reference Books:

1. Donald Schilling, Charles Belove, *Electronic Circuits: Discrete and Integrated*, McGraw Hill Education (India) Private Limited; 3rd Edition, 2002.

2. S Salivahanan, N. Suresh Kumar, *Electronic Devices and Circuit*, McGraw Hill Education (India) Private Limited; 3rd Edition, 2012.

3. D. Chattopadhyay, P.C. Rakshit, *Foundations of Electronics*, New Age International Publishers Ltd., 2nd Edition, 2015.

4. Choudhury D. Roy, Shail B. Jain, *Linear Integrated Circuits*, New Age International Publishers Ltd., 4th Edition, 2010.

5. David A. Bell, *Electronic Devices and Circuits*, Oxford Publications, 5th Edition, 2008

6. Albert Malvino, David Bates, *Electronic Principles*, McGraw Hill Education (India) Private Limited; 7th Edition, 2006.

BC104A3 **Credit: 3 (L-3, T-0, P-0)**

MICROPROCESSOR AND MICROCONTROLLERS

Questions to be set: 05 (All Compulsory)

Course Objectives: To provide solid foundation on the fundamentals of microprocessors and microcontrollers and their applications, interfacing the external devices to the processor according to the user requirements thus, enabling to create novel products and solutions for real time problems. The students will also be introduced to basic architecture of ARM Processors.

Pre-requisites: Digital Circuits & Logic Design, Basics of PC Hardware and peripherals

Course Outcomes (CO): After completion of this course, students should be able to
CO-1: Learn about the basics of architecture of a microprocessor.

CO-2: Describe the architectures of 8086 microprocessors.

CO-3: Know about the architecture of 8051, its interrupts and interfacing applications.

CO-4: Understand the features of architecture of ARM7 and Applications.

CO5: Interpret the exception, interrupts, and interrupt handling schemes.

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to 8085**	in class	CPU architecture – register organization, 8085 instruction set, addressing modes. Instruction cycle, machine cycle, timing diagrams. Programming using 8085 instruction set Interfacing memory: Interfacing I/O – memory mapped I/O and I/O mapped I/O,	8	1
		**Assignment Topics 8257 – Direct Memory Access Controller (DMAC).		1
Module 2: **Introduction to 8086**	in class	8086 architecture, addressing mode. Instructions and assembly language programming. Interrupts of 8086. Intel 8086 bus cycles, instruction queue, read/write cycle in MIN and MAX mode, reset operation, wait state, halt state, hold state, lock operation, interrupt processing. DOS interrupt 21 h functions	10	2
		**Assignment Topics Introduction to 80286, 80386, 80486 & Pentium Microprocessors		2
Module 3: **Introduction to 8051**	in class	8051 Architecture - Registers, Pin diagram, I/O ports functions, Internal Memory organization. External 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops. Real Time Control: Programming Timer interrupts, programming external hardware interrupts, Programming the serial	6	3

		communication interrupts, Programming 8051 timers and counters.		
Module 4: **ARM Processor Fundamentals**	in class	The RISC design philosophy, ARM design philosophy, ARM core data flow model, ARM Processor Fundamentals, Registers, CPSR-Processor modes, Banked registers. Pipeline- Characteristics Fundamentals of ARM instructions, Barrel shifter, Classification, and explanation of instructions with examples. Explanation of instructions with examples Data processing, Branch, Load-store, SWI and Program Status Register instruction.	6	4
Module 5: **Exception and Interrupt handling schemes**	in class	Exception handling- ARM processor exceptions and modes, vector table, exception priorities, link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQ exceptions with example	6	5
		**Assignment Topics Differences between ARM and THUMB		5

Text Books:

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International, Sixth Edition, 2013.
2. Douglas V. Hall, "Microprocessor & interfacing programming and hardware", Tata McGraw Hill. 2nd Edition,1992
3. ARM System Developer's guide –Andrew N. SLOSS, ELSEVIER Publications, ISBN 978-81-8147-646-3, 2016
4. ARM Assembly Language – William Hohl, CRC Press, ISBN:978-81-89643-04-1

Reference Books:

1. B. Ram, Fundamentals of Microprocessors and Microcontrollers, Seventh Edition, Dhanpat Rai Publications, 2010.
2. Bary B. Brey, "The Intel Microprocessors: 8086/8088, 80286, 80386, 80486", Prentice Hall,2nd Edition ,1996.
3. ARM System-on-chip Architecture by Steve Furber, Pearson Education, ISBN978-81-317-0840-8, 2E,2012
4. LPC 2148 USER MANUAL IN SIDE R'S GUIDE TO PHILIPS ARM7 BASED MICROCONTROLLER Shitex.co.uk .
5. ARM Programming Techniques – from ARM website.
6. Embedded Systems: A Contemporary Design Tool- James K. Peckol ISBN: 978-0-471-72180-2 October 2007, ©2008.

Electives for Second Year

BC201A3 **Credit: 3 (L-3, T-0, P-0)**

R PROGRAMMING

Questions to be set: 05 (All Compulsory)

Course Objectives: The main objective of the course is to ensure students are able to write and execute programs in R.

Scope: The course covers basic R programming concepts like data structures, data manipulation and analysis and data visualization using R.

Pre-requisites: Basic Programming Concept

Course Outcomes (CO):

1. The student should be able to understand the importance of R and the process of installation and use of the R platform.
2. The student should be able to understand the basics of R programming like data structures in R and their manipulation.
3. The student should be able to write programs to manipulate data in R.
4. The students should be able to develop their own functions in R.
5. The student should have a clear understanding of various loops and data visualization techniques in R.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to R**	in class	Introduction to R , Installing R , R environment, How to get help in R ,R console and Editor	5	1
	****Assignment Topics**			1
Module 2: **Understanding R Data Structure**	in class	Understanding R data structure, Variables in R, Scalars, Vectors, Matrices, List, Data frames, Using c, Cbind, Rbind, attach and detach functions in R , Factors	7	2
	****Assignment Topics**			2
Module 3: **Importing Data**	in class	Importing data, Reading Tabular Data files, Reading CSV files, importing data from excel, importing data from SAS, Accessing database, Saving in R data, Loading R data objects, Writing to file.	6	3
	****Assignment Topics**			3
Module 4: **Manipulating Data and**	in class	Selecting rows/observations, Selecting columns/fields, Merging data, Relabeling the column names, Converting variable types, Data	9	4

Using Functions in R		sorting, Data aggregation Using functions in R, Commonly used Mathematical Functions, Commonly used Summary Functions, Commonly used String Functions, User-defined functions, local and global variable		
	****Assignment Topics**			4
Module 5: **Loops and Plots**	in class	R Programming, While loop, If loop, For loop, Arithmetic operations Charts and Plots, Box plot, Histogram, Pareto charts, Pie graph, Line chart, Scatterplot, Developing graph	9	5
	****Assignment Topics**			5

Text Books :

1. Hands-On Programming with R: Write Your Own Functions and Simulations by By Garrett Grolemund, O 'Reily publishers.
2. 2. R Packages: Organize, Test, Document, and Share Your Code,by Book by Hadley Wickham, O 'Reily publishers

Reference Books:

1. R PROGRAMMING FOR BEGINNERS, by Sandip Rakshit, publisher Mc Graw Hill.
2. Beginning R: The Statistical Programming Language 1 Edition (English, Paperback, Dr. MarkGardener.

BC202A3 **Credit: 3 (L-3, T-0, P-0)**

PROJECT MANAGEMENT

Questions to be set: 05 (All Compulsory)

Course Objectives: This subject will help the students in understanding various working, process, legal requirement, financial requirement, operational requirement, difficulties faced during staring of a Project.

Pre-requisites: Basic Understanding of Operations Management.

Course Outcomes (CO):

CO1: Understanding various working processes of a project.
CO2: Recognize the legal requirement of any project.
CO3: Identify different aspects of project feasibility.
CO4: Plan and implement any project.
CO5: Analyse the risk factors of any project and take the corrective measures.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction And Project Lifecycle**	in class	Nature, Scope, Process Elements, Significance and Emergence of Projects, Benefits of Project Management, Initiation, planning, execution, & termination.	8	1
	**Assignment Topics			1
Module 2: **Project Planning And Location Of Project Site**	in class	Project plan elements, developing action plans, Developing Project Models through Simulation, Working Conditions Development, Plans and Policies of the Government and the Local Bodies, Elements and Factors Affection Locational Decisions	8	2
	**Assignment Topics	Labour, Raw Material, Transport and Other Factors.		2
Module 3: **Budget And Analysis**	in class	Capital Expenditure, Importance and Difficulties, Market Demand and Situational Analysis, Technical Analysis, Financial Analysis.	10	3
	**Assignment Topics	Social cost benefit analysis.		3
Module 4: **Project Implementation**	in class	Project Monitoring, and Control System, Network Analysis Resource Scheduling Levelling.	8	4

And Management, Network Analysis	**Assignment Topics	Crashing of Project Cost.		4
Module 5: **Risk And Appraisal**	in class	Risk-Firm Risk and Market Risk, Multiple Projects and Constraints, Different Criteria for Project Appraisal, Project review and Administrative Aspects.	6	5
	**Assignment Topics	Environmental Appraisal of Projects.		5

Text Books:

Prasana Chandra - Project Management.

Reference Books:

1. Bhavesh M Patel - Project Management
2. S S Khanka - Entrepreneurship Development
3. PCK Rao - Project Management and Control

BC203A3 **Credit: 3 (L-3, T-0, P-0)**

E-COMMERCE

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides the basic understanding of Electronic Commerce, Business models, use of electronic media for e-commerce, electronic payment system, understanding of legal issues of e-business, e-commerce infrastructures. At the end of the course, students will be able to explain business technologies, standards and processes involved in implementing e-commerce, learn the usage of information technology in business and to develop simple e-commerce applications.

Pre-requisites: Basic Knowledge of Internet

Module	Topics	Hrs	CO
Module 1: **Introduction to E-Commerce**	Definition of E-commerce, M-Commerce, The Scope of E-Commerce and M-Commerce, E- Commerce trade cycle, Features of E-Commerce, E-Commerce Applications, Benefits and Limitations, Traditional commerce vs. E-Commerce, Electronic Data Interchange (EDI), Types of E-Commerce.	6	1
Module 2: **E-Commerce Business Models**	Elements of Business Models- B2B, B2C, C2C, P2P, M-Commerce business models.	8	2
Module 3: **E-Commerce Infrastructure-Intranet and Extranet**	Categories of network, Internet service provider, virtual private network, Intranet, Extranet, Architecture, Intranet and Extranet Software, Applications of Intranets and Extranets, Web-Based client/ Server system.	7	3
Module 4: **Electronic Payment Systems**	Introduction, Types of payments, Types of Electronic payment system, Concept of UPI, Value exchange system, Credit card system, Electronic funds transfer, Electronic cash.	7	4
Module 5: **E-Commerce Security**	E-Commerce security environment, Type and sources of threats in E-Commerce, Protecting the electronic commerce assets and intellectual property, Firewalls, antivirus, client server protection, Data and message security, digital identification and electronic signature, encryption approach to e commerce security, Security Schemes in Electronic Payment Systems, Secure Electronic Transaction (SET), Secure Socket Layer (SSL).	8	5

Text Books:

1. Kenneth C. Laudon, Carol Guercio Traver, E-Commerce-Business, Technology, Society, Pearson Education.
2. David Whitely, E-Commerce, Tata McGraw Hill.

