R23

Curriculum & Syllabus for B. Tech under Autonomy
Incorporation of NEP2020

First Year Curriculum Structure (Effective from 2023-24 admission batches)

Department of Computer Science and Engineering

Group A

		1stYear 1stSemester							
Sl.No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	SCI	Multidisciplinary	CH(CSE) 101	Engineering Chemistry	2	0	0	2	2
2	SCI	Multidisciplinary	M101	Engineering Mathematics –I	3	0	0	3	3
3	ENGG	Major	CS101	Programming for Problem Solving	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU(CSE)101	Professional Communication	2	0	0	2	2
5	HUM	Value added course	HU(CSE)102	Values and Ethics	2	0	0	2	2
6	HUM	Value added course	HU(CSE)103	Constitution of India	1	0	0	1	1
B.PRACTICAL									
7	SCI	Skill enhancement	CH(CSE)191	Engineering Chemistry Lab	0	0	2	2	1
8	ENGG	Skill enhancement course	ME(CSE)191	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
9	ENGG	Major	CS191	Programming for Problem Solving Lab	0	0	3	3	1.5
10	HUM	Ability Enhancement Course	HU(CSE)191	Professional Communication Lab	0	0	2	2	1
Total of Theory, Practical, and Mandatory Activities/Courses								23	18

****HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ: Project;***

1st Year 2nd Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS201	Data Structures	3	0	0	3	3
2	SCI	Multidisciplinary	PH(CSE) 201	Engineering Physics	3	0	0	3	3
3	SCI	Multidisciplinary	M(CSE)201	Engineering Mathematics –II	3	0	0	3	3
4	ENGG	Minor	EE(EC) 201	Basic Electrical and Electronics Engineering	3	0	0	3	3
5	HUM	Value added course	HU(CSE)201	Environmental Science	2	0	0	2	2
6	HUM	Value added course	HU(CSE)202	Indian Knowledge System	1	0	0	1	1
B.PRACTICAL									
7	ENGG	Major	CS291	Data Structures Lab	0	0	3	3	1.5
8	SCI	Skill enhancement course	PH(CSE)291	Engineering Physics Lab	0	0	3	3	1.5
9	ENGG	Minor	EE(EC) 291	Basic Electrical and Electronics Engineering Lab	0	0	3	3	1.5
10	ENGG	Skill enhancement course	ME(CSE)291	Engineering Graphics & Design Lab	0	0	3	3	1.5
11	HUM	Ability Enhancement Course	HU(CSE)291	Design thinking Lab	0	0	2	2	1
Total of Theory, Practical, and Mandatory Activities/Courses								29	22

2nd Year 3rd Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS301	Computer Organization and Architecture	3	0	0	3	3
2	ENGG	Major	CS302	Design and Analysis of Algorithms	3	1	0	4	4
3	SCI	Minor	M(CSE)301	Discrete Mathematics	3	0	0	3	3
4	ENGG	Minor	EC(CSE)301	Digital Logic and Electronics	3	0	0	3	3
B.PRACTICAL									
5	ENGG	Major	CS391	Computer Organization and Architecture Lab	0	0	3	3	1.5
6	ENGG	Major	CS392	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
7	ENGG	Skill Enhancement Course	CS393	IT Workshop Lab (SciLab/MATLAB/C++)	0	1	3	4	2.5
8	ENGG	Minor	EC(CSE)391	Digital Electronics Lab	0	0	3	3	1.5
Total of Theory, Practical and Mandatory Activities/Courses								26	20

2nd Year 4th Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS 401	Operating Systems	3	0	0	3	3
2	ENGG	Major	CS 402	Formal Language and Automata Theory	3	0	0	3	3
3	ENGG	Major	CS 403	Computer Networks	3	0	0	3	3
4	SCI	Minor	M(CSE)401	Probability and Statistics	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU(CSE)401	Principles of Management	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	CS 491	Operating Systems Lab	0	0	3	3	1.5
7	ENGG	Major	CS 493	Computer Networks Lab	0	0	3	3	1.5
8	ENGG	Major	CS 494	Programming using Python	0	0	3	3	1.5
9	ENGG	Minor	CS 492	Numerical Methods Lab	0	0	3	3	1.5
10	HUM	Ability Enhancement Course	HU(CSE)491	Soft Skill & Aptitude	2	0	0	2	1
Total of Theory, Practical and Mandatory Activities/Courses								28	21

3rdYear5thSemester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS 501	Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	CS 502	Database Management Systems	3	0	0	3	3
3	ENGG	Major	CS 503	Object Oriented Programming using Java	3	0	0	3	3
4	ENGG	Major	CS 504 A CS 504 B CS 504 C	Compiler Design Cryptography and Network Security Computer Graphics	3	0	0	3	3
5	HUM	Minor	HU(CSE)501	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	CS 591	Artificial Intelligence Lab	0	0	3	3	1.5
7	ENGG	Major	CS 592	Database Management Systems Lab	0	0	3	3	1.5
8	ENGG	Major	CS 593	Object Oriented Programming using Java Lab	0	0	3	3	1.5
9	PRJ	Internship	CS581	Internship	0	0	2	2	2
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

3rd Year 6th Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS 601	Web and Internet Technology	3	0	0	3	3
2	ENGG	Major	CS 602	Machine Learning	3	1	0	4	4
3	ENGG	Major	CS 603	Software Engineering	3	0	0	3	3
4	ENGG	Major	CS 604 A CS 604 B CS 604 C	Mobile Computing Natural Language Processing Cloud Computing	3	0	0	3	3
5	ENGG	Minor	CS 605	Cyber Law and Ethics	3	0	0	3	3
B.PRACTICAL									
6	ENGG	Major	CS 691	Web and Internet Technology Lab	0	0	3	3	1.5
7	ENGG	Major	CS 692	Machine Learning Lab	0	0	3	3	1.5
8	ENGG	Major	CS 693	Software Engineering Lab	0	0	3	3	1.5
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

4th Year 7th Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS 701	Neural Networks and Deep Learning	3	0	0	3	3
2	ENGG	Major	CS 702 A CS 702 B CS 702 C	Advanced Algorithms Advanced Computer Architecture Advanced Operating Systems	3	0	0	3	3
3	ENGG	Minor	CS 703 A CS 703 B CS 703 C	Information Theory and Coding Ad-Hoc and Sensor Networks Data Mining and Data Warehouse	3	0	0	3	3
4	HUM	Minor	HU(CSE)701	Human Resource Development and Organizational Behavior	2	0	0	2	2
B.PRACTICAL									
5	ENGG	Major	CS 791	Neural Networks and Deep Learning Lab	0	0	3	3	1.5
6	ENGG	Major	CS 792 A CS 792 B CS 792 C	Advanced Algorithms Lab Advanced Computer Architecture Lab Advanced Operating Systems Lab	0	0	3	3	1.5
7	PRJ	Project	CS 793	Major Project-I	0	0	12	12	6
Total of Theory, Practical and Mandatory Activities/Courses								29	20

4th Year 8th Semester									
Sl.No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS 801 A CS 801 B CS 801 C	Real Time Systems Data Analytics Soft Computing	3	1	0	4	4
2	ENGG	Major	CS 802 A CS 802 B CS 802 C	VLSI Design & Application Bio-informatics Robotics	3	1	0	4	4
3	ENGG	Minor	CS 803 A CS 803 B CS 803 C	Introduction to IoT Image Processing Optimization Techniques	3	0	0	3	3
B.PRACTICAL									
4	ENGG	Minor	CS 893 A CS 893 B CS 893 C	Internet of Things Lab Image Processing Lab Optimization Techniques Lab	0	0	3	3	1.5
5	PRJ	Project	CS 881	Major Project-II	0	0	12	12	6
6	PRJ	Internship	CS882	Grand Viva	0	0	0	0	1.5
Total of Theory, Practical and Mandatory Activities/Courses								26	20

Department: Computer Science & Engineering

Curriculum Structure & Syllabus

(Effectivefrom2023-24 admission batch)

1st Year 1st Semester									
Sl.No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS101	Programming for Problem Solving	3	0	0	3	3
2	SCI	Multidisciplinary	CH(CS)101	Engineering Chemistry	2	0	0	2	2
3	SCI	Multidisciplinary	M(CS)101	Engineering Mathematics –I	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU101	Professional Communication	2	0	0	2	2
5	HUM	Value added course	HU102	Values and Ethics	2	0	0	2	2
6	HUM	Value added course	HU103	Constitution of India	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS191	Programming for Problem Solving Lab	0	0	3	3	1.5
2	HUM	Ability EnhancementCourse	HU191	Professional Communication Lab	0	0	2	2	1
3	SCI	Skill enhancement course	CH(CS)191	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Skill enhancement course	ME(CS)191	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
Total of Theory & Practical								23	18

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ: Project;*

Course Name: Programming for problem solving
Course Code: CS101
Contact (Periods/Week):3L/Week
Total Contact Hours: 36
Credits: 3

Course Outcome(s):

CO1: To identify the working principle of input and output devices of Computers memorize the basic terminology used in computer programming.

CO2: To express programs in C language and use different data types for writing the programs.

CO3: To implement programs using the dynamic behavior of memory by the use of pointers. **CO4:** To explain the difference between call by value and call by address.