3. E. Turban, J. Lee, D. King, K. Michale Chung, Electronic Commerce, Pearson Education.

Reference Books:

1. Rayport, Introduction to E-Commerce, Tata McGraw Hill.
2. Greenstein, Electronic Commerce, Tata McGraw Hill.
3. Chan Henry, E-commerce Fundamentals and Applications, WILEY.
4. Minoli Daniel, Minoli Emma, Web Commerce Technology Handbook, Tata McGraw Hill.

BC204A3 **Credit: 3 (L-3, T-0, P-0)**

PRINCIPLES OF PROGRAMMING LANGUAGE

Objectives: This course covers the issues and principles of programming languages design. The topics such as design and translation issues related to programming language, elementary data types, sequence control and program control designing are covered. By the end of the course, the student will be able to visualize the problems for decomposing into various modules for clarity and efficiency using various programming paradigm.

Pre-requisites: Programming Language concepts.

UNIT-I

Language Design Issues [7 Hrs.]

History of Programming Languages, Impact of Programming Paradigm, Role of Programming Languages.

Language Translation Issues [6 Hrs.]

Programming Language Syntax, Stages in Translation.

Elementary Data Types [7 Hrs.]

Properties and Types of Objects, Scalar Data Types, Composite Data Types

UNIT-II

Sequence Control [7 Hrs.]

Implicit and Explicit Sequence Control, Sequence with Arithmetic Expression, and Sequence, Control between Statements.

Subprogram Control [7 Hrs.]

Subprogram Sequence Control – Simple and Recursive, Attributes of Data Control (Names, Reference, Scope), Parameter Transmission.

Case Studies [6 Hrs.]

Advanced Programming Languages C, C++, ADA.

Text Books:

1. T W Pratt, M V Zelkowitz, T V Gopal, Programming Languages Design and Implementation, Pearson.
2. Seyed H Roosta, Foundation of Programming Languages – Design and Implementation, Cengage Learning.

Reference Books:

1. Ravi Sethi, Programming Languages – Concepts and Constructs, Pearson Education.
2. Allen B. Tucker, Programming Language, McGraw Hill.
3. Cairo Gnezzi, Mehd Jazayen, Programming Language Concepts, John Willey and Sons. Robert W. Sebesta, Concepts of Programming Languages, Benjamin Cummings Publications.

BC205A3 **Credit: 3 (L-3, T-0, P-0)**

SENSORS AND ACTUATORS FOR IoT

Questions to be set: 05 (All Compulsory)

Course Objectives: To make students familiar with the constructions and working principle of different types of sensors and transducers. To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.

Pre-requisites: Basic Electronics.

Course Outcomes (CO):

CO1: The students should be able to identify the components required for IoT system.

CO2: The students should be able to solve problems of amplifiers and converters.

CO3: The students should be able to explain the working of different sensors used in IoT.

CO4: The students should be able to explain the working of different actuators used in IoT.

CO5: The students should be able to integrate sensors and actuators in a single system.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Hardware used for IoT**	in class	Introduction to IOT, Microcontrollers, Microprocessors, SoC. Applications of IOT, Reference Architecture of IOT, IOT Functional Blocks, Need of Sensors in IOT, Selection Parameters of Sensors and Actuator for IOT, Introduction to Arduino, Pi, Spark, Intel Galileo.	8	1
	**Assignment Topics			1
Module 2: **Sensor Signal Conditioning And Interfacing**	in class	Amplifier, Driver Circuit, V-I converter, R-V converter, etc.	6	2
	**Assignment Topics	Numerical problems.		2
Module 3: **Sensor for IoT**	in class	Different type of Sensors used in IOT- PIR Motion Sensor, Rain Drop Sensor, Moisture Sensor, Temperature Sensor, Touch Sensor, Infrared Sensor, Camera Sensor, RFID System, Bluetooth Module and Wi-Fi Module.	8	3
	**Assignment Topics	Use cases		3
Module 4: **Actuators for**	in class	Introduction, Actuator Definition, Classification of Actuators, Need for Actuators	8	4

IoT		in IOT enabled system; Working Principle and Applications in IOT – Pneumatic actuators, Hydraulic actuators, Electric actuators, Thermal actuators and Mechanical actuators		
	**Assignment Topics	Use cases		4
Module 5: **Interfacing of sensors and actuators**				
	in class	Introduction to interfacing real-world sensors and actuators to embedded computing systems, real-time operation and user interaction, such as digital input/outputs, interrupt service routines and serial communications.	6	5
	**Assignment Topics	Examples of integrated systems of sensors and actuators.		5

Text Books:

1. Kamal Kishore Jha "Getting Started with IoT: A Hands-on Approach ", Evincepub Publishing, 1/e , 2019

2. Al-Turjman Fadi, "Multimedia-enabled Sensors in IoT: Data Delivery and Traffic Modelling", CRC Press Inc., 1/e, 2018

Reference Books:

1. Rayes A., Salam S. (2017) "The Things in IoT: Sensors and Actuators. In: Internet of Things From Hype to Reality", Springer.

Electives for Third Year

BC301A3 **Credit: 3 (L-3, T-0, P-0)**

WIRELESS SENSOR NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objectives:

1. To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
2. To study the various protocols at various layers and its differences with traditional protocols.
3. To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.
4. To be able to understand the routing procedures in a wireless environment.
5. To understand the various QoS parameters of Wireless Sensor Networks

Pre-requisites: Basic Computer Networks

Module	Topics	Hrs	CO
Module 1: **Introduction**	Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.	8	1
Module 2: **Introduction to adhoc/sensor networks:**	Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.	8	2
Module 3: **MAC Protocols**	Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.	8	3
Module 4: **Routing Protocols**	Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.	6	4
Module 5: **QoS and Energy Management**	Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.	6	5

Text Books:

C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.

Reference Books:

1. Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004.
2. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.

3. William Stallings, "Wireless Communications and Networks ", Pearson Education – 2004

BC302A3 **Credit: 3 (L-3, T-0, P-0)**

DATA SCIENCE

Questions to be set: 05 (All Compulsory)

Course Objectives: The main objective of the course is to provide insight into the concepts of data science and understand the various tasks a data scientist is expected to perform.

Scope: The course includes study and understanding of Data Science and various methods used for data analysis and visualization

Pre-requisites: Linear Algebra and Statistics

Course Outcomes (CO): The students should be able to

1. Understand the basic concepts of Data Science Process and the role of Data Scientists
2. Understand and carry out data cleaning.
3. Perform data analysis using various machine learning models and write basic Python programs to manipulate and process data.
4. Understand text mining techniques.
5. Understand various data visualization techniques.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Data Science**	in class	Benefits and Applications of DS, Reason for popularity of DS, Types of Data, Skills needed by a data scientist, Comparison between Business Analyst and Data Scientist, Data Science Life cycle	6	1
	****Assignment Topics**			1
Module 2: **The Data Science Process**	in class	Defining objectives, Retrieving Data, Cleansing, Integrating & Transforming Data, Exploratory Data Analysis, Model Building	7	2
	****Assignment Topics**			2
Module 3: **Machine Learning**	in class	Applications of ML, Modelling Process, Types of ML, Python tools used in ML, Case Study	8	3
	****Assignment Topics**			3
Module 4: **Text Mining**	in class	Text Mining Techniques-Bag of Words, Stemming, Lemmatization	8	4
	****Assignment Topics**			4
Module 5:	in class	Data Visualization options, Interactive Dashboards, Introduction to Google Charts, Tableau	7	5

Data Visualization	****Assignment Topics**			5

Text Books:

1. Davy Cielen, Arno DB Meysman , Mohamed Ali, *Introduction to Data Science* by Dreamtech Press, Edition 2016
2. Rachel Schutt and Cathy O'Neil, *Doing Data Science,* 1/e, O'Reilly Media, 2013

Reference Books:

1. Gilbert Strang , *Introduction to Linear Algebra,* 5/e, Wellesley-Cambridge Press and SIAM, 2016
2. Douglas Montgomery, *Applied Statistics and Probability for Engineers,* 3/e, John Wiley & Sons, Inc., 2003

BC303A3 **Credit: 3 (L-3, T-0, P-0)**

SOFT COMPUTING TECHNIQUES

Questions to be set: 05 (All Compulsory)

Course Objectives: The main objective of the course is to expose the students to various types of soft computing techniques, and applications of soft computing. Upon completion of this course, the student should be able to get an idea on different methods of soft computation which mainly includes Artificial Neural Networks, Fuzzy Logic, genetic Algorithm and their applications.

Prerequisites: Proficiency with algorithm and Computation

Course Outcomes (CO):

After studying this course, students will be able to:

1. Comprehend soft computing techniques and Pattern recognition methods.

2. Apply the knowledge of artificial neural networks in various engineering problem.

3. Develop the fuzzy logic sets and membership function.

4. Apply Fuzzy inference and de-fuzzification techniques to solve the uncertain problems.

5. Analyze the single-objective optimization problems using GAs.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
1. **Introduction to Soft Computing and Pattern recognition**	In class	Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing. Introduction to Pattern Recognition, Feature Extraction, Feature selection, Classification Techniques.	7	1
	**** Assignment topics**	Some applications of Soft computing techniques. Introduction to Principal component Analysis (PCA)		
2. **Artificial Neural Network**	In Class	Biological Model of a neuron, Neural network as a directed graph, Network Architectures, Knowledge representations, Learning Processes/Principles, Supervised Algorithms, Feed forward Neural Network, Linear Separability, Back-propagation Algorithm, Unsupervised Learning based Networks, Radial Basis Function Networks	8	2
	**** Assignment topics**	Applications of ANN.		
3. **Fuzzy logic**	In Class	Classical Sets and Fuzzy Sets and Fuzzy relations: Operations on Classical sets, properties	7	3

		of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality,		
	**** Assignment topics**	Applications of Fuzzy Logic		
4. **Fuzzy Inference System**	In Class	Rules and operations, different fuzzification methods, Defuzzification methods	7	4
5. **Genetic Algorithms**	In Class	Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA). Applications of Genetic Algorithm:	7	5
	**** Assignment topics**	Applications of GA.		

Text Books:

1. Simon Haykin, Neural Networks: A Comprehensive Foundation, 2nd Ed. PHI, India, 2007
2. M. Hagan, H. Demuth and Mark Beale,Neural Network Design, Cengage Learning, India Edition, 2008.
3. S. Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI,2003
4. Samir Roy, Udit Chakraborty, Introduction to Soft Computing Neuro Fuzzy and Genetic Algorithms, Pearson 2013

Reference Books:

1. F. Martin, Mc neill, and Ellen Thro, AP Professional, Fuzzy Logic: A Practical approach, 2000.
2. David E. Goldberg, Pearson Genetic Algorithms in Search, Optimization and Machine Learning,Education, 2002
3. S.N Sivanandam, S. Sumathi, Principles of Soft Computing, John Wiley &Sons, 2007
4. Rajjan Singhal, Pattern Recognition Techniques and Applications, Oxford Higher Education, 2009

BC304A3 **Credit: 3 (L-3, T-0, P-0)**

DISCRETE STRUCTURE

Objective: This course emphasizes mathematical structures for describing data, algorithms, and computing machines. Theory and applications of sets, relations, functions, combinatorics, matrices, graphs, and algebraic structures, which are pertinent to computer science, are also covered.

Pre-requisites: Data Structures and Concepts of algorithms. Some programming experience is helpful but not necessary.

Learning outcomes: Having successfully completed the module, students will be able to

1. Understand the notion of mathematical and algorithmic thinking and apply them for problem solving.
2. Understand and use the basics of discrete probability and number theory for problem solving.
3. Use effectively algebraic techniques to analyse basic discrete structures and algorithms.
4. Understand and relate the graphs and related discrete structures to practical examples.
5. Apply the concepts of sets, integers, reals, and functions of such quantities to solve simple problems.

UNIT-I

Sets [2 Hrs]
Definition, Operations, Counting, Comparing the size of sets, Countable sets, Diagonalization, Limits of computability, Bags (multisets).

Ordered structures [3 Hrs]
Tuples, Lists, Strings and languages, Relations.

Inductively defined sets [5 Hrs]
Numbers, Strings, Lists, Binary trees, Cartesian products of sets.

Recursive functions and procedures [6 Hrs]
Numbers, Strings, Lists, Binary trees, Infinite sequences, Recursion in programs, Repetitive program design.

Propositional calculus [4 Hrs]
Well-formed formulas and semantics, Equivalence, Truth functions and normal forms.

UNIT-II

Predicate logic [5 Hrs]
Predicates, Qualifiers, Well-formed formulas, Semantics and interpretations, Validity, Equivalence, Normal Forms, Formalizing English sentences.

Program logic [5 Hrs]
Equality, Imperative program correctness, Array assignment, Termination.

Automatic reasoning [5 Hrs]
Clauses, Propositions, Substitution and unification, Resolution, Logic programming: Family trees,

Logic program, Logic programming techniques.

Algebraic structures and abstract data types [5 Hrs]
Natural numbers, Lists and strings, Stacks and queues, Binary trees and Priority queues, Abstract arrays, Container classes.

Text Books:

1. James L. Hein, "Discrete Structures, Logic and Computability", Narosa.
2. J.P. Tremblay, R.Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill.

Reference Books:

1. Leon S. Levy, "Eastern, Discrete Structures of Computer Science", Wiley
2. C.L.Liu, "Elements of Discrete Mathematics", McGraw-Hill.
3. Bruce Mills, "Theoretical Introduction to Programming" , Springer.
4. Fletcher R. Norris, "Discrete structures: An introduction to mathematics for computer science" Prentice Hall.

BC305A3 **Credit: 3 (L-3, T-0, P-0)**

NUMERICAL ANALYSIS

Chapter 1 Errors, different type of errors. Representation of numbers in computer, computer arithmetic, zero in floating point number. Chapter 2 Operators –finite differences, average, differential, etc., their inter-relations. Difference of polynomials. Difference equation. Interpolation. Lagrange's methods, error terms. Uniqueness of interpolating polynomial. Newton's fundamental interpolation. Forward, backward and central difference interpolations. Interpolation by iteration. Spline interpolation, comparison with Newton's interpolation. Hermite's interpolation. Bivariate interpolation, Lagrange and Newton's methods. Inverse interpolation.

Chapter 3 Approximation of function. Least square method. Use of orthogonal polynomials. Approximation by Chebyshev polynomials, Max-min principle. Economization of power series.

Chapter 4 Solution of non-linear equation containing one variable. Newton's methods. Modified Newton-Raphson method. Birge-Vieta method, Bairstow method. System of non-linear equations-iteration and Newton Raphson methods.

Chapter 5 System of linear equations. Iteration methods, rate of convergence. Matrix factorization methods. Tridiagonal equations. Least square method for inconsistent system. Ill conditioned systems. Relaxation method.

Chapter 6 Eigenvalues and eigenvectors of matrix. Leverrier-Faddeev method. Power method. Jacobi's method, Givens method, Householder's method. Comparisons.

Chapter 7 Differentiation. Lagrange's method. Gauss-quadrature. Degree of precision. Gauss-Legendre and Gauss-Chebyshev methods. Double integration. Monte-Carlo method.

Chapter 8 Ordinary differential equation. Euler's method. Runge-Kutta methods. Predictor-corrector method. Finite-difference method. IVP and BVP. Shooting method. Stability analysis.

Chapter 9 Partial differential equation. Finite-difference approximation. Explicit methods. Crank-Nivolson method. Parabolic, hyperbolic and elliptic equation. Stability.

BC306A3 **Credit: 3 (L-3, T-0, P-0)**

INDUSTRIAL MANAGEMENT

Questions to be set: 05 (All Compulsory)

Course Objective: The objective of this course is to acquaint the student with developing deeper understanding of the concept of management by understanding its evolution. It also introduces the functions of general management in detail as well as the quantitative techniques useful to make objective decisions. It also acquaints the students with techniques useful for production planning and control as also materials management.

Pre-requisites: Basic knowledge of statistics.

Course Outcomes (CO): On Successful Completion of the course, students will be able to

CO1 Understand theories of management and their practical applications in solving business/ industrial problems.

CO2 Describe the available resources to achieve the desired goal in a more efficient and effective way.

CO3 Apply the production technique in solving the issues related with proper management of material and inventory management.

CO4 Apply the operation techniques in solving the issues related with proper management of material and inventory management

CO5 Apply statistical methods to solve various business-related issues.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1 **Introduction to Management and Pioneers in Management**	in class	Philosophy and Development of Management thought. Concept and definition of management, Functions and Roles of Management, Social Responsibilities of Management, Taylor's Scientific Management, Contribution of Henry Fayol, Gilberth and Mayo.	7	1
Module 2 **Schools of Management Thought and Planning**	in class	Human Behaviour, Social System, Systems approach, management process school, Planning Nature and purpose of planning objectives, Different types of Plans, steps in planning, schedule planning, product planning, Strategic Planning, Long, medium and short term planning, decision making, project planning, management by objectives.	7	2

Module 3 **Organizing and Staffing**	in class	Principles of organizing, steps in organizing, organizational structure, levels and span of management, span of control, formal and informal organization, line and staff functions, responsibility and accountability, delegation of authority, Manpower planning and recruitment, selection process, training and development, performance appraisals.	7	3
Module 4 **Leading and Controlling**	in class	Models and styles of leadership, managerial grid, motivation, interpersonal relations, personality, and communication process, types, barriers, effective communication, Concept, nature and purpose, process, methods and practice of control, role of internal audit.	7	4
Module 5 **Quantitative Techniques in Managerial Decisions: Production Management, Materials Management and Inventory Management**	in class	Concept of budget and budgetary control. Time event network analysis; Decision Tables; Concept of productivity, measuring productivity, Types of production; Types of Planning, Manufacturing Planning; Production planning, Scheduling; Work study & Method study, Practice of purchasing and materials management, quality, Inventory Management, EOQ model; Value Analysis and Value Engineering,	8	5

Text Books:

H. Koontz and H. Weihrich, "Management", McGraw Hill, 1989.

Reference Books:

Dobler W.D. "Purchasing & Materials Management", TMHC, New Delhi, 1984.

BC307A3 **Credit: 3 (L-3, T-0, P-0)**

PHP TECHNOLOGY

Objectives: This course provides a comprehensive knowledge of web development using PHP. It covers basic programming concepts and logic controls and advanced topics in PHP such as File handling, developing web services and application using PHP. At the end of this course the students are expected to be able to develop PHP-based web applications.

Pre-requisites: Database management systems, Computer network and Object Oriented programming concepts.

UNIT I

PHP Basics [4 Hrs.]

Introduction to PHP, PHP Variable, Static & Global Variable, GET & POST Method, PHP Operator, Conditional Structure & Looping, Structure, Array.

User Define Function [4 Hrs.]

Function Argument, Default Argument, Variable Function, Return Function, Variable Length Argument, Function- FUNC_NUM_ARGS, FUNC_GET_ARG, FUNC_GET_ARGS, GETTYPE, SETTYPE, ISSET, UNSET, STRVAL, FLOATVAL, INTVAL, PRINT_R,

String Function [4 Hrs.]

CHR, ORD, STRTOLOWER, STRTOUPPER, STRLEN, LTRIM, RTRIM TRIM, SUBSTR, STRCMP, STRCASECMP, STROPS, STRRPOS, STRSTR, STRISTR, STR_REPLACE, STRREV, ECHO, PRINT.

Math Function [4 Hrs.]

ABS, CEIL, FLOOR, ROUND, FMOD, MIN, MAX, POW, SQRT, RAND), DATE FUNCTION (DATE, GETDATE, SETDATE, CHECKDATE, TIME, MKTIME.

Array Function [4 Hrs.]

COUNT, LIST, IN_ARRAY, CURRENT, NEXT, PREVIOUS, END, EACH, SORT, RSORT, ASSORT, ARSORT, ARRAY_MERGE, ARRAY_REVERSE.

UNIT-II

File Handling Function [4 Hrs.]

FOPEN, FREAD, FWRITE, FCLOSE, FILE_EXISTS, IS_READABLE, IS_WRITABLE, FGETS, FGETC, FILE, FILE_GET_CONTENTS, FILE_PUTCONTENTS, FTELL, FSEEK, REWIND, COPY, UNLINK, RENAME, MOVE_UPLOAD_FILE

PHP Components [4 Hrs.]

PHP GD Library, PHP Regular Expression, Function, Cookies, Session, Server variable, Database Connectivity with MySQL (Using PhpMyAdmin).

Advance PHP [5 Hrs.]

PHP with OOPS, Class, Constructor, Inheritance, Serialize Objects, PHP with XML, XML Overview, Simple XML Functions, PHP with AJAX, AJAX Overview, XMLHttpRreqeust

Style Sheet [7 Hrs.]

Introduction of Style Sheet, Types of Style Sheet – Class & ID, CSS Font Property, CSS Text Property, CSS Background Property, CSS Border Property, CSS List Property, CSS Padding Property, CSS Margin Property.

Text Books:

1. Steven Holzner, PHP: The Complete Reference, Tata McGraw Hill.
2. Atkinson, Core PHP Programming, Pearson India.

Reference Books:

1. Steve Suehring, PHP6 and MYSQL Bible, Wiley.
2. Ivan Bayross, S. Shah, Applications Development with Oracle & PHP on Linux for Beginners, O'Reilly.
3. N. Elizabeth, J. Gerner, Y. Scouarnec, Beginning PHP5 Apache My SQL Web Development, Wiley Thomas, Professional PHP, Shroff Publication.