CO5: To write programs using basic data files and developing applications for real world problems.

CO-PO-PSO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2						2	3	2	3	3
CO2	2	2	3	3	3							3	2	2	3
CO3	2	3	2	2	2							3	2	3	2
CO4	3	2	2	3	3							2	2	2	2
CO5	2	2	2	1	1						2	3	3	3	3

Course Content:

Module-1: Fundamentals of Computer (9L)

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.

Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in singed magnitude singed 1's complement system and signed 2's complement system.

Arithmetic– Addition and Subtraction (using1's complement and 2's complement). Representation of Characters-ASCII Code, Basics of Compiler, Interpreter and Assembler

Problem solving – Basic concept of Algorithm. Representation of algorithm using flowchart and pseudo code, Some basic examples.

Module-2: Introduction to C Programming (5L)

Overview of Procedural vs Structural language; History of C Programming Language. Variable and Data Types: The C characters identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational operators, Logical operators, increment and decrement operators, bitwise operators, Assignment operators, conditional operators, special operators-type Conversion, C expressions, precedence and associativity. Input and Output: Standard input and output, formatted output–printf, formatted input scanf.

Module-3: **Branch and Loop (5L)**

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder. Switch Case: break and continue; switch-case, concept of go to and labels Loops- while, for, do while.

Module-4: Program Structures (4L)

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function.

Storage Class in C: Storage Class-auto, external, static and registers to rage class, scope rules and lifetime of variables

C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: **Array and Pointer (7L)**

Arrays: One dimensional array, Two-dimensional arrays Passing an array to a function Pointers: Pointers, Pointer and Array, Pointer and functions.

Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String. Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum (3L)

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C (3L)

Files handling-opening and closing a file indifferent mode, formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2. **Kanetkar Y.- Let us C, BPB Publication,15th Edition**

Reference Books:

1. Brian W.Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad– MASTERINGC,TMH,2ndEdition

Course Name: Engineering Chemistry
Course Code: CH(CS)101
Total Contact Hours: 24
Credits: 2
Prerequisites:

COURSE OBJECTIVE

- To understand the basic principles of elements, organic reactions, drug synthesis and technological aspects of modern chemistry
- To apply the knowledge of different engineering materials, advanced polymers, and nanomaterials to solve complex engineering problems
- To analyze and evaluate quality parameters of water and its treatment
- Apply the knowledge of free energy, energy storage device, semiconductors, fuels and corrosion to design environment friendly & sustainable devices
- Apply the knowledge of different instrumental techniques to analyze unknown engineering materials.

COURSE OUTCOME

CO1. Able to understand the basic principles of elements, organic reactions drug synthesis and computational chemistry
CO2. Able to apply the knowledge of different engineering materials, advanced polymers, and nanomaterials to solve complex engineering problems
CO3. Able to analyze and evaluate water quality parameters and its treatment
CO4. Able to the knowledge of free energy, energy storage device, fuels and corrosion to design environment friendly & sustainable devices
CO5. Able to apply the knowledge of different instrumental techniques to analyze unknown engineering materials

CO v/s PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	2	2	2	-	-	-	-	-	2	2
2	3	3	3	3	-	-	2	-	-	-	2	2
3	3	3	-	-	-	-	3	-	-	-	3	2
4	3	3	3	2	-	-	3	-	-	-	3	2
5	3	3	3	3	2	-	-	-	-	-	2	2

COURSE CONTENT

Module 1 - Elements and their properties (6L)

1. **Elements and their properties(3L)**
   Bohr's theory for one electron system, Hydrogen spectrum, Quantum numbers, atomic orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle, Electronic configuration and Magnetic properties.

2. **Periodic Table for Engineers(3L)**
   Modern Periodic table, Periodic properties, study of advanced functional materials like Silicones, Silicates, Zeolite and alloys like steel, mischmetall, Neodymium alloy and their applications.

Module 2 - Energy devices and Semiconductors (6L)

1. **Use of free energy in chemical equilibria(3L)**
   Laws of Thermodynamics, Enthalpy, Entropy, Spontaneity, Electrochemical Cell, Dry Cell, Mercury Cell, Lead Storage batteries, Ni-Cd Cells, Fuel Cells, Solar Cells, Nernst equation and applications, Electrochemical sensors
2. **Crystals and Semiconductors(3L)**
   Crystals and their defects, Stoichiometric and Non-stoichiometric defects, Band theory and Doping, n-type and p-type semiconductors, Superconductors

Module 3 –Industrial Applications of Chemistry (8L)

1. **Advanced Polymeric materials (3L)**
   Classification, Engineering Plastics, conducting polymers, bio polymers, polymer composites
2. **Industrial corrosion(2L)**
   Classification, Effects of corrosion, Preventive measures
3. **Analysis of Water Quality (1L)**
   Physicochemical and Biological parameters
4. **Nano materials(1L)**
   Synthesis of Nano materials, Applications in modern devices
5. **Basic Computational Chemistry(1L)**
   Introduction of computational chemistry and their applications

Module 4 – Organic Reaction Products and their spectroscopic analysis (4L)

1. **Organic Reactions(2L)**
   Substitution, Elimination and Addition reactions
2. **Drug designing and synthesis(1L)**
   Paracetamol, Aspirin
3. **Spectroscopic Analysis (1L)** UV – Visible Spectra, IRspectra

Course Name: Engineering Mathematics -I
Paper Code: M(CS)101
Contact (L: T: P): 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra, and calculus.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in matrix algebra and calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Recall the properties related to matrix algebra and calculus.

CO2: Determine the solutions of the problems related to matrix algebra and calculus.

CO3: Apply the appropriate mathematical tools of matrix algebra and calculus for the solutions of the problems.

CO4: Analyze different engineering problems linked with matrix algebra and calculus.

CO-PO/PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	2	-	-	-	-	-	-	-	1
CO	**2.75**	**2.25**	**1.5**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.25**

Weightage Values: Strongly mapped: ‘3’, moderately mapped: ‘2’, weakly mapped: ‘1’, Not mapped: ’-‘

Course Content:

Module I: Liner Algebra (11L)
Echelon form and normal (canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigen values and eigenvectors; Diagonalization of matrix, Cayley-Hamilton theorem.

Module II: Single Variable Calculus (5L)
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Power series; Taylor's series.

Module III: Multivariable Calculus (Differentiation) (13L)
Function of several variables; Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function; Jacobian; Maxima and minima of functions of two variables.

Module IV: Multivariable Calculus (Integration) (7L)
Double Integral, Triple Integral; Change of order in multiple integrals; Line Integral, Surface Integral, Volume Integral. Change of variables in multiple integrals.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age InternationalPublishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.

Course Name: Professional Communication
Paper Code: HU101
Contact: 2:0:0
Total Contact Hours: 24
Credit: 2

Pre-requisites:	Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.
Course Objectives	The course aims to impart domain and industry-specific communications kill sin a globalized context and to promote the understanding of business communication ractices and cross cultural dynamics.
Course Outcomes:	By pursuing this course the students shall be able to
	1. Define, describe and classify the modalities and nuances of communication in a workplace context.
	2. Review, appraise and understand the modes, contexts and appropriacy of communicating across cultures and societies.
	3. Identify, interpret and demonstrate the basic formats, templates of business and official communication.
	4. Identify, compare and illustrate reading strategies and basic writing strategies.
	5.Interpret, analyze and evaluate semantic-structural, interpersonal and multicultural dynamics in business communication.

Course Content:

Module1:
Verbal and Nonverbal communication **4L**
Definition, Relevance and Effective Usage
Components of Verbal Communication: Written and Oral Communication
Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage
Barriers to Effective Communication

Module2:
Workplace Communication Essentials and Cross Cultural Communication **4L**
Communication at the Workplace—Formal and Informal Situations
Language in Use—Jargon, Speech Acts/Language Functions, Syntactical and Grammatical Appropriacy
Cultural Contexts in Global Business: High Context and Low Context Cultures Understanding Cultural Nuances and Stereotyping Achieving Culturally Neutral Communication in Speech and Writing

Module3: **4L**
Reading Strategies and Basic Writing Skills
Reading: Purposes and Nature of Reading
Reading Sub-Skills—Skimming, Scanning, Intensive Reading
Reading General and Business Texts (Reading for Comprehension and Detailed Understanding)
Basic Writing Skills—Paragraph and Essay writing, writing technical documents
Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Module4: **4L**

Report Writing

Nature and Function of Reports
Types of Reports
Researching for a Business Report
Format, Language and Style
Report Documentation

Module5:

Employment Communication

a. WritingBusinessLetters—(Enquiry,Order,Sales,Complaint,Adjustment,JobApplication,Offer) **2L**

b. Creating an Employee Profile—Preparing a CV orRésumé.