BC308A3 **Credit: 3 (L-3, T-0, P-0)**

DIGITAL MARKERTING

Questions to be set: 05 (All Compulsory)

Course Outcomes (CO):

CO-1: To understand fundamentals of Digital Marketing.

CO-2: To understand the knowledge on Search Engine Optimization.

CO-3: To understand concepts of search engine and social media marketing.

CO-4: To be able to understand the concepts of content marketing and web analytics.

CO-5: To understand the various concepts of digital media planning and buying.

Pre-requisites: Basic Knowledge of Internet architecture

Module	Topics	Hrs	CO
Module 1: **Introduction to Digital Marketing**	Introduction to digital marketing, Importance of digital marketing. Difference between traditional and digital marketing. Discuss the recent trends and current scenario of the industry. Digital marketing as a tool of success for companies, Use of digital marketing in sales, Competitive analysis, Case studies on digital marketing strategies.	8	1
Module 2: **Website Planning & Creation and Search Engine Optimization (SEO)**	Understanding the functionality of WordPress, Development of Website, Components of Website, Adding Contents, Install and Activate plugins. The functionality of different plugins. Introduction to Search Engine Optimization. On-page SEO – concepts like content research, keyword research, meta tags. Off-page SEO – link building. Keyword Research. Factors affecting the rank of a webpage.	8	2
Module 3: **Search Engine Marketing and Social Media Marketing**	Features of the Google Ads platform and its algorithm. Creating campaigns. Search volume. Google Adwords. Ad Creation. Site & Keyword Targeting. CPC, CPA & CPM-based Accounts. Demographic Targeting. Google Keyword Planner. Concepts of CPM, CLV and other such metrics. Understanding how SMM works & how businesses leverage social platforms. Targeting Demographics through social media. Metrics like cost-per-click (CPC), cost-per-view (CPV), cost-per-impression (CPM), and more. Social Media Analytics. Social Media Advertising.	8	3
Module 4: **Content Marketing & Strategy and Web Analytics**	Content bucketing. Creating a social media content calendar for a brand. Content marketing tools. Guest Blogging. Google Analytics. Concepts of bounce rate, page view, session time. Optimal use of Google Analytics, Behavior, and acquisition reports.	6	4

Module 5: **Digital Media Planning and Buying**	Concept of Media buying and its types. Concepts of cost-per-install (CPI), cost-per-order (CPO), cost-per-acquisition (CPA), click-through-rate (CTR), etc.	6	5

Text Books:

1. "Digital Marketing for Dummies" by Ryan Deiss and Russ Henneberry.
2. "Operations Management" by William Stevenson.

Reference Books:

1. "Production and Operations Management" by Pannerselvam R.
2. Operations Management (McGraw-Hill Series in Operations and Decision Sciences) 12th Edition by William J Stevenson.

BC309A3 **Credit: 3 (L-3, T-0, P-0)**

JAVA PROGRAMMING

Course Objectives: The Java Programming Language course provides students with a solid foundation for programming with JAVA. It also highlights the creation of Graphical User Interfaces (GUIs), exceptions, file input/output (I/O), and threads and network programming.

Pre-requisites: Object Oriented Programming.

Course Outcomes (CO):

1. Use the syntax and semantics of java programming language and basic concepts of OOP.
2. Develop reusable programs using the concepts of inheritance, polymorphism and interfaces.
3. Transfer reusable programs using the concepts Strings handling, Interfaces and Packages.
4. Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.
5. Design event driven GUI and web related applications which mimic the real word scenarios.

Module	Topic	Hrs	CO
1 **Introduction to Java**	Evolution and features of java, Overview of java, Two control statements, Lexical issues, Data types, Variables and arrays, Literals, Variables, Type conversion and casting, Type promotion in expression, arrays, Operators, Bitwise operators, Relational operators, Boolean and logical operators, Assignment Operators, The '?' operator, Operator precedence, JAVA statements.	7	1
2 **Introducing classes and Methods**	Class fundamentals, Declaring objects, Assigning object reference Variables, Introducing methods, Constructors, 'this' keyword, Garbage collection, The finalize() method, stack class. Overloading methods and constructors, using object as parameters, Argument passing, Returning objects, Recursion, Access control, Static methods, Nested and inner classes, Command line argument.	7	2
3 **Strings handling, Interfaces and Packages**	String constructors, String length, Special string operators, Character extraction, String comparison, String searching, String modification, Changing case of characters within a string, Compression and String buffer, String builder. Inheritance, Basics of inheritance, Types of inheritance, Using super keyword, method overriding, Dynamic method dispatch, Abstract class, Using final with inheritance, The object class, Defining and implementing interface, Extending interfaces, Nested interfaces, Applying interfaces, Defining and creating packages, Access protection, Importing packages. Exception Handling, Fundamentals, Exception types, Uncaught exceptions, Using try and catch, Multiple catch clauses, Nested try statements, Throws, Finally, Java's built in exceptions, Creating own exception classes.	7	3

4 **Input/Output, file handling and Multithreaded programming**	Java I/O classes and interfaces, The stream classes, Byte streams, The character streams, The console class, File class, Byte-stream class, Random access files. Thread basics, Java's thread model, Thread priorities, Synchronization, Messaging, Thread class and runnable interface. The main thread, Creating a thread, Creating multiple threads, Interthread communication, Suspending/resuming and stopping threads.	7	4
5 **Network programming and Event Based Programming**	Networking basics, The networking classes and interfaces, The Inet Address class, Inet4Address, TCP socket, URL, URL Connection, HTTP/URL Connection, TCP/IP server sockets, Datagram socket and Datagram Packet. The applet class, Repaint(), The HTML applet tag, Passing Parameter to applet, Event handling, Using delegation event model, Abstract Window program, Displaying information within a window, AWT controls.	7	5

Text Books:

1. Programming With JAVA, 2nd Edition, E. Balaguruswami and TMH Publication.
2. Java: The Complete Reference, 7th Edition, Herbert Scheldt, TMH Publication.

Reference Books:

1. The Java Programming Language: K.Arnold and J. Gosling.
2. Professional java Server Programming: Allamaraju.
3. JAVA2: The Complete Reference, 3rd Edition, Patrick Naughton and Harbert Schildt, TMH Publication

BC310A3 **Credit: 3 (L-3, T-0, P-0)**

ARTIFICIAL NEURAL NETWORK

Course Outcomes (CO): At the end of the course, students should be able to:

CO-1: Describe the basics of ANN and comparison with Human brain.
CO-2: Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling.
CO-3: Understand the concepts and techniques of neural networks through the study of the most important neural network models.
CO-4: Evaluate whether neural networks are appropriate to a particular application.
CO-5: Apply neural networks to particular application, and to know what steps to take to improve performance.

Introduction:

Biological Neuron- Artificial Neural Model-Types of activation functions-

Architecture:

Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks.

Learning:

Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.

Supervised Learning:

Perceptron learning and Non Separable sets, a-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, μ-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Backpropagation Learning Algorithm, Practical consideration of BP algorithm.

Support Vector Machines and Radial Basis Function:

Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis FWJ.ction Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

Attractor Neural Networks:

Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in aBox neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

Self -organization Feature Map:

Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self -organization Feature Maps, Application of SOM, Growing Neural Gas.

TextBook:

Neural Networks A Classroom Approach -Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.

Reference Books:

1. Introduction to Artificial Neural Systems - J.M. Zurada, Jaico Publications 1994.

2 Artificial Neural Networks- B. Yegnanarayana, Pill, New Delhi 1998.

BC311A3 **Credit: 3 (L-3, T-0, P-0)**

COMPILER DESIGN

Objectives: The course is aimed at offering complete knowledge on compiler design and ends with the development of a working compiler in parts. Topics include compiler structure, symbol tables, regular expressions and languages, finite automata, lexical analysis, context-free languages, LL(1), recursive descent, LALR(1), and LR(1) parsing semantic analysis, and code generation. This will enable the learners to use formal attributed grammars for specifying the syntax and semantics of programming languages and their impact on compiler design.

Pre-requisites: Discrete Structures for Computer Science, Formal Language and Automata Theory and Programming skills.

Course Outcomes (CO): After completing the course, the students will be able to

CO-1: Understand the structure of compilers.
CO-2: Understand the basic techniques used in compiler construction such as lexical analysis, top-down, bottom-up parsing, context-sensitive analysis, and intermediate code generation.
CO-3: Understand the basic data structures used in compiler construction such as abstract syntax trees, symbol tables, three-address code, code optimizer and stack machines.
CO-4: Design and implement a compiler using a software engineering approach.
CO-5: Design different types of parser for a given grammar and design their own compiler.

UNIT- I

Compiler structure [4 Hrs]
Analysis-synthesis model of compilation, Various phases of a compiler, Tool based approach to compiler construction.

Lexical analysis [6 Hrs]
Interface with input, Parser and symbol table, Token, Lexeme and patterns, Regular definition, Transition diagrams, LEX.

Syntax analysis [8 Hrs]
CFG's, Ambiguity, Associativity, Precedence, Top down parsing, Recursive descend parsing,Transformation on the grammars, Predictive parsing, Bottom up parsing, Operator precedence grammars, LR parsers (SLR, Canonical, LALR), YACC.

Syntax directed translation [2 Hrs]
Inherited and synthesized attributes, Dependency graph, Evaluation order, Bottom-up evaluation of S- attributed definitions L- attributed definitions and top-down translation of attributes.

UNIT-II

Type checking [2 Hrs]
Type system, Type expressions, Structural and name equivalence of types, Type conversion.

Run time environments [4 Hrs]
Storage organization, Storage-allocation strategies, Access to nonlocal names, Activation tree, Activation record, Parameter passing, Symbol table and dynamic storage allocation
.

Intermediate code generation [8 Hrs]
Intermediate representations, Translation of declarations, Assignments, Control flow, Boolean expressions and procedure calls.

Code generation [6 Hrs]
Issues in the design of a code generator, Basic blocks and flow graphs, Next use information, Register allocation, Code generation algorithm, Dag representation of programs, Code generation from dags, Peephole optimization and code generator generators.

Text Books:

1. A.V. Aho, R. Sethi, J.D. Ullman, "Compilers: Principles, Techniques and Tools", Addison – Wesley.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Elsevier.

Reference Books:

1. W. Appel, "Modern Compiler Implementation in C: Basic design", Cambridge Press.
2. Fraser and Hanson, "A Retargetable C Compiler: Design and Implementation", Addison-Wesley.
3. Dhamdhere, "Compiler Construction", McMillan. A. V. Aho and J. D. Ullman, "Theory of Parsing, Translation and Compiling", Prentice Hall.

BC312A3 **Credit: 3 (L-3, T-0, P-0)**

OBJECT ORIENTED ANAYLSIS & DESIGN

Objective: This course delves into the processes of both object-oriented analysis and object-oriented design using UML as the notation language to provide a common, standard notation for recording both analysis models and design artifacts. Facets of the Unified Process approach to designing and building a software system are also covered.

Pre-requisites: Object oriented Design concepts, Design & Analysis of Algorithms and Software engineering.

Course Outcomes: At the end of the course, students will be able to
CO-1: be familiar with standard Unified Modelling Language (UML) notation
CO-2: model requirements with Use Cases
CO-3: describe the dynamic behaviour and structure of the design.
CO-4: describe Object Oriented Analysis and Design concepts and apply them to solve problems.
CO-5: prepare Object Oriented Analysis and Design documents for a given problem using UML.

UNIT I

Introduction [2 Hrs]
About Object Orientated Technology, Development and OO Modeling History.

Modeling Concepts [4 Hrs]
Modeling design Technique, Three models, Class Model, State model and Interaction model.

Class Modeling [6 Hrs]
Object and class concepts, link and association, Generalization and Inheritance, Advanced class modeling- aggregation, Abstract class metadata, constraints.

State Modeling [6 Hrs]
Event, state, Transition and conditions, state diagram, state diagram behavior, concurrency, Relation of Class and State models.

Interaction Modeling [2 Hrs]
Use case Models, sequence models, activity models.

UNIT II

Analysis and Design [7 Hrs]
Development Life cycle, Development stages, Domain Analysis-Domain class model, domain state model, domain interaction model, Iterating and analysis. Application Interaction model, Application class model, Application state Model, Adding operation.

System Design [7 Hrs]
Estimating Performance, Making a reuse plan, breaking system into subsystems, identifying

concurrency, allocation of subsystems, management of data storage, Handling Global resources, choosing a software control strategy, Handling boundary condition, common Architectural style.

Class design [6 Hrs]
Overview of class design, designing algorithms recursing downward, refactoring, design optimization, Adjustment of Inheritance, Reification of Behavior.

Text Books:
1. Michael R Blaha, James R Rumbaugh, "Object-Oriented Modeling and Design with UML", Pearson.
2. Ali Bahrami, "Object Oriented Systems using the United Modeling Language", McGraw Hill.

Reference Books:
1. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language", Pearson Education.
2. Grady Booch, "Object Oriented Analysis and Design", Pearson Education.
3. Graig Larman, "Applying UML and Patterns", Addison Wesley.
4. Perdita Stevens, Rob Pooley, "Using UML Software Engineering with Objects and Components",Pearson.

BC313A3 **Credit: 3 (L-3, T-0, P-0)**

MACHINE LEARNING

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of this course is to provide a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. The standard and most popular supervised learning algorithms including linear regression, logistic regression, assembling and boosting algorithms and neural networks with an introduction to Artificial Neural Networks.

Pre-requisites: Basics of Probability and Linear Algebra

Course Outcomes (CO): After Successful completion of this course, students should be able to

CO-1: Apply the knowledge of linear regression and logistic regression for prediction and classification problems.

CO-2: Use supervised learning algorithms to solve classification problems.

CO-3: Explain the theoretical framework for analyzing the generalization error of a learning algorithm.

CO-4: Apply unsupervised learning algorithms for dimensionality reduction and clustering techniques to real world problems.

CO-5: Explain the basic concept of Artificial Neural Network.

Module	Topics	Hrs	CO
Module 1: **Basics of ML and Regression**	Basic Definition, Types of Learning: Supervised Learning, Unsupervised Learning, semi-supervised Learning and Reinforcement Learning, Examples of Machine Learning Applications., hypothesis space and inductive bias, evaluation, cross-validation. Linear Regression: Linear Regression with Single Variables- Model Representation and Cost Function. Parameter Learning: Gradient Descent, Gradient Descent Intuition, Gradient Descent for Linear Regression, Linear Regression with Multiple Variables Multiple Features, Gradient Descent for Multiple Variables, Gradient Descent in Practice: Feature Scaling and Learning Rate; Features and Polynomial Regression. Logistic Regression: Classification and Representation. Classification, Hypothesis Representation and Decision Boundary, Logistic Regression Model - Cost Function, Simplified Cost Function and Gradient Descent Multiclass Classification- One-vs-all, Regularization: Overfitting problems, Regularized Linear Regression, Regularized Logistic Regression.	8	1
Module 2: **Supervised Learning**	Nearest neighbor (NN), Linear Discriminant Analysis, Support vector machines, Decision Trees, Generative classifiers like naïve Bayes.	8	2

Module 3: **Computational learning theory**	PAC learning model, Sample complexity, VC Dimension, Ensemble learning: Bagging, Boosting, Stacking	6	3
Module 4: **Unsupervised Learning**	Principle component Analysis, Factor Analysis, Nonnegative matrix factorization, Rate-Distortion Theory, Kmeans, hierarchical clustering, Gaussian mixture model, Expectation-Maximization Algorithm	8	4
Module 5: **Neural Networks**	Overview of neural networks, perceptron's, Activation functions, Multilayer network, backpropagation Algorithm	6	5

Text Books:

1. Ethem Alpaydın, "Introduction to Machine Learning", 2nd Edition, MIT Press, 2010. 2. Tom M. Mitchell, "Machine Learning ", McGraw-Hill Science, 1997.
2. Trevor Hastie, Robert Tibshirani and Jerome Friedman.. The Elements of Statistical Learning. Second Edition, Springer, 2009

Reference Books:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer 2006
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, CRC Press, 2015.
3. R. O. Duda, P. E. Hart, and D. G. Stork, "Pattern classification". John Wiley & Sons, 2012.
4. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning.. Cambridge University Press. 2017.
5. Tom Mitchell, Machine Learning, McGraw Hill, 1997

BC314A3 **Credit: 3 (L-3, T-0, P-0)**

CYBER SECURITY

Questions to be set: 05 (All Compulsory)

Course Objectives:

1. Understand the fundamentals of cyber security and cybercrimes.
2. Understand the tools and methods in cybercrimes and understanding computer forensics.

Pre-requisites: Knowledge of Computer Networks, DBMS.

Course Outcomes (CO):

CO1: The students should be able to explain the basics of Cyber security and threat landscape

CO2: The students should be able to explain different aspect of Cybercrime and Cyber law.

CO3: The students should be able to responsible use of online social media networks.

CO4: The students should be able to explain various Tools and Methods Used in Cybercrime

CO5: The students should be able to explain different concept of Computer Forensics

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Cyber security**	in class	Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.	8	1
Module 2: **Cybercrime and Cyber law**	in class	Classification of cybercrimes, Common cybercrimes- cybercrime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi, Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments, Cybercrime and offences, Organisations dealing with Cybercrime and Cyber security in India, Case studies	8	2
	****Assignment Topics**	Case study		2

Module 3: **Social Media Overview and Security**		Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies	7	3
	****Assignment Topics**	Use cases		
Module 4: **Tools And Methods Used In Cybercrime**	in class	Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan-horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction to Phishing, Identity Theft (ID Theft).	6	4
	****Assignment Topics**	Use cases		4
Module 5: **Computer Forensics**	in class	Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics.	7	5
	****Assignment Topics**	Use cases		5

Text Books:

1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition, 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)

Reference Books:

1. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson , 13th November, 2001)
2. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
3. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.

4. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.
5. Fundamentals of Network Security by E. Maiwald, McGraw Hill

BC315A3 **Credit: 3 (L-3, T-0, P-0)**

CLOUD COMPUTING

Objectives: This course gives an introduction to cloud computing and its techniques - issues, ecosystem.

Pre-requisites: Operating Systems and Computer Network.

Course Outcomes (CO): On successful completion of this module, learners will be able to

CO-1: Understand the basic concept behind the cloud technology.

CO-2: Understand the overview of cloud computing paradigm.

CO-3: Understand the various cloud models.

CO4: Analyse and understand the applications of cloud computing.

CO5: Understand the concept of utility of cloud applications.

Module	Topics	Hrs	CO
Module 1: **Distributed Computing Concepts**	Introduction to distributed computing, centralized vs distributed computing, advantages and disadvantages, types of distributed systems, parallel computing, ubiquitous computing, Utility computing model, cluster and grid computing, Distributed File Systems, NFS, AFS, Commodity hardware-based file systems, Hadoop Distributed File System (HDFS)	10	1
Module 2: **Introduction to Cloud Computing**	Introduction- Definition, Characteristics, Components, Applications, Pros and cons, Limitations. Need for cloud computing. History/ Evolution of cloud and related technologies- Multi-processing, Distributed computing, Parallel computing to ubiquitous computing. What cloud computing really is and what really isn't? Importance of cloud computing in current era- why cloud computing matters? Who should use cloud computing and who shouldn't use it? Types of cloud computing. Major players in cloud computing.	10	2
Module 3: **Cloud Computing Platforms and Technologies**	Migrating into the cloud platform- Issues and deployment considerations. NIST Cloud model, Exploring cloud service models- IaaS, PaaS, SaaS. Deployment models- Private, Public, Community and Hybrid clouds. Cloud computing platforms- Microsoft Azure, Hadoop, Map- reduce, Amazon Web services (AWS)	8	3
Module 4: **Cloud Computing for Everyone**	Centralizing email communications, Collaborating on schedules, Collaborating on To-Do Lists, Collaborating contact lists, Cloud computing for the community, Collaborating on group projects and events, Cloud computing for the corporation.	6	4

Module 5: **Using Cloud Services**	Collaborating on calendars, Schedules and task management, Exploring online scheduling applications, Exploring online planning and task management, Collaborating on event management, Collaborating on contact management, Collaborating on project management, Collaborating on word processing, Collaborating on spreadsheet, Storing and sharing files.	6	5

Textbooks:

1. Barrie Sosinsky, Cloud Computing Bible, Wiley.
2. Rajkumar Buyya, James Broberg, AndrzejGoscinski, Cloud Computing– Principles and paradigms, Wiley.
3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw Hill.
4. Kai Hwang, Geoffrey C Fox, Jack J. Dongarra, Distributed and Cloud Computing: From parallel processing to the Internet of Things, Elsevier.

Reference Books:

1. George Reese, Cloud Application Architectures, O'Reilly.
2. Michael Miller, Cloud computing: Web based applications that change the way you work and collaborate online, Pearson.
3. Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer.
4. Brian J. S. Chee, Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Centre, CRC Press.
5. Haley Beard, Cloud computing best practices for managing and measuring processes for on demand computing, Applications and data centres in the cloud with SLAs, Emereo.

BC316A3 **Credit: 3 (L-3, T-0, P-0)**

BLOCKCHAIN TECHNOLOGY

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides a broad overview of the essential concepts of blockchain technology – by initially exploring the Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.

Pre-requisites: Basic Knowledge of Computer

Module	Topics	Hrs	CO
Module 1: **Introduction To Blockchain**	Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.	8	1
Module 2: **Blockchain Architecture**	Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain-Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET).	8	2
Module 3: **Blockchains in Business and Creating ICO**	Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Block chain-as-a-Service-Initial Coin Offering (ICO): Project setup for ICO implementation- Token contracts-Token sale contracts-Contract security and testing the code.	8	3
Module 4: **Blockchain-Based Futures System**	Project presentation- Futures smart contract: Blockchain oracles- Web3j: Setting up the Web3J- Installing web3j- Wallet creation, Java client: The wrapper generator- Initializing web3j- Setting up Ethereum accounts- Deploying the contract.	6	4
Module 5: **Distributed Storage IPFS and Swarm**	Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS, Hosting our frontend: Serving your frontend using IPFS, Serving your frontend using Swarm, IPFS file uploader project: Project setup the web page.	6	5

Text Books:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.

2. Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, “Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger”, Packt Publishing Limited, 2018.

Reference Books:

1. Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2015.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.

Electives For Fourth Year

BC401A3 **Credit: 4 (L-4, T-0, P-0)**

NANOELECTRONIC DEVICES AND MATERIALS

Questions to be set: 05 (All Compulsory)

Course Objectives:

1. The students should be able to understand concepts of historical perspective of Nanotechnology with reference to different devices.
2. The students should be able to understand crystallography concepts and quantum mechanical aspects of nanomaterials.
3. The students should be able to different nanoelectronics and quantum electronic devices concepts.
4. The students should be able to have insights and have insights of IC fabrication and characterization processes.
5. The students should be able to understand and know the various applications of nanoelectronics and societal impacts.

Pre-requisites: Knowledge of Basic Electronics

Module	Topics	Hrs	CO
Module 1: **Introduction:** Nano Technology	Introduction; Historical Perspectives; Vacuum Electron Tube; Quantum Theory; Invention of Transistor; Integrated Circuit Era; Physical Size Scales; Nanomaterials Used Prior to 1990s; Prospects and Potential of Nanotechnology.	8	1
Module 2: **Physics Applied to Nanostructures**	Crystal Structures - Crystallography-Historical Perspectives; Size Dependence of Material Properties. Quantum Mechanical Aspects of Nanomaterials – Introduction; Bohr's Theory of Hydrogen Atom. Energy Bands in Solids – Introduction; Band Theory of Solids-Historical Perspectives; Bonding in Hydrogen Molecule.	8	2
Module 3: **Nanomaterial: Quantum Electronics and Devices**	Carbon Nanoclusters - Nature of Carbon Bonds; Allotropes of Carbon; Graphene; Carbon Fullerenes-Buckyballs; Nanodiamonds; Diamond-like carbon Nanotubes - Historical Background of CNT; Physical Structure of CNT; Types of Nanotubes; Synthesis of CNT. Properties of Nanomaterials - Why Nanomaterials Show Unique Properties; Structural Properties; Electronic Properties; Magnetic Properties; Electrical Properties; Optical Properties; Mechanical Properties. Tunnel Diodes; Single Electron Devices; Quantum Well Devices; Superconducting Devices; Photonic Crystals	8	3

Module 4: **Methods: Growth, Synthesis and Characterization of Nanomaterials**	Physical Methods of Nanostructure Fabrication; Chemical Synthesis of Nanomaterials; Biological Synthesis of Nanomaterials. Particle Size Determination; Surface Layer Structural Determination; Electron Microscopy; Scanning Probe Microscopy; Field Ion Microscopy; Spectroscopy; Mass Spectrometry.	6	4
Module 5: **Applications Of Nanoelectronics and its Societal Impact**	Applications of Nanotechnology – Energy; Information Technology; Displays; Computers; Defence; Nanomedicines; Consumer Goods Societal Impact of Nanotechnology Uniqueness of Nanomaterials; Implications of Nanotechnology; Health Issues; Environmental and Energy Issues; Basic Necessities-Safe Drinking Water and Food Security; Other Societal Implications.	6	5

Text Books:

1. Donald A. Neamen, Semiconductor Physics and Devices: Basic Principles, 4e, Tata McGraw-Hill Pvt. Ltd., 2012.
2. Singh R., Gupta S. P., Introduction to Nanotechnology, 1e, Oxford University Press, 2016

Reference Books:

1. G. W. Hanson, “Fundamentals of nanoelectronics”, Pearson, 2009.
2. Ben Streetman and Sanjay Banerjee, Solid State Electronic Devices, 7e, Prentice-Hall, 2015

BC402A3 **Credit: 4 (L-4, T-0, P-0)**

.NET PROGRAMMING

Questions to be set: 05 (All Compulsory)

Course Objective: The primary objective of this course is to provide concepts of .NET framework and different concepts of programming language and make students familiar with their uses and applications.

Pre-requisites: Computer Programming

Course Outcomes (CO): On Successful Completion of the course, students will be able to

CO1 Understand the concept of .Net Framework and control structure
CO2 Describe Object Oriented Approach, String and Collections
CO3 Understand the knowledge of Exception Handling and Windows application.
CO4 Apply Dialog controls and Port Programming
CO5 Implement Data Access using ADO.NET and Multithreading

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1 **Introduction to .Net and control structure**	in class ****Assignment Topics**	Programming language, Application, Library, Framework, The Microsoft .NET framework, Technology, Components within .NET framework, Features of .NET framework, Tokens, Compiler, Environment variable, Rule of c#(C Sharp), C# Program using .NET Framework, Rule of VB, Common Type System, Data type, Type conversion, Managing console I/O operations, Read() and ReadLine(), Write() and WriteLine(), Formatted output, Standard number Format, Format Character, The Decision control structures, The Selection control structures, The Jump control structures, The Repetition control structures. Practise C# Program using .NET	7	1
Module 2 **Object Oriented Approach, String and Collections**	in class	Classes and Objects, Class Members, Properties and Fields, Methods, Constructors, Finalizers, Events, Nested Classes, Access Modifiers and Access Levels, Instantiating Classes, Static Classes and Members, Anonymous Types,	8	2

		Inheritance, preventing inheritance, Virtual Methods, Abstract Class, Interfaces, Overriding Members, Delegates, Object class, Object type, Structure object and class object, String, String method, String builder, Array, Declaration, Memory creation, Single Dimensional Array, Double Dimensional Array, Jagged Array, Collection, Collection Classes		
Module 3 **Exception Handling and Windows application**	in class	Basic Concept, Type of exception, Exception class, Try, catch, final, throw, Checked and unchecked, Creating user defined exception, Windows form, Form class, Properties, Events and Methods of Form, Toolbox, Common controls, Control class	8	3
Module 4 **Dialog controls and Port Programming**	in class	Color dialog control, Folder Browser dialog control, Font Dialog control, Open Dialog, Save dialog control, Introduction, Serial port, Read, Write, Get ports, Priority, Open, close, Baud rate	7	4
Module 5 **Data Access using ADO.NET and Multithreading**	in class ****Assignment Topics**	Characteristics of ADO.NET, Comparing ADO and ADO.NET, Creating a connection, select command, Using a command with a data reader, Updating data, Accessing, modifying, updating disconnected data, Selecting multiple tables, Process, Thread, Multithreading, Thread class mutex class, Creating and starting thread, Scheduling a thread, Synchronizing threads, Thread pooling Practice problems	7	5

Text Books:

1. Jesse Liberty, Dan Hurwitz, *Programming .NET Windows Applications*, O'Reilly.
2. Pradeep Kumar Tapadiya, *.NET Programming: A Practical Guide Using C#*, Prentice Hall Professional

Reference Books:

1. Paul Vick, *The Visual Basic .Net Programming Language*, Addison-Wesley
2. Eric Butow, Tommy Ryan, *C#: Your Visual Blueprint for Building .NET Applications*, Hungry Minds, 2002
3. Michael Stiefel, Robert J. Oberg, *Application Development Using C# and .NET*, Prentice Hall Professional

BC403A3 **Credit: 4 (L-4, T-0, P-0)**

MOBILE COMMUNICATION

Questions to be set: 05 (All Compulsory)

Course Objectives: To introduce the concepts of wireless/mobile communication using cellular environment. To make the students know about the various modulation techniques, propagation methods, and multiple access techniques used in the mobile communication. Various Wireless network systems and standards are to be introduced.

Pre-requisites: Knowledge of Computer Network.

Course Outcomes (CO): The students should be able to

CO1: Explain the evolution of mobile communication systems.

CO2: Explain the cellular concept and should be able solve problems on radio propagation channel.

CO3: Explain the concept of various cellular communication techniques.

CO4: Explain the working of 4G and 5G mobile communication techniques.

CO5: Identify the requirements and challenges of 6G mobile communication techniques.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction to Mobile Communication Systems**	in class	Evolution of mobile communication systems, OFDMA/SC-FDMA, FDD/TDD, Overview of MIMO.		1
Module 2: **Cellular Concept and Mobile Radio Propagation**	in class	Cellular Concept and Mobile Radio Propagation Basic Concepts, Frequency reuse, Channel assignments, handoff, Trunking and Grade of Service, Improving coverage and system capacity. Introduction and basic properties of radio wave propagation, Outdoor and Indoor propagation models, Small scale Multipath propagation and measurements, fading.		2
	****Assignment Topics**	Numerical examples on radio propagation		2
Module 3: **Overview of Cellular systems**	in class	AMPS, GSM, WCDMA/HSPA, CDMA2000, LTE and WiMAX.		3
	****Assignment Topics**	Use cases		3
Module 4:	in class	1. LTE radio access - an overview, Radio interface architecture- an overview.		4

4G and 5G Communication Systems		2. Physical transmission resources. Overall Time–Frequency Structure, Normal Subframes and Mbsfn Subframes, Carrier Aggregation, 3. 5G wireless Access: 5G and IMT2020, Network Slicing, LTE evolution versus New 5G Technology, Frequency Bands for 5G Deployments. 4. New 5G Radio –Access Technology: Some general Design Principles, 5G Key Technology Components.		
	****Assignment Topics**	Downlink physical-layer processing, Transport-Channel Processing, Downlink Reference Signals, Multi-Antenna Transmission.		4
Module 5: **6G Communication**	in class	1. 6G vision 2. 6G Networks: The 6G KPIs, Machine Learning and AI, Multi-Access Edge Computing, RF and Optical Spectrum, Ultra-Massive MIMO & Graphene 3. 6G Security: Cybersecurity Global Challenges – The era of cyberwarfare, 6G Security Roadmap, Blockchain Security Model for 6G, Quantum Computing Infrastructure for 6G Security Strategy, Quantum Communications		5
	****Assignment Topics**	Megatrends driving 6G research, Developing a linkage between the UN SDGs and 6G and related indicators. **6G Use Cases:** Smart-Cities, Rural Areas Areas, Multimedia Applications, e-Health		5

Text Books:

1. Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, 2e, Pearson, 2005.
2. William C.Y.Lee, *Mobile Cellular Telecommunication*, 2e,McGraw Hill International Edition, 1998.
3. Erik Dahlman, Stefan Parkvall, Johan Skold, "4G, LTE-Advanced Pro and The Road to 5G", Elsevier, 2016
4. Paulo Sergio Rufino Henrique; Ramjee Prasad, "6G The Road to the Future Wireless Technologies 2030," River Publishers, 2021.