Creating a Digital/Online Profile–LinkedIn(Résumé/VideoProfile) **2L**

c. Writing Other Interoffice Correspondence--E-mails: types, convention, and etiquette, Memo, Notices andCirculars **2L**

d. Preparing Meeting Documentation—Drafting Notice and Agenda of Meetings, Preparing Minutes of Meetings. **2L**

References:-

1. **Meenakshi Raman and Sangeetha Sharma. Technical Communication. 3rd edition. New Delhi: Oxford University Press,2015.**
2. Mark Ibbotson. Cambridge English for Engineering. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. Professional English in Use: Engineering. Cambridge: Cambridge UP,2009.
4. Lesikar et al. Business Communication: Connecting in a Digital World. New Delhi: TataMcGraw-Hill,2014.
5. John Seeley. Writing Reports. Oxford: Oxford University Press,2002.
6. Judith Leigh. CVs and Job Applications. Oxford: Oxford University Press,2002.
7. Judith Leigh. Organizing and Participating in Meetings. Oxford: Oxford University Press, 2002.
8. Michael Swan. Practical English Usage. Oxford: OUP,1980.
9. Pickett, Laster and Staples. Technical English: Writing, Reading & Speaking. 8 thed.London: Longman, 2001.
10. Diana Booher. E-writing: 21st Century Tools for EffectiveCommunication.

Links:-

1. PurdueUniversity'sOnlineWritingLab(OWL)-https://owl.purdue.edu/
2. BusinessEnglishPod-https://www.businessenglishpod.com/

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	2	1	1	2	3	-	2
CO2	-	-	-	-	-	1	1	2	2	3	-	3
CO3	-	-	-	-	-	3	3	1	1	3	2	3
CO4	-	-	-	-	-	3	3	1	-	3	-	3
CO5						2	2	2	2	3	-	3

Course Name: Values and Ethics
Course Code: HU102
Contacts: 2:0:0
Total Contact Hours: 24
Credit: 2
Prerequisite: None

Module: 1 Introduction:(4L)
Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, and Social
Types of values-Social, Psychological, Aesthetic, Spiritual, and Organizational
Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Module 2: Universal Human Harmony. (4L)
Basic Human Aspirations, Happiness and Prosperity, Self-Exploration, Self and the Body Understanding the harmony in the Nature.
Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature.
Values Crisis in contemporary society Nature of values: Value Spectrum of a good life (Maslow's Pyramid)

Module: 3 Ethical Concerns: (6L)

Renewable Energy Resources, Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics. Rapid Technological growth and depletion of resources, Reports of the Club of Rome.

Problems of Technology transfer- Technology assessment impact analysis -Human Centered Technology.

Module: 4 Ethics of Profession: (4L)

Work Ethics and Work Values, Business Ethics, Human values in organizations: Social and ethical responsibilities of Technologists. Codes of professional ethics.

Types of Ethical issues-Internal Ethics of Business–

Whistle Blowing, Impact of Ethics on Business Policies and Strategies– Ethical Leadership – Characteristics

Module: 5 Self Development AND Gender Awareness (6L)

Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender
Gender Roles and Relations, Types of Gender Roles, Gender Roles and Relationships Matrix, Gender- based Division and Valuation of Labour. Gender Development Issues, Identifying Gender Issues

Text Books:

1. Beneria, Lourdes. (2004). Gender, Development, and Globalization: Economics as if All People Mattered. Roultedge Press.(GDGE)
2. Molyneux and Razavi. (2002). Gender Justice, Development and Rights. Oxford University Press (GJDR orWGD)
3. Visvanathan, Duggan,Wiegersma and Nisonoff.(2011).

4. The Women, Gender and Development Reader. 2nd Edition. Zed Press(WGD)
5. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2ndEd)
6. DeborahJohnson,EthicalIssuesinEngineering,PrenticeHall,EnglewoodCliffs,NewJersey1991.
7. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

Course Outcomes:

CO 1	Understand the significance of values, various approaches to ethics and its applications in life and profession.
CO2	Able to distinguish Self and the Body, to understand Harmony in the Self
CO3	To identify and eradicate environmental concerns through technology
CO4	Demonstrate work ethics and analyse business strategies
CO5	Ability to understand gender terminologies and to identify gender issues

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**2**
CO2	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**2**	**-**	**-**
CO3	**-**	**3**	**3**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**2**
CO4	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**-**
CO5	**-**	**3**	**-**	**-**	**-**	**2**	**1**	**-**	**-**	**2**	**-**	**2**

Paper Name: Constitution of India
Paper Code: HU103
Credit: 01
No. of lectures: 12

Module 1: History of Making of the Indian Constitution: History. Drafting Committee, (Composition & Working) **3L**
Philosophy of the Indian Constitution: Preamble Salient Features
Module2: FundamentalRights,FundamentalDuties,DirectivePrinciplesofStatePolicy **6L**

The Right to Equality
The Right to Freedom: I (Article 19)
The Right to Freedom: II (Articles 20, 21 and
22) The Right against Exploitation
The Right to freedom of
Religion Cultural and
Educational rights The Right to
Property
The Right to Constitutional Remedies
Fundamental Duties

Module-3: Organs of Governance: 3L
Parliament - Composition - Qualifications and Disqualifications -Powers and Functions – Executive- President -Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers andFunctions

Text / Reference Books:

1) Indian Constitution by D. D. Basu, The Publisher,LexisNexis
2) Constitution of India by Subhas C Kasyap, VitastaPublishing
3) TheConstitutionofIndia,P.MBakshi,UniversalLawPublishingCo.Ltd,NewDelhi,2003.
4) IndianConstitutionTextBook-Avasthi,Avasthi,Publisher:LAKSHMINARAINAGARWAL
5) Introduction to the Constitution of India, Brij Kishore Sharma,PHI

Course Name: Programming for problem solving
Lab Course Code: CS191

Contact Hours: 3L/Week
Total Contact Hours: 36
Credits: 1.5

Course Outcomes	Name of Course Outcomes
CO1	To identify the working of different operating systems like DOS, Windows, Linux
CO2	To express programs in C language
CO3	To implement programs connecting decision structures, loops
CO4	To experiment with user defined functions to solve real time problems
CO5	To write C programs using Pointers to access arrays, strings, functions, structures and files

CO-PO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2						2	3	2	3	3
CO2	2	2	3	3	3							3	2	2	3
CO3	2	3	2	2	2							3	2	3	2
CO4	3	2	2	3	3							2	2	2	2
CO5	2	2	2	1	1						2	3	3	3	3

Course Content:

Module- 1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Codeblock.

Module-2: Problem based on

a) Basic datatypes
b) Different arithmeticoperators.
c) Printf() and scanf()functions.

Module-3: Problem based on conditional statements using

a) if-else statements
b) different relationaloperators
c) different logicaloperators

Module-4: Problem based on

a) **for** loop
b) **while** loop
c) **do-while** loop

Module-5: Problem based on

a) How to write a menu driven program using switch-case statement
b) How to write a function and passing values to a function
c) How to write a recursive function.

Module-6: Problem based on

a) How to use array (bothI-Dand2-D).
b) How to pass an array to a function.

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

a) How to handle compound variable sin C
b) How to handle file in C
c) How to use command line argument in C

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. Kanetkar Y.-Let us C,BPB Publication,15th Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India K R Venugopal & S R Prasad–MASTERINGC,TMH, 2nd Edition

Course Name: Professional Communication Lab
Course Code: HU191
Contact: (0:0:2)
Total Contact Hours: 26
Credit: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Objectives: To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error feedback.

Course Outcome:
By pursuing this course the students will be able to:
CO1: Recognize, identify and express advanced skills of Technical Communication in English through Language Laboratory.
CO2: Understand, categorize, differentiate and infer listening, speaking, reading and writing skills in societal and professional life.
CO3: Articulate and present the skills necessary to be a competent Interpersonal communicator. CO4: Deconstruct, appraise and critique communication behaviors.
CO5: Adapt, negotiate and facilitate with multifarious socio-economical and professional arenas with effective communication and interpersonal skills.

Course Contents:
Module 1: Introduction to the Language Lab
a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Notebooks

Module 2: Active Listening
a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Listening in Business Telephony

Module 3: Speaking
a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focused activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focused activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice
f. Giving a Presentation—Learning Presentation Basics and Giving Micro Presentations

Module 4: Lab Project Work
a. Writing a Book Review
b. Writing a Film Review
c. Scripting a Short Presentation (2minutes)
d. Making a short video CV (1-2minutes)

References:

1. IT Mumbai**, Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasi Kumar et al. *A Course in Listening and Speaking*. New Delhi: Foundation Books, 2005.
4. Tony Lynch, *Study Listening*. Cambridge: Cambridge UP,2004.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	-	1	1	-	2	3	-	2
CO2	-	-	2	2	-	3	3	-	2	3	-	3
CO3	-	-	2	2	-	3	3	2	2	3	-	3
CO4	-	-	-	-	-	3	3	2	2	3	-	3
CO5	-	-	2	2	-	3	3	2	2	3	-	3

Course Name: Engineering chemistry lab
Paper Code: CH (CS) 191
Total Contact Hours: 24
Credit: 1

Course Objective

- Study the basic principles of pH meter and conductivity meter for different applications
- Analysis of water for its various parameters & its significance in industries
- Learn to synthesis Polymeric materials and drugs
- Study the various reactions in homogeneous and heterogeneous medium

Course Outcome

CH191.1: Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CH191.2: Able to analyse and determine the composition and physical property of liquid and solid samples when working as an individual and also as a team member
CH191.3: Able to analyse different parameters of water considering environmental issues
CH191.4: Able to synthesize drug and sustainable polymer materials.
CH191.5: Capable to design innovative experiments applying the fundamentals of modern chemistry

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	1	3	1	-	2	3	-	-	-	-	1
2	2	2	1	1	-	1	-	-	-	1	-	1
3	-	-	-	-	-	-	-	-	3	3	2	2
4	2	1	2	2	-	-	1	-	-	-	-	2

5	3	3	3	3	1	1	1	1	-	-	2	2

COURSE CONTENT

1. Determination of the concentration of the electrolyte through conductance measurement.
2. Determination of water quality measurement techniques.
3. Determination of the concentration of the electrolyte through pH measurement.
4. Estimation of Cu in brass
5. Estimation of Fe_2O_3 in Cement
6. Isolation of graphene from dead dry batteries and their use for temporary soldering.
7. Synthesis of Silver Nanoparticles doped organic thin film for organic transistors.
8. Estimation of corrosion in a given sample metal.
9. Preparation of Si-nano crystals for future memory devices.
10. Green Synthesis of ZnO based Polymer Nano composites.
11. Synthesis of polymers for electrical devices and PCBs.
12. Determination of Partition Coefficient of acetic acid between two immiscible liquids.
13. Drug design and synthesis
14. Rheological properties of the Newtonian fluids
15. Innovative Experiments

Course Name: Workshop and Manufacturing
Lab Course Code: ME(CS)191
Contact: 0:0:3
Credits: 1.5

Prerequisite: Physics & Mathematics (10+2 Level)

CO1: Gain basic knowledge of Workshop Practice and Safety useful for our daily living.
CO2: Understand the use of Instruments of a pattern shop like Hand Saw, Jack Plain, Chisels etc.
CO3: Apply and performing operations like such as Marking, Cutting etc used in manufacturing processes.
CO4: Analyze the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc to understand the concept of tolerances applicable in all kind of manufacturing.
CO5: Gethandson practice of in Welding and apply various machining processes which give a lot of confidence to manufacture physical prototype sin project works.

Course Content:

3P

(i)Theoretical discussions:

1. Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding(arc welding & gas welding),brazing
5. Electrical Electronics
6. Metal casting
7. CNC machining ,Additive manufacturing, 3D Printing
8. Plastic molding &Glass Cutting

(ii)Workshop Practice:

At least 6 Modules should be covered

Module 1-Machineshop **6P**

Typical jobs that may be made in this practice

i. To make a pin fromamild steel rod in lathe.
ii. Tomakerectangularandveeslotinablockofcastironormildsteelinashapingand/ormillingmachine.

Module2-Fitting shop **6P**

Typicaljobsthatmaybemadeinthispractice**Module**: TomakeaGaugefromMSplate.

Module3 –Carpentry Shop **6P**

Typicaljobsthatmaybemadeinthispractice**Module**: Tomakewoodenjointsand/or apatternorlike.

Module4-Welding & Soldering shop **6P**

Typicaljobsthatmaybemadeinthispractice**Module**:

i. Arc Welding:To jointwothick (approx5mm)MSplatesby manualmetalarcwelding.
ii. Gas Welding:Tojointwothinmild steelplatesorsheetsbygaswelding.
iii. Housewiring,softSoldering

Module 5–Smithy & Casting **6P**

Typical jobsthatmaybemadeinthispractice**Module**:

i. Asimplejobofmakingasquarerodfromaroundbar or similar.
ii. One/twogreensandmodulstoprepare, andacastingbedemonstrated.

Module6– CNC Machining & LaserCutting 6P

Typicaljobsthatmaybemadeinthispractice**Module**:

i. Atleastonesample shape on mild steel plate shouldbe made using CNC Milling / CNC Lathe Machine
ii. Atleastonesampleshape onglassshouldbe madeusinglasercuttingmachine.

Module 7 – 3D Printing 6P

i) Exposure to a 3D printing machine,
ii) 3D printing of at least one sample model using available materials.

Examinationscouldinvolvetheactualfabricationofsimplecomponents, utilizingoneormoreofthetechniques coveredabove.

TextBooks:

1. HajraChoudhuryS.K., HajraChoudhuryA.K.andNirjharRoyS.K.,-ElementsofWorkshopTechnology‖,Vol.I2008andVol.II 2010,Media promotersandpublishersprivatelimited,Mumbai.
2. RaoP.N.,-ManufacturingTechnology‖,Vol.IandVol.II, TataMcGrawHillHouse,2017.

ReferenceBooks:

1. GowriP.,HariharanandA.SureshBabu, ManufacturingTechnology–I,PearsonEducation,2008.
2. RoyA.Lindberg,-Processes and MaterialsofManufacture‖, 4thedition,PrenticeHallIndia,1998.
3. KalpakjianS.andStevenS.Schmid,ManufacturingEngineeringandTechnology,4thedition,PearsonEducationIndiaEdition,2002.
4. ManufacturingScience byA.GhoshandA.K.Mallick,WileyEastern.
5. PrinciplesofMetalCutting/PrinciplesofMachineToolsby G.C. SenandA.Bhattacharya,NewCentralBookAgency,Kolkata.

CO-PO/PSO Mapping:

CO Codes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						2		2	2					
CO2	3						2		2	2					
CO3	3						2		2	2			2		2
CO4	3						2		2	2			2		2
CO5	3	2	2				2		2	2					

1st Year 2nd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS201	Data Structures	3	0	0	3	3
2	ENGG	Minor	EE(CS)201	Basic Electrical & Electronics Engineering	3	0	0	3	3
3	SCI	Multidisciplinary	PH(CS)201	Engineering Physics	3	0	0	3	3
4	SCI	Multidisciplinary	M(CS)201	Engineering Mathematics –II	3	0	0	3	3
5	HUM	Value added course	HU204	Environmental Science	2	0	0	2	2
6	HUM	Value added course	HU205	Indian Knowledge System	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS291	Data Structures Lab	0	0	3	3	1.5
2	ENGG	Minor	EE(CS)291	Basic Electrical & Electronics Engineering Lab	0	0	3	3	1.5
3	HUM	Ability Enhancement Course	HU292	Design Thinking	0	0	2	2	1
4	SCI	Skill enhancement course	PH(CS)291	Engineering Physics Lab	0	0	3	3	1.5
5	ENGG	Skill enhancement course	ME(CS)291	Engineering Graphics & Design Lab	0	0	3	3	1.5
Total of Theory & Practical								29	22

Course Name: Data Structures
Course Code: CS201
Contact (Periods/Week):=3L/Week
Total Contact Hours: 36
Credits: 3

Course Objectives:

1. To learn the basics of abstract datatypes.
2. To learn the principles of linear and nonlinear datastructures.
3. To build an application using sorting andsearching.

Course Outcomes	Name of Course Outcomes
CO1	To identify how the choices of data structure & algorithm methods impact the performance ofprogram.
CO2	To express problems based upon different data structure for writingprograms.
CO3	To implement programs using appropriate data structure & algorithmic methods for solving problems.
CO4	To explain the computational efficiency of the principal algorithms for sorting, searching, and hashing.
CO5	To write programs using dynamic and static data structures and building applications for real world problems.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2	3						1	3	1	1	1
CO2	3	2	2	2	2							2	3	2	2
CO3	2	3	3	2	3						1	2	3	3	3
CO4	2	2	2	3	1							1	2	1	2
CO5	2	3	3	3	2						1	2	3	3	3
	2.40	**2.40**	**2.50**	**2.40**	**2.20**							**2.00**	**2.40**	**2.00**	**2.20**

Course Content:

Module 1: Introduction [4L]

Concepts of data and information; Concept of Abstract Data Type, Data Structure and Data Type. Classification of Data Structures- Primitive and Non-Primitive Data Structure, Linear and Non-Linear Data Structure. Need of Data Structures. (1L)

Concept of algorithms and programs, Different methods of representing algorithm; Algorithm analysis, time and space analysis of algorithms – Asymptotic notations like Big Oh (O), Small Oh(o), Big Omega(Ω), Small Omega(ω) and Theta(Θ) notation (definition and significance).(3L)

Module 2: Non-Restricted Linear Data Structure[9L]

List or Linear List: Definition and Example, List as ADT. Representation of Linear List- Sequential Representation and Linked Representation.
Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array-representation of polynomial using array,Representation ofSparsematrixusingarray.
Linked List: Introduction to linked representation, Implementation of different types of linked list- Singly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List. Application of Linked list- Representation ofpolynomial.

Module 3: Restricted Linear Data Structure [6L]

Stack: Definition of Stack, implementations of stack using array and linked list, Applications of stack- infix to postfix conversion, Postfix Evaluation
Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion. Queue: Definition of Queue; Implementation of queue using array-physical, linear and circular model; Implementation of queue using linkedlist.
Dequeue - Definition and different types of dequeue.

Module 4: Nonlinear Data structures [9L]

Trees and Binary Tree:

Basic terminologies; Definition of tree and binary tree. Difference between tree and binary tree, Representation of binary tree (using array and linked list)
Binary tree traversal (pre-, in-, post- order); Threaded binary tree- definition, insertion and deletion algorithm; Binary search tree- Definition, insertion, deletion, searching algorithm;
Height balanced binary tree: AVL tree- definition, insertion and deletion with examples only.
m –Way Search Tree: B Tree – Definition, insertion and deletion with examples only; B+ Tree – Definition, insertion and deletion with examples only.
Heap: Definition (min heap and max heap), creation, insertion and deletion algorithm. Application of heap (priority queue and sorting).
Graphs: Definition and representation (adjacency matrix, incidence matrix and adjacency list).
Graph traversal– Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, andforward-edge).

Module 5: Sorting and Searching [8L]

Sorting Algorithms: Definition and need of sorting, different types of sorting algorithm (internal, external, stable, in-place, comparison based); Factors affecting sorting Methods, Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort – algorithm with analysis (time complexity) Searching: Factors affecting searching Methods; Sequential search –algorithm with analysis (time complexity); improvement using sentinel.
Binary search and Interpolation Search algorithm with analysis (time complexity)
Hashing: Introduction and purpose of Hashing and Hash functions (division, folding and mid-

square), Collision resolution techniques.

Text book:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPBPublications
2. FundamentalsofDataStructuresofCbyEllisHorowitz,SartajSahni,SusanAnderson-freed2nd Edition, Universities Press

Reference Books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. DataStructuresandProgramDesigninCbyRobertL.Kruse,BruceP.Leung2ndEdition,Pearson
4. DataStructuresinCbyAaronM.Tenenbaum,1sEdition,Pearson.

Course Name: Basic Electrical & Electronics Engineering
Course Code: EE(CS)201
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.

Course Outcomes: After successful completion of the course, student will be ableto

CO	Statement
CO1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO2	To solve simple ac circuits in steady state
CO3	Impart the knowledge of Basic Electronics Devices and ICs.
CO4	Analyze the simple electronics circuits

MODULE 1: Elementary Concepts of Electric Circuits 6L

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problemsonly)

MODULE 2:Electrical machine 8L

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation andefficiency.

DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.

MODULE 3: Fundamentals of Semiconductor Devices: 6L

Introduction to Semiconductor: Concept of energy band diagram; Comparison among metal, insulator, semiconductor; Semiconductors-classifications and Fermi energy level; Charge neutrality and Mass-Action law in semiconductor; Current flow in semiconductor due to drift & diffusion process; Einstein relation.

MODULE 4: PN Junction Diode: 4L

Principle of operation; V-I characteristics; principle of avalanche & Zener breakdown; Junction resistances and capacitances; V-I characteristics of Zener diode.

MODULE 5: Bipolar Junction Transistors: 4L

PNP and NPN structures; Principle of operation; Current gains in CE, CB and CC mode; input and output characteristics; Biasing & Stability Analysis-Concept of Fixed Bias, Collector to base Bias & voltage divider bias.

MODULE 6: Introduction to IC: 8L

Integrated circuit-Basic idea, classifications, advantages, disadvantages; OPAMP(IC741)-Pin configuration and equivalent circuit; Characteristics of OPAMP(IC741); Inverting & Non- Inverting Amplifier; Adder, Subtractor, Differentiator & Integrator Circuit.

Textbooks:

1. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) & VolumeII(Ac&DCMachines)-B.LTheraja&A.K.Teraja,S.Chad,23rdEdition,1959
2. D. Chattopadhyay, P.C Rakshit, "Electronics Fundamentals and Applications", New Age International (P) Limited Publishers, SenenthEdition,2006
3. Basic Electrical & Electronics Engineering by J.B. Gupta , S.K.Kataria & Sons,2013
4. Basic Electrical and Electronics Engineering-I by Abhijit Chakrabarti and Sudip Debnath, McGraw Hill,2015
5. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford UniversityPress,2012.
6. DP Kothari and IJ Nagrath, "Basic Electrical & Electronics Engineering", Tata McGraw Hill,2020.

Reference Books

1. D C Kulshreshtha, "Basic ElectricalEngineering",TataMcGrawHill,2010.
2. T.K. Nagsarkar, M.S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hughes,"Electrical and Electronic Technology", PearsonEducation".
4. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
5. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers,2005.
6. Bernard Grob, Basic Electronics,McGrawHill.
7. Chinmoy Saha, Arindham Halder and Debarati Ganguly, Basic Electronics-Principles and Applications, Cambridge University Press,2018.

CO-PO Course Articulation Matrix Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	2	1	-	-	-	-	-	-	2	2
CO2	3	3	2	1	-	-	-	-	-	-	2	2
CO3	3	2	2	1	-	-	-	-	-	-	1	2
CO4	2	3	2	1	-	-	-	-	-	-	2	1

Course Name: Engineering Physics
Course Code: PH (CS)201
Contact: (3:0:0)
Total Contact Hours: 36
Credits: 3
Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of courses in Physic-I is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes (COs):

After attending the course students' should be able to

CO	Description
CO1	explain basic principles of laser and optical fibers.
CO2	understand the properties of Nano material.
CO3	analyze different crystallographic structures according to their co-ordination number and packing factors.
CO4	analyze the structure, function and characteristics of different storage devices.
CO5	justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	--	--	--	--	--	--	--	2
CO2	3	3	2	2	--	--	--	--	--	--	--	2
CO3	3	3	2	2	--	--	--	--	--	--	--	1
CO4	3	2	2	2	--	--	--	--	--	--	--	2
CO5	3	3	3	2	2	--	--	--	--	--	--	1

Course Content:

Module 1 (12L)
Modern Optics

1.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and
equations, working principle of laser, meta stable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 6L

1.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems.3L

1.03-Holography-Theory of holography, viewing of holography, applications 3L

Module 2 (6L) Solid State Physics

2.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numericalproblems.

3L

2.02 Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-njunction.3L

Module 3 (8L) Quantum Mechanics

3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity;deBrogliehypothesis;DavissonandGermerexperiment,relatednumericalproblems.

4L

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions-Qualitative discussion; uncertainty principle, relevant numerical problems, Introduction of Schrödinger wave equation (only statement). 4L

Module 4 (4L)

Physics of Nano materials

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, graphene, electronic, environment,medical).

Module 5 (6L)

Storage and display devices

Different storage and display devices-Magnetic storage materials, Hard disc (examples related to computers compared with semiconductor storage viz. Pendrive), Operation and application of CRT, CRO, Liquid crystal display (LCD), LED, OLED, Plasma display, Thin film transistor display).

Recommended Text Books for Physics I:

Text Books:

1. Refreshercoursesinphysics(Vol.1,Vol.2&Vol.3)-C.L.Arora(S.ChandPublishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt.Ltd.)
3. Perspective & Concept of Modern Physics -ArthurBaiser
4. Principles of engineering physics – Md. N Khan and SPanigrahi.

Course Name: Engineering Mathematics - II
Paper Code: M(CS)201
Contact (L: T: P): 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standard calculus.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations, Laplace transform and numerical methods. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Recall the properties related to ordinary differential equations, Laplace transform and numericaltechniques.

CO2: Determine the solutions of the problems related to ordinary differential equations, Laplace transform and numerical techniques.

CO3: Apply appropriate mathematical tools of ordinary differential equations, Laplace transform and numerical techniques for the solutions of the problems.

CO4: Analyze engineering problems by using ordinary differential equation, Laplace transform and numerical Methods.

CO-PO/PSO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	2	-	-	-	-	-	-	-	1
M(CS) 201	**2.75**	**2.25**	**1.5**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.25**

Weightage Values: Strongly mapped: ‘3’, Moderately mapped: ‘2’, Weakly mapped: ‘1’, Not mapped: ’-‘.

Course Content:

Module I: First Order Ordinary Differential Equations (ODE) (9L)
Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation.**Solution of first order and higher degree ODE**: solvable forp, solvable for y and solvable for x and Clairaut'sequation.

Module II: Second Order Ordinary Differential Equations (ODE) (8L)

Solution of second order ODE with constant coefficients: C.F. &P.I., Method of variation of parameters, Cauchy-Euler equations.

Module III: Laplace Transform (LT) (12L)

Concept of improper integrals; Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of tf(t), LT of f(t)t, LT of derivatives of f(t), LT of integral of f(t), Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) usingLT.

Module IV: Numerical Methods (7L)

Introduction to error analysis, Calculus of finite difference. **Interpolation:** Newton forward and backward interpolation, Lagrange's interpolation. **Numerical integration:** Trapezoidal rule, Simpson's 1/3 rule. **Numerical solution of ordinary differential equation:** Euler method, Fourth order Runge - Kuttamethod.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New ageInternational Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint,2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9thEdition, Pearson, Reprint,2002.
6. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern,1980.
7. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
8. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole,2005.
9. Bronson, R., Schaum's Outline of Matrix Operations.1988.
10. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II,Mir Publishers, 1969.

Course Name: Environmental Science
Paper Code: HU204
Contact (L: T: P): 2 : 0 : 0
Total Contact Hours: 24
Credit: 3

Course Objective(s)

This course will enable the students to,

- Realize the importance of environment and its resources.
- Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Solve scientific problem-solving related to air, water, land and noise pollution.

Course Outcome

CO	Statement
C01	Able to understand the natural environment and its relationships with human activities
C02	The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk
C03	Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues
CO4	Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

CO – PO Mapping

CO	Statement	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2
1	Able to understand the natural environment and its relationships with human activities	2	2	3	-	-	2	3	3	-	-	1	2

2	The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk	3	3	3	1	1	2	3	3	-	-	1	2
3	Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues	3	3	3	2	1	2	3	3	-	-	1	2
4	Acquire skills for scientific problem-solving related to air, water, noise & land pollution.	1	1	1	1	2	2	3	3	-	-	1	2
AVERAGE		2	2	2	1	1	2	3	3	-	-	1	2

Module 1 - Resources and Ecosystem (6L)

1. Resources (2L)

Types of resources, resistance to resources, Human resource, Population Growth models: Exponential Growth, logistic growth

2. Ecosystem (3L)

Components of ecosystem, types of ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Food chain, Food web.

3. Energy and Environment(1L)

Conventional energy sources, coal and petroleum, Green energy sources, solar energy, tidal energy, geothermal energy, biomass

Module 2 – Environmental Degradation (9L)

1. Air Pollution and its impact on Environment (3L)

Air Pollutants, primary & secondary pollutants, Criteria pollutants, Smog, Photochemical smog and London smog, Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion.

2. Water Pollution and its impact on Environment (3L)

Water Pollutants, Oxygen demanding wastes, heavy metals, BOD, COD, Eutrophication, Hardness, Alkalinity, TDS and Chloride, Heavy metal poisoning and toxicity.

3. **Land Pollution and its impact on Environment (2L)**

Solid wastes, types of Solid Waste, Municipal Solid wastes, hazardous wastes, bio-medical wastes, E-wastes

4. **Noise Pollution and its impact on Environment (1L)**

Types of noise, Noise frequency, Noise pressure, Noise intensity, Noise Threshold limit, Effect of noise pollution on human health.

Module 3 – Environmental Management (6L)

1. **Environmental Impact Assessment (1L)**

Objectives of Environmental management, Components of Environmental Management, Environmental Auditing, Environmental laws and Protection Acts of India

2. **Pollution Control and Treatment (2L)**

Air Pollution controlling devices, Catalytic Converter, Electrostatic Precipitator, etc., Waste Water Treatment, Noise pollution control.

3. **Waste Management (3L)**

Solid waste management, Open dumping, Land filling, incineration, composting, E-waste management, Biomedical Waste management.

Module 4 – Disaster Management (3L)

1. **Study of some important disasters (2L)**

Natural and Man-made disasters, earthquakes, floods drought, landside, cyclones, volcanic eruptions, tsunami, Global climate change. Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

2. **Disaster management Techniques (1L)**

Basic principles of disasters management, Disaster Management cycle, Disaster management policy, Awareness generation program

Text Books:

1.Basic Environmental Engineering and Elementary Biology (For MAKAUT),
Gourkrishna Dasmohapatra, Vikas Publishing.
2. Basic Environmental Engineering and Elementary Biology, Dr. Monindra Nath Patra & Rahul Kumar Singha, Aryan Publishing House.
3. Textbook of Environmental Studies for Undergraduate Courses, Erach Barucha for UGC, Universities Press

Reference Books:

1. A Text Book of Environmental Studies, Dr. D.K. Asthana & Dr. Meera Asthana, S.Chand Publications.
2.Environmental Science(As per NEP 2020), Subrat Roy, Khanna Publisher

Course Name: Indian knowledge System
Course Code: HU205
Credit: 01
No. of lectures: 12

Module-1 (3L)

An overview of Indian Knowledge System (IKS): Importance of Ancient Knowledge - Definition of IKS - Classification framework of IKS - Unique aspects ofIKS.
The Vedic corpus: Vedas and Vedangas - Distinctive features of
Vedic life. Indian philosophical systems: Different schools of
philosophy.

Module-2 (3L)

Salient features of the Indian numeral system - Importance of decimal representation - The discovery of zero and its importance - Unique approaches to representnumbers.

Highlights of Indian Astronomy: Historical development of astronomy in India

Module-3 (3L)

Indian science and technology heritage - Metals and metalworking - Mining and ore extraction – Physical structures in India - Irrigation and water management - Dyes and painting technology - Surgical Techniques - Shipbuilding

Module-4 (3L)

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, Traditional Knowledge in agriculture, Traditional societies depend on it for their food and healthcare needs.

References:

1. Introduction to Indian knowledge system: concepts and applications-Mahadevan B.Bhat, Vinayak Rajat, Nagendra PavanaR.N.,PHI
2. Traditional Knowledge system in India, Amit Jha, AtlanticPublishers
3. S. N. Sen and K. S. Shukla, History of Astronomy in India, Indian National Science Academy, 2nd edition, New Delhi,2000

Course Name: Data Structures Lab
Course Code: CS291
Contact (Periods/Week): 3L/Week
Total Contact Hours: 36
Credits: 1.5

Course Outcomes	Name of Course Outcomes
CO1	To identify the appropriate data structure as applied to specified problem definition.
CO2	To summarize operations like searching, insertion, deletion, traversing mechanism used on various data structures.
CO3	To implement practical knowledge of data structures on the applications.
CO4	To illustrate how to store, manipulate and arrange data in an efficient manner.
CO5	To write programs to access queue and stack using arrays and linked list, binary tree and binary search tree.

CO-PO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	-	-	-	-	-	-	2	1	1	1
CO2	3	2	2	3	3	-	-	-	-	-	3	2	3	2	2
CO3	2	3	3	-	2	-	-	-	-	-	-	2	3	3	3
CO4	2	2	1	3	2	-	-	-	-	-	2	3	2	1	2
CO5	2	2	3	1	2	-	-	-	-	-	-	3	3	3	3
	2.4	2.4	2.4	2.3	2.4	-	-	-	-	-	2.5	2.4	2.4	2	2.2

Course Content:

Module 1: Implementing Non-Restricted Linear Data Structure [2 Lab]
Problem based on Implementation of Non-Restricted Linear Data Structure like- Implementation of list as data structure using array. Implementation of list as data structure using linked list of different types. Implementation of polynomial as data structure using array and linked list. Implementation of sparse matrix as data stricture usingarray.

Module 2: Implementing Restricted Linear Data Structure [3 Lab] Problem based on Implementation of Restricted Linear Data Structure like- Implementation of stack as data structure using array. Implementation of stack as data structure using linked list. Implementation of queue as data structure using array (physic al, linear and circular model). Implementation of queue as data structure using linked list. Converting infix to post-fix and evaluating post-fix expression using stack. Implementing Tower-of-Hanoiproblem.

Module 3: Implementing Non-Linear Data Structure [2 Lab]

Problem based on Implementation of Non-Linear Data Structure like Implementation of Binary Tree as data structure using array and linked list. Implementation of Binary Search Tree (BST) as data structure using linked list. Implementation of Heap as data structure using array. Implementation of Priority Queue as data structure usingHeap.

Module 4: Implementing Sorting and Searching algorithm [5 Lab] Problem based on Implementation of Sorting and Searching algorithm

Implementation of Bubble sort using appropriate data structure. Implementation of Selection sort using appropriate data structure.

Implementation of Insertion sort using appropriate data structure. Implementation of Quick sort using appropriate datastructure.

Implementation of Merge sort using appropriate data structure.

Implementation of Heap sort using appropriate data structure.

Implementation of Radix sort using appropriate data structure.

Implementation of Sequential Search using appropriate data structure.

Implementation of Binary Search using appropriate data structure.

Implementation of hashing with collision resolution using linear and quadratic probing.

Text books:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPBPublications.
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, UniversitiesPress.

Reference books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition,Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India)Private.
3. Limited Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition,Pearson.
4. Data Structures in C by Aaron M. Tenenbaum, 1St Edition,Pearson

Course Name: Basic Electrical & Electronics Engineering Lab
Course Code: EE(CS)291
L-T-P: 0-0-3
Total Lecture: 36
Credit: 1.5

CO	Statement
CO1	To Analyze a given network by applying KVL and KCL.
CO2	To Examine the Operation of DC Motor.
CO3	To Examine the Operation of Basic Electronics Devices and ICs.
CO4	To design simple electronics circuits.

List of Experiments: -

1. Familiarization with different passive and active electrical &electroniccomponents.
2. Familiarization with different Electrical & ElectronicsInstruments.
3. Verification of KVL andKCL.
4. Forward and reversal of DC shuntmotor.
5. Speed control of DC shuntmotor.
6. Study of the P-N junction diode V-I characteristics (Forward & ReverseBias).
7. Study of the Characteristics of Zener diode (Forward &ReverseBias).
8. Study of the Input and Output characteristics of BJT in CEmode.
9. Determination of offset voltage, offset current &bias current of OPAMP(IC741).
10. Determination of CMRR and slew rate ofOPAMP(IC741).
11. Determination of inverting and non-inverting gain ofOPAMP(IC741).
12. ExtramuralExperiment.

Textbooks:

1. Handbook of Laboratory Experiments in Electronics Engineering Vol. 1, AuthorName: A.M. Zungeru, J.M. Chuma, H.U. Ezea, and M. Mangwala, Publisher -Notion Press Electronic Devices and Circuit Theory by Robert Boylestad Louis Nashelsky,7th Edition, Prentice Hall
2. Experiments Manual for use with Grob's Basic Electronics 12th Edition by Wes Ponick, Publisher-McGraw Hill,2015
3. Laboratory Manual for 'Fundamentals of Electrical & Electronics Engineering': A handbook for Electrical & Electronics Engineering Students by Manoj Patil (Author), Jyoti Kharade (Author),2020
4. The Art of Electronics, Paul Horowitz, Winfield Hill,Cambridge University Press,2015.
5. A Handbook of Circuit Math for Technical Engineers, Robert L. Libbey CRC Press, 05-Jun-1991

Reference Books

1. Basic Electrical and Electronics Engineering, Author:S. K. Bhattacharya, Publisher: Pearson EducationIndia,2011
2. Practical ElectricalEngineering
3. By Sergey N. Makarov, Reinhold Ludwig, Stephen J. Bitar, Publisher: Springer International Publishing,2016
4. Electronics Lab Manual (Volume 2) By Navas, K. A. Publisher: PHI Learning Pvt. Ltd. 2018
5. Practical Electronics Handbook, Ian R. Sinclair and John Dunton, Sixth edition 2007, Published by ElsevierLtd.

CO-PO Course Articulation Matrix Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	3	2	-	2	-	-	2	-	2	3
CO2	3	3	2	3	-	2	-	-	3	-	2	2
CO3	3	2	2	3	-	2	-	-	2	-	3	3
CO4	3	3	2	2	-	2	-	-	3	-	2	3

Course Name: Engineering Physics Lab
Code: PH(CS)191
Contact Hours: 0:0:3
Credit: 1.5
Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes (COs):

After attending the course students' will be able to
CO1 : demonstrate experiments allied to their theoretical concepts CO2 : conduct experiments using LASER, Optical fiber.
CO3 : participate as an individual, and as a member or leader in groups in laboratory sessions actively CO4 : analyze experimental data from graphical representations, and to communicate effectively them in Laboratory reports including innovativeexperiment.
CO5: Design solutions for real life challenges.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	3	--	--	--	--	--	--	--
CO2	2	3	2	3	3	--	--	--	--	--	--	--
CO3	2	3	2	3	3	--	--	--	--	--	--	--
CO4	2	2	3	2	3	--	--	--	--	--	--	--
CO5	2	2	3	2	3	--	--	--	--	--	--	--

Course Content:

General idea about Measurements and Errors (One Mandatory):

1. Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
2. Experiments on Classical Physics (Any 4 to be performed from the following experiments):
3. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of theoscillator.
4. DeterminationofYoung'smoduliofdifferentmaterials.
5. Determination of Rigidity moduli of different materials.
6. Determination of wavelength of light by Newton's ringmethod.
7. Determination of wavelength of light by Laser diffractionmethod.
8. Optical Fibre-numerical aperture, powerloss.
9. Experiments on Quantum Physics (Any 2 to be performed from the following experiments):
10. Determination of Planck's constant using photoelectriccell.
11. Verification of Bohr's atomic orbital theory through Frank-Hertzexperiment.
12. Determination of Stefan's Constant.
13. Study of characteristics of solar cell.
14. Perform at least one of the following experiments:

15. Calibration of an oscillator using LissajousFigure.
16. Determination of specific charge of an electron (e/m) by J. J ThompsonMethod.

**In addition it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Study of dispersive power of material of aprism.
2. Study of viscosity using Poiseuille's capillary flow method/using Stoke'slaw.
3. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.
4. Determination of the angle of optical rotation of a polar solution usingpolarimeter.
5. Any other experiment related to thetheory.

Text Books:

1. Practical Physics by Chatterjee & Rakshit (Book & AlliedPublisher)
2. Practical Physics by K.G. Mazumder (New CentralPublishing)
3. Practical Physics by R. K. Kar (Book & AlliedPublisher)

Course Name: Design thinking
Course Code: HU292
Credit: 01
L:T:P:: 0:0:2

Module 1: Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting. **2**

Module 2: Memory: process, Sensory memory, STM and LTM, Problems in retention, Memory enhancementtechniques. **4**

Module 3: Emotions: Experience & Expression Understanding Emotions, Empathy, And Concept of EmotionalIntelligence. **2**

Module 4: Basics of Design Thinking Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate,Prototype,Test. **6**

Module 5: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative ProblemSolving **4**

Unit 6: Prototyping & Testing -Rapid Prototype Development process, Testing, Sample Example, Test GroupMarketing **2**

Module-7: Design thinking for strategic innovations Growth –Change- Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience -Value redefinition - Extreme Competition – Standardization —Strategy– BusinessModeldesign. **4**

References:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) second Edition,2013.

2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press,2009.

3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons2013

4. George,E,Dieter,Linda,C,Schmidt.(2017).EngineeringDesign,McGrawHillpublisher,4thedition

Course Name: Engineering Graphics & Design Lab
Course Code: ME(CS)291
Contact: 0:0:3
Credits: 1.5

Prerequisites: Basic knowledge of geometry
Course Outcomes: Upon successful completion of this course, the student will be

able to: CO1: Learn the basics of drafting

CO2: Understand the use of drafting tools which develops the fundamental skills of industrial drawings.
CO3: Apply the concept of engineering scales, dimensioning and various geometric curves necessary to understand design of machineelements.
CO4: Analyse the concept of projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine parts.
CO5: Evaluate the design model to different sections of industries as well as for research & development.

Course Contents:

Basic Engineering Graphics: **(3P)**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing (6P)

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and VernierScales.

Module 2: Orthographic & Isometric Projections (6P)

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice- versa.

Module 3: Sections and Sectional Views of Right Angular Solids (6P)

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slabonly).

Computer Graphics: (3P)

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics: (3P)

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxesandwindows,Shortcutmenus(ButtonBars),Zoomingmethods,Selectanderaseobjects].

Module 5: CAD Drawing, Customization, Annotations, layering (6P)

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerance; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printingdocuments.

Module 6: Demonstration of a simple team design project (3P)

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age Internationalpublishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna PublishingHouse
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMHPublication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2			2									2	2	2
CO2	2			2									2	2	2
CO3	3			2									2	2	2
CO4	3			3									3	3	2
CO5	3	2		3	2								3	3	2

2ND YEAR 3RD SEMISTER									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	CS301	Computer Organization and Architecture	3	0	0	3	3
2	ENGG	Major	CS302	Design and Analysis of Algorithms	3	1	0	4	4
3	SCI	Minor	M(CS)301	Discrete Mathematics	3	0	0	3	3
4	ENGG	Minor	EC(CS)301	Digital Logic and Electronics	3	0	0	3	3
A. PRACTICAL									
1	ENGG	Major	CS391	Computer Organization and Architecture Lab	0	0	3	3	1.5
2	ENGG	Major	CS392	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
3	ENGG	Minor	EC(CS)391	Digital Electronics Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	CS393	IT Workshop Lab (SciLab/MATLAB/C++)	0	1	3	4	2.5
Total of Theory, Practical								26	20

Course Name: Computer Organization and Architecture
Course Code: CS301
Contact: 3:0:0
Total Contact Hours: 36L
Credits: 3

Prerequisite: Digital Electronics

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate the basic concept of computer architecture and its performance measurement, parallel processing, Flynn's classification and Amdahl's law and apply this knowledge in designing solutions for real life engineering problems.
CO2	Summarize the basic concept of pipeline, instruction pipeline, arithmetic pipeline hazards detection and prevention and use this knowledge for designing and implementing mathematical and engineering problems leading to lifelong learning.
CO3	Identify the concept of Instruction-Level Parallelism to solve engineering problems.
CO4	Illustrate and compare the concept of Multiprocessor architecture and parallel architecture and apply this knowledge for developing an approach by means of existing and new methods as teamwork.
CO5	Understand the concept of message passing architecture and interconnection network and design an optimized model for building a new solution as a professional engineering practice as a team.

Course Contents:

Module 1[8L]:
Introduction to CPU and concepts of ALU [2L], Instruction format and Instruction Cycle [1L], Addressing Modes [1L] Fixed- point multiplication -Booth's algorithm. [2L], Fixed-point division - Restoring and non-restoring algorithms [1L], Floating-point number representation-IEEE754 format and Floating-point arithmetic operation [1L].

Module 2 [7L]:
Introduction to basic computer architecture [1L], Stored Program Concepts: Von Neumann & Harvard Architecture [1L], RISC VS CISC [1L],Amdahl law [1L], Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. [2L] Micro programmed and hardwired control unit [1L].

Module 3[8L]:
Introduction to memory-RAM and ROM [1L], Register transfer, memory transfer, Tri-state bus buffer, Memory Hierarchy: Secondary memory [1L], Main Memory [1L], Cache Memory [1L], Mapping Technique in cache memory: Direct, Full Associative and Set Associative [2L], Performance Implementation in Cache Memory [1L], Virtual memory Concepts [1L], page replacement policies [1L].

Module 4[9L]:
Pipelining: Basic concepts, instruction and arithmetic pipeline[2L], data hazards, control hazards and structural hazards, techniques for handling hazards[2L]Pipeline vs. Parallelism, Levels of parallelism [1L], Instruction- Level Parallelism: Basic Concepts, Techniques for Increasing ILP, Superscalar, Super Pipelined and VLIW Processor Architectures [2L], Array and Vector Processors[1L]

Module 5[4L]:
Multiprocessor architecture: taxonomy of parallel architectures; Flynn Classification [1L], Centralized and

Shared- memory architecture: synchronization [1L], Interconnection Network (Omega, Baseline, Butterfly, Crossbar) [2L].

Text Books:

1. Hwang - Advanced Computer Architecture Parallelism Scalability Programmability, Tata McGraw- Hill Education Private Limited ISBN-13: 978-0-07-053070-6 ISBN-10:0-07-053070-X
2. Hwang & Briggs—Computer Architecture & Parallel Processing,TMH

Reference Books:

1. Patterson D.A. and Hennessy,J.L.—Computerarchitectureaquantitativeapproach‖,2nd ed.MorganKaufman,1996
2. Hayes J. P., —Computer Architecture & Organization, McGrawHill
3. Siegel,H.J.,—InterconnectionNetworkforLargeScaleparallelProcessing‖,2ndEd.McGrawHill,1990
4. Design and Analysis of Parallel Algorithm-Schism G. Akl

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
CO1	3	3	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	3
CO3	2	2	2	3	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Design & Analysis of Algorithm
Course Code: CS302
Contact: 3:1:0
Total Contact Hours: 36L
Credits: 4

Prerequisites: To know data-structure and basic programming ability

Course Outcomes (COs):

After attending the course students should be able to

CO1	To understand and illustrate the concepts of time and space complexity, worst case, average case and best-case complexities and the asymptotic notation.
CO2	To analyze and apply the design principles and concepts to various basic algorithm design viz. dynamic programming, greedy methods etc.
CO3	To understand and analyze various string matching and graph algorithms.
CO4	To understand, illustrate and analyze the different complexity classes
CO5	To discuss, implement and analyze, verify the efficiency of the randomized and approximation algorithms.

Course Content:

Module-1 [4L]

Algorithm Development & Complexity Analysis: [4L] Stages of algorithm development for solving a problem: Describing the problem, identifying a suitable technique, Design of an algorithm, Proof of Correctness of the algorithm. Time and Space Complexity, Different Asymptotic notations – their mathematical significance. Solving Recurrences: Substitution Method, Recurrence Tree Method, Master Theorem (Statement Only).

Module-2 [14L]

Algorithm Design Techniques Brute force techniques – Traveling Salesman Problem, Divide and Conquer - Matrix multiplication: Strassen algorithm, Greedy techniques - Fractional Knapsack problem, Job Sequencing with Deadline, Graph Coloring, Finding Minimum Cost Spanning Tree using Prim's and Kruskal's algorithm, Dynamic programming - O/1 Knapsack problem, Matrix chain multiplication, Travelling Salesman Problem, Backtracking-N-Queens Problem, Knights Tour on Chess Board.

Module-3 [3L]

String matching problem: Different techniques – Naive algorithm, string matching using finite automata, and Knuth, Morris, Pratt (KMP) algorithm with their complexities.

Module-4 [5L]

Graph Algorithms Single Source Shortest Path –Dijkstra Algorithm, All pair shortest path – Floyd-Warshall Algorithm. Network Flows, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm, Minimum Cost Flows – Cycle Cancelling Algorithm.

Module-5 [5L]

Complexity Classes: The Class P, The Class NP, Reducibility and NP-completeness – SAT (without proof), 3-SAT, Vertex Cover, Independent Set, Maximum Clique.

Module-6 [5L]

Approximation and Randomized Algorithms [3L], Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering. Randomized Algorithms - The hiring problem, Finding the global Minimum. Recent Trends [2L]

Textbook:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman. 3. "Algorithm Design" by Kleinberg and Tardos**.**

Reference Books:

3. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi
4. Design Analysis and Algorithms by Hari Mohan Pandey.

CO-POMapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	2
CO2	3	3	3	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	-	-	-	-	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2
CO5	3	3	3	3	-	-	-	-	-	-	-	2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Discrete Mathematics
Course Code: M(CS)301
Contact: 3:0:0
Total Contact Hours: 36L
Credits: 3

Prerequisites: Higher Secondary Level Mathematics

Course Outcome(s):

After completion of the course students will be able to

CO1	Understand the fundamental concepts of Set Theory to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Mathematical Logic and Proof Techniques so that they can Prove theorems using Proof Techniques and Mathematical Logic Frameworks to justify a claim.
CO3	Explain or illustrate the fundamental Theory of Numbers and Identify problems where students can Use the concept appropriately to Solve them.
CO4	Explain or illustrate the fundamental principles of Algebraic Structures and Identify problems where students can Apply the concept appropriately to Solve them.
CO5	Develop ideas to Propose solutions to the problems of Graph Theory and Identify problems where students can Apply the concept appropriately and analyze the Effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Content:

Module -1[16L]

Set Theory [8L]Set: Operations and Properties of set, Finite Set, Power Set, Cardinality of finite set, Cartesian Product, Relation: Types of Relations, Properties of Binary Relation, Equivalence Relation, Partial Ordering Relation and Poset, Lattice.[4L] Combinatorics and Counting: Sum and product rule, Permutation and Combination Principle of Inclusion Exclusion. Pigeon Hole Principle.[2L] Generating Functions and Recurrence Relations: Recursively defined relation and functions, Discrete Numeric Function, Growth of Functions, Problems on Recurrence Relations and their solutions using different methods.[2L]

Module-2[16L]

Mathematical Logic and Proof Techniques [8L] Propositional Logic: Basics of Boolean Logic, Idea of Propositional Logic, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Inference theory of Propositional Logic.[3L] Predicate Logic: Idea of First Order Predicate Logic and Quantifiers, well-formed formula of predicate, Inference theory of Predicate Logic.[3L] Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.[2L].

Module-3 [8L]

Theory of Numbers [4L] Well-Ordering Principle, Divisibility theory and properties of Divisibility, Fundamental theorem of Arithmetic, Prime and Composite Numbers. [2L] Greatest Common Divisor and Euclidean Algorithm, Congruence, Residue Classes. [2L]

Module-4 [16L]

Algebraic Structures [8L] Concepts of Groups, Subgroups and Order, Cyclic Groups, Cosets, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms.[5L] Elementary properties of Rings and related problems[1L] Elementary properties of Fields and related problems. [1L] Elementary properties of Vector Space and related problems. [1L]

Module-5 [16L]

Graph Theory [8L] Graph Terminologies and their properties: Degree, Connectivity, Path, Cycle, Sub-Graph, Isomorphism, Eulerian and Hamiltonian Walks, Matrix representation of graphs, Shortest Path in Graph. [2L] Graph Colouring and Matching: Colouring Vertices and Chromatic Number, Colouring Edges and Total Colouring, Independence and Chromatic Partitioning, Cliques, Perfect Graphs, Bounds on Chromatic Numbers, Chromatic Polynomials, Matching.[3L] Tree: Rooted Trees, Binary Search Tree and Tree Sorting, Spanning Tree, Weighted Trees and prefix codes. [3L]

Textbook:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw –Hill.
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.

Reference Books:

1. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw –Hill.
2. J.P.TremblayandR.Manohar,DiscreteMathematicalStructureandItsApplicationtoComputerSciencǁ, TMG Edition, TataMcGraw-Hill
3. Seymour Lipschutz, Marc Lipson, Discrete Mathematics (Schaum Outlines Series), Tata McGraw -Hill.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-
CO5	3	3	2	3	-	-	-	-	-	-	-	-

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course Name: Digital Logic and Electronics
Course Code: EC(CS)301
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Pre-requisite:
Basic concepts of Logic gates, Truth Tables, Concept of basic components of a digital computer.

Course Outcome(s):

CO1: To realize basic gate operations and laws Boolean algebra.
CO2: To understand basic mechanism of digital computers and digital logic behind different arithmetic and control unit operations.
CO3: To design combinational circuits and combinational functions for larger more complex circuits. CO4: To Perform different operations with sequential circuits.
CO5: To understand fundamental concepts and techniques used in Logic families and PLDs

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Course Content:

Module – 1[8L]

Binary Number System [1L]; BCD, ASCII, EBDIC, Gray codes and their conversions [1L], Introduction and laws of Boolean algebra [1L], Boolean functions, Minterm and maxterm, Prime implicants, Representation in SOP and POS forms[2L], Minimization of logic expressions by Karnaugh Map and algebraic method [3L]

Module – 2[8L]

Combinational circuits:
Adder and Subtractor (half-full adder & subtractor) [2L], Serial & Parallel Adder, Carry look ahead adder and Parity Generator[2L], Encoder, Decoder, Multiplexer [2L], Demultiplexer, Comparator, Code Converters [2L]

Module – 3[12L]

Sequential Circuits:
Flip-Flops, SR, JK, Master slave JK, D, T, characteristic Tables, Excitation tables [5L]. Basic concept of Synchronous and Asynchronous counters, Up/Down Counters, Ring counter, Johnson counter, Design of Modulo-N Counter, Counter applications [5L]. Registers (SISO, SIPO, PIPO, PISO) [2L].

Module – 4[8L]

A/D and D/A conversion techniques – Basic concepts (D/A:R-2-R only [2L], A/D: successive approximation [2L])Logic families- TTL, ECL, MOS and CMOS - basic concepts [2L],Programmable logic Array, programmable Array logic, Sequential Programmable Devices