5. White Paper on 6G Drivers and the UN SDGs. https://arxiv.org/ftp/arxiv/papers/2004/2004.14695.pdf

Reference Books:

1. Jochen Schiller, *Mobile Communication*, Addison-Wesley, 2nd edition,
2. MorayRumney, LTE and the Evolution to 4G Wireless Design and Measurement Challenges,Agilent Technologies Publication, 2009.

3. 3GPP Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (Release 10)", **3GPP TS 36.212** v10.0.0 (2010-12) http://www.3gpp.org/ftp/Specs/html-info/36-series.htm.3GPP.

4. Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures(Release 10)", **3GPP TS 36.213** v10.0.0 (2010-12).

BC404A3 **Credit: 4 (L-4, T-0, P-0)**

PRODUCTION MANAGEMENT

Questions to be set: 05 (All Compulsory)

Course Objectives:

1. To understand scope and functions of production management and apply the knowledge to identify optimal locations and match plant capacity and technology.
2. To understand the principle of inventory/materials management and apply the same in real life situations to make decisions.
3. Apply the concepts of forecasting, productivity and developing and designing new product development to make decisions.
4. Utilize the concepts of standardization, automation and work study to be able to analyze and decide optimal solutions.
5. Apply concepts of safety and quality to real life production situations in industries.

Pre-requisites: NIL

Module	Topics	Hrs	CO
Module 1: **Introduction**	Nature and Scope of Production management, Production Analysis and planning.	6	1
Module 2: **Principle of Inventory/Materials Management**	Inventory Control, Relevant Costs, Economic Lot Size, Inventory Analysis, Sales Forecasting Techniques.	8	2
Module 3: **Forecasting, Productivity and Developing**	Productivity-Concept And factors on Which Productivity depends, Measurement of Productivity, Input Output Analysis and Productivity, Product Development and Designing.	8	3
Module 4: **Standardization, Automation and Analyze**	Standardization, Simplification and specialization, Automation. Development of efficiency Work Method, Method, Material Flow Process Chart, Man flow Process Chart, Principles of Motion Economy, Comparison of Alternative Work Methods, Safety and health considerations, Maintenance of Production Facilities, Quality Control and Inspection.	8	4
Module 5: **Application**	Stages of New Product Development, Sampling Inspection, Quality Control Charts, Attributes and Variables Charts.	6	5

Text Books:

Production and Operations Management, K Ashwathappa & K Shridhara Bhatt, Himalaya Publishing House.

Reference Books:

Production Management, Martand T. Telsang, S Chand & Company Ltd.

BC405A3 **Credit: 4 (L-4, T-0, P-0)**

ACOUSTIC SIGNAL PROCESSING

OBJECTIVES:

1. To study the basic concepts of speech and audio.

2. To study the analysis of various M-band filter banks for audio coding

3. To learn various transform coders for audio coding.

4. To study the speech processing methods in time and frequency domain

MODULE-I

MECHANICS OF SPEECH AND AUDIO

Introduction - Review Of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non simultaneous Masking - Perceptual Entropy - Basic measuring philosophy - Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

MODULE-II

TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS

Introduction -Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters- Tree-Structured QMF and CQF M-band Banks - Cosine Modulated "Pseudo QMF" M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion-Preecho Control Strategies.

MODULE-III

AUDIO CODING AND TRANSFORM CODERS

Lossless Audio Coding-Lossy Audio Coding- ISO-MPEG-1A,2A,2A Advanced, 4Audio Coding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization.

MODULE-IV

TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING

Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods

MODULE-V

HOMOMORPHIC & LINEAR PREDICTIVE SPEECH ANALYSIS

Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders. Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

Text-Books & References:

1. Digital Audio Signal Processing, Second Edition, Udo Zölzer, A John Wiley& sons Ltd Publications.
2. Applications of Digital Signal Processing to Audio And Acoustics Mark Kahrs, Karlheinz Brandenburg, Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow.
3. Digital Processing of Speech signals – L. R. Rabiner and R.W. Schaffer - Prentice Hall – 1978.

BC406A3 **Credit: 4 (L-4, T-0, P-0)**

SYSTEM AND NETWORK ADMINISTRATION

Questions to be set: 05 (All Compulsory)

Course Objectives:

1. To familiarize with the networking aspect in UNIX environment..
2. To understand the basic concepts of network management in the Link-Layer.
3. To understand the issues pertaining to Network Layer and the challenges involved in managing the network.
4. To be able to understand the routing procedures in a UNIX environment.
5. To understand the various QoS parameters of in network management

Pre-requisites: Basic Computer Networks and Linux Basics

Module	Topics	Hrs	CO
Module 1: **Introduction to Computer Networks**	Intro to Networks, OSI interconnect model, topologies, Internet history and TCP/IP, Physical Layer: transmission media, socket programming, UNIX Process Creation and UNIX IPC.	8	1
Module 2: **Data Link and MAC**	Data Link Layer: framing, flow control, error control, encoding for local and wide areas, Admin tricks with UNIX shell, Medium Access Layer. Broadcast, CSMA/CD, CDMA, FDDI, 802.X, Bluetooth.	8	2
Module 3: **Networks**	Flow control, congestion control, Routing,. quality of service, switching, CIDRs, mobile IP, WAP	8	3
Module 4: **Routing Protocols**	Finish Routing. Transport Layer: TCP, UDP, IP v 6. CISCO Router IoS.	6	4
Module 5: **Application and QoS parameters**	Application Layer: httpd, smtp, dns, snmp, ftp, Telnet, streaming video, video compression, multicast, JME. Network Services, Dist Computing, Network Management, Dist File Systems.	6	5

Text Books:

1. Computer Networks, 3rd edition, by Andrew Tanenbaum, Prentice Hall, ISBN 0-13-349945-6
2. Advanced Programming in the Unix Environment., by W. Richard Stevens.

Reference Books:

1. An Engineering Approach to Computer Networks, S. Keshav, ISBN 0-201-63442-2
2. High Performance Communication Networks, Jean Walrand, Pravin Varaiya, ISBN 1-55860-341-7
3. Internetworking Multimedia, Jon Crowcroft, Mark Handley and Ian Wakeman ISBN 1-55860-584-3

4. The C Programming Language, by Kernighan and Ritchie (a.k.a, the famous "K&R" book).

BC407A3 **Credit: 4 (L-4, T-0, P-0)**

SOFTWARE DEFINED NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objectives: A paradigm shift in the use cases of 'mobile broadband' to 'connected smart society' in the form of IoT and Smart Cities enabling technologies is noticed by the society. Three enabling technologies using the LTE and 5G mobile are i) eMBB ii) MTC and iii) URLLC. More flexibility in both the Network as well as Physical layers are being introduced in the heterogeneous network (HetNet) in the name of Cloud RAN, SON and SDN. The Mobile Service Providers all over the world including India are engaged in this technological evolution by implementing all the above.

Pre-requisites: Digital Communication, Computer Networks.

Course Outcomes (CO): After completion of this course, students will be able to

CO	STATEMENT
CO1	Explain the Cloud RAN
CO2	Analyze the Software Defined Network
CO3	Apply the Adaptive SON and Smart LPN for 5G Heterogeneous Networks
CO4	Analyze the Intelligent SDN and Case Study of a HetNet
CO5	Analyze the NFV for 5G HetNet Dynamics.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Cloud RAN**	in class	Cloud RAN (C-RAN) Basics, Architecture Components, System Structures, Advantages of C-RAN, Virtualization in C-RAN, Network Functional Virtualization in C-RAN, Challenges of C-RAN.	6	1
	****Assignment Topics**			1
Module 2: **Software Defined Network**	in class	History and Evolution of Software Defined Networking (SDN), Overview of Control Plane and Data Plane, Active Networking, Open Flow protocol, Concept of Network Virtualization, implementation using SDN.	6	2
	****Assignment Topics**			2
Module 3: **Adaptive SON and Smart LPN for 5G Heterogeneous Networks**	in class	Introduction to Self-organization network, Need of Self-organization, Cognitive Radio and Compressed Sensing, Compressed Sensing Background, Compressed Sensing of Analog Signal, Parallel Segmented Compressed Sensing Structure (PSCS), Joint Signal Reconstruction, Simulation Example. Channel Modelling:	10	3

		Software Designed Cloud Data Center Simulation – Goals and Requirements, Framework Design---Cloud Sim Core Logic, Abstracting Physical and virtual Topology, Network Modules, Calculating packet Transmission Time, Abstracting User Requests, GUI Modules, Validation with MiniNet Setup, Testbed Configuration. Introduction to Smart Low power node.		
	****Assignment Topics**			3
Module 4: **Intelligent SDN and Case Study of a HetNet**	in class	Envision of 5G Mobile Networks, Overview of Heterogeneous Networks (HetNet), 5G Mobile Design Principles, Key Technological Components, Spectrum Consideration, Intelligent SDN Architecture for 5G HetNets, New T Mobile 5G advantage, Radio Resource and Interference Management for Heterogeneous Networks, Capacity and Coverage Enhancement in Heterogeneous Networks, Advanced Heterogeneous Networks. Necessary Standard Extensions for Enabling 5G:	7	4
	****Assignment Topics**			4
Module 5: **NFV for 5G HetNet Dynamics.**	in class	Preliminaries of Network Function Virtualization (NVF), Software Defined radio (SDR), Software Defined Network (SDN) and an integrated 4G/5G Network architecture, Current Standardization Progress on NVF, SDR, SDN. Requirements of 4G/5G NVF, SDR, SDN, Existing Standard and necessary Extension for NVF, SDR, SDN Enabled Network, Necessary Standard Extension for 4G/5G Network.	7	5
	****Assignment Topics**			5

Text Books:

1. Thomas D. Nadeau, Ken Gray,*SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies*, Thomas D Nadeau, Ken Gray, O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.

2. Software Defined Networks: A Comprehensive Approach By Paul Goransson, Chuck Black.

3. SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies, Book by Ken Gray and Tom Nadeau.

4. HrishikeshVenkatarman and Ramona Trestian, *5G Radio Access Networks: Centralized RAN, Cloud-RAN, and Virtualization of Small Cells*, CRC Press, 2017.

5. Bo Rong (et.al.) *5G Heterogeneous Networks Self-organizing and Optimization*, Springer, 2016.

Reference Books:

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, CRC Press, ISBN-10: 1466572094, 2014.

2. Paul Goransson and Chuck Black, Morgan Kaufmann,*Software Defined Networks: A Comprehensive Approach*, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844.

3. Tony Q. S. Quek(et.al.), *Cloud Radio Access Networks: Principles, Technologies, and Applications*, 1e, Cambridge University Press, 2017.

BC408A3 **Credit: 4 (L-4, T-0, P-0)**

COMPUTER VISION

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of the course is to introduce the concepts of computer vision.

Scope: The students will learn basic image processing concepts and algorithms for object detection, tracking and segmentation. The students will also learn about efficient ways of image data representation.

Pre-requisites: Basic knowledge of linear algebra and Basic programming

Course Outcomes (CO):

1. The student should be able to explain the fundamental concepts of digital images.
2. The student should be able to explain projective geometry and image data processing.
3. The students should be able to apply algorithms for object detection.
4. The student should be able to apply algorithms for object tracking.
5. The student should be able to apply algorithms for image segmentation.

** not more than 20% of total topics to be allotted for assignment.

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction**	in class	Fundamentals of computer vision and image processing, Digital images, Color models, Image processing goals and tasks, Contrast and brightness correction, Image convolution, Edge detection	7	1
	****Assignment Topics**	Line detection using Hough Transform		1
Module 2: **Computer Vision**	in class	2-D Projective Geometry, Homographgy, Properties of homography, Camera geometry, stereo geometry, feature detection and description, feature matching and model fitting, Dimensionality reduction and sparse representation	7	2
	****Assignment Topics**	Principal Component Analysis		2
Module 3: **Object Detection**	in class	Object detection problem, Sliding windows, HOG-based detector, Detector training, Viola-Jones face detector, Attentional cascades and neural networks	7	3
	****Assignment Topics**	Applications of Attention Cascades networks		3
Module 4: **Object Tracking and Action Recognition**	in class	Introduction to video analysis, Optical flow, Visual object tracking, Examples of visual object tracking methods, Multiple object tracking, Examples of multiple object tracking methods, Introduction to action recognition, Action classification	8	4

	****Assignment Topics**	Object tracking algorithm for vehicle tracking systems		4
Module 5: **Image Segmentation and Synthesis**	in class	Image segmentation, Over segmentation, Human pose estimation as image	7	5
	****Assignment Topics**	Case study of Human Pose estimation		5

Text Books:

1. Deep Learning By Ian Goodfellow, Yoshua Bengio and Aaron Courville.
2. Deep Learning Tutorial By LISA Lab, University of Montreal

Reference Books:

1. R. Szeliski, Computer Vision Algorithm and Applications, Springer,2010
2. Forsyth, Ponce, Computer Vision, A modern Approach, Pearson; 2nd edition (October 26, 2011)

BC409A3 **Credit: 4 (L-4, T-0, P-0)**

AUTOMATION AND ROBOTICS

No. of questions to be set: 1 from each CO

No. of questions to be answered: Five

Course Objectives: To serve as a course in acquiring knowledge in Robotics. After the completion of the course, students should be able to design and analyze automatic robot systems. Also, they will gather sufficient knowledge to understand the direction of the research activities going on in the field of robot automation.

Pre-requisites: Basics of Mathematics

Course Outcomes (CO): On completion of the course the student should be able to:

CO-1: Describe the basic concept of automation and robotics.

CO-2: Explain different sensors and actuators and their uses in robotics.

CO-3: Illustrate the concept of automation in robotics.

CO-4: Summarize the concept of artificial intelligence and intelligent agents.

CO-5: Relate the concept of machine learning with robotics.

** not more than 20% of total topics to be allotted for assignment

Module	Topic to be covered	Hrs	CO
Module 1: **Robotics & Robot Controls**	Classification of Robots, Degree of freedom, Kinematics; Multidisciplinary approach: Motors-DC motors, Stepper Motors, Servo Motors. Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, Adaptive control, Trajectory planning, Pick and place Operations.	8	1
Module 2: **Introduction To Robotic Sensors**	Introduction to sensor & classifications. Sensors Range detectors, assembly aid devices, force and torque sensors, machine vision, ranging, laser, acoustic, magnetic, fiber optic and tactile sensors.	7	2
Module 3: **Introduction To Automation**	Definition, automation principles and strategies, scope of automation, socio-economic consideration, low-cost automation, basic elements of advanced functions. Automated Navigation guidance by vision system.	7	3

Module 4: **Introduction To Artificial Intelligence And Intelligent Agents**	Introduction to Artificial Intelligence and Intelligent agents, categorization of AI. Rules for some AI problems: water jug problem, missionaries-cannibals problem etc. Solving problems by searching: state space formulation, depth first and breadth first search, Iterative deepening Artificial neural networks.	7	4
Module 5: **Introduction To Machine Learning**	Introduction to machine learning, well posed learning problem, designing a learning system: training experience, target function, final design. Issues in machine learning Concept, Learning and General to specific ordering: concept learning task, concept learning as search,	7	5

Text Books:

1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2nd Edition 2012.
2. S. Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI, 2003.
3. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., Robotics control, sensing, vision and intelligence, 1e, McGraw Hill Book co, 2008.

Reference Books:

1. David A. Forsyth, Jean Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2003.
2. S.R. Deb, Robotics Technology and flexible automation, 2e, Tata McGraw-Hill Education, 2009.

BC410A3 **Credit: 4 (L: 4, T:0, P: 0)**

COMPUTER GRAPHICS

No. of questions to be set: 5 (All are compulsory)

Objective: This course highlights the overview of display devices and peripherals, software and techniques used in computer graphics. Study of the principles of interactive computer graphics; systems organization and device technologies for raster and vector displays; region filling techniques; 2-D and 3- D viewing, clipping, segmentation and interaction handling; 3-D geometrical transformations, projections and hierarchical data structures for graphics modelling including hidden lines and surfaces, lighting, texturing, shading and colour models.

Pre-requisites: Programming concepts and Basic Mathematics

After studying this course, students will be able to:

CO1 Demonstrate an understanding of contemporary graphics hardware

CO2 Create interactive graphics applications

CO3 Implement graphics primitives and 2D geometrical transformations

CO4 Understand 3D concept and transformations

CO5 Understand the various viewing concepts in 3D

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Introduction, overview of graphics systems**	In class	Introduction to computer graphics: Brief Survey of Computer Graphics - Graphics Systems: Video Display Devices - Types - Raster-Scan Systems and Random-Scan Systems – Input Devices - Hard-Copy Devices - Graphics Software	8	1
	Assignment			1
Module 2: **Output primitives**	In class	Output primitives and their attributes, Line-Drawing (DDA and Bresenham's) Algorithms - Circle-Generating (Midpoint) Algorithm - Ellipse-Generating (Midpoint) Algorithms- Area-Filling (Boundary-Fill and Flood-Fill) Algorithms - Line Attributes - Colour and Grayscale Levels - Character Attributes	8	2
	Assignment			2
Module 3: **Two dimensional concepts**	In class	Two-dimensional transformations and viewing: Basic Transformations - Matrix Representations and Homogeneous Coordinates – Composite Transformations - Other Transformations – Window – to - Viewport Coordinate Transformation	9	3

	Assignment			3
Module 4: **Three dimensional concepts**	In class	Three-dimensional concepts: Three-Dimensional Display Methods: Parallel and Perspective Projections - Depth Cueing - Visible Line and Surface Identification -Three-Dimensional Transformations: Translation- Rotation - Scaling - Other Transformations	8	4
	Assignment			4
Module 5: **Three-dimensional viewing**	In class	Three-dimensional viewing: Viewing Pipeline and Coordinates - Transformation from World to Viewing Coordinates - Projections – Parallel Projection- Perspective Projection	6	5
	Assignment			5

Text Books:

1. D. Hearn and M.P. Baker,2005, Computer Graphics, 2ndEdition, Pearson Education, Prentice Hall, 19th Reprint.
2. S. Harrington, 1987, Computer Graphics, 2nd Edition, Tata McGraw-Hill Book Co.

Reference Books:

1. W. M. Newman and R. F. Sproull, 1997, Principles of Interactive Computer Graphics, 2nd Edition, Tata McGraw-Hill Publishing Co. Ltd.
2. D.P. Mukherjee, 1999, Fundamentals of Computer Graphics and Multimedia, 1st Edition, Prentice-Hall of India Pvt. Ltd.

BC411A3 **Credit: 4 (L-4, T-0, P-0)**

INFORMATION THEORY AND CODING

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is intended to give students a basic idea of information theory and coding. The course offers different types of sources and channel coding technique, channel capacity and bounds, probability of error calculation for different channels.

Pre-requisites: Random variable and Process, Probability.

Course Outcomes (CO): Students should be able to

1. Calculate information, entropy and kraft's inequality.
2. Identify the concept of Shannon's theorem.
3. Analyze the concept of mutual information and channel capacity.
4. Inspect error detection and correction in linear block codes.
5. Construct convolutional codes and turbo codes.

Module	Topics to be covered	Topics	Hrs	CO
Module 1: **Information Sources And Properties Of A Codes**	In class Topics	Definition of Information, Properties of Information, Entropy, Information rate, Zero memory information source, Entropy, Properties of Entropy, Markov information source, Adjoint Source, Extensions of a Markov source. source coding: Uniquely decodable codes, Instantaneous codes, Construction of Instantaneous cods, Kraft's Inequality, McMillan's Inequality.	6	1
	Assignment Topics	Tutorial problems on entropy, classification of codes based on kraft's Inequality		1
Module 2: **Information Codes**	In class Topics	The average length of a code, Encoding for the special sources, Shannon's First Theorems, Shannon Fano algorithm, Huffman's Codes, r-array compact cods, code efficiency and redundancy. Shannon- Hartley law, Trade-off between bandwidth and SNR.	6	2
	Assignment Topics	Tutorial problems on source coding		2
Module 3: **Channel And Mutual Information**	In class Topics	Information Channels, probability relation in a channel, apriori and posteriori entropies, A generalization of Shannon's first theorem, Mutual information, properties of mutual information, noiseless and deterministic channels, channel capacity,	9	3

	Assignment Topics	Tutorial problems on mutual information and channel capacity		3
Module 4: **Reliable Messages Through Nonreliable Channels Using Error Correcting Codes**	In class Topics	Error probability and decision rules, The Fano bound, Reliable messages and unreliable channels, An example of coding to correct errors, Hamming distance, Shannon's Second theorem for binary symmetric channel (BSC)-The First step, Random coding- Linear block codes and their properties, syndromes, weight distribution. BCH Codes: Binary and Nonbinary BCH codes (Reed Solomon) BCH codes for Channel performance improvement against burst errors.	7	4
	Assignment Topics	Tutorial problems on linear block codes		4
Module 5: **Convolution Codes, LDPC Codes And Turbo Coding**	In class Topics	Convolutional codes: Convolutional encoders and decoding convolution codes for performance analysis & cyclic codes for error detection and correction. trellis diagrams, Viterbi algorithm. Turbo codes: Turbo encoders and Iterative turbo decoding LDPC Codes: Encoding and decoding	8	5
	Assignment Topics	Tutorial problems on Convolutional codes.		5

Text Books:

1. N. Abrahamson, Information Theory, and coding. 2e, McGraw Hill, 1963
2. Thomos M.Cover et.al, Elements of Information Theory. 2e, Wiley Series in Telecommunication, 2004.
3. Sarah J Johnson, Iterative error correction. Cambridge University Press, 2010.

Reference Books:

1. R.G. Gallager, "Information Theory and reliable communication", Wiley Newyork,1e, 1968
2. Richard E. Blahut, "Principles and practices of information Theory", Addison Wesley,1e 1987.
3. David Slapian, "Key papers in the development of information theory", IEEE press, 1e, 1973.
4. Shu Lin et.al, Error Control coding. 2e, Pearson, 2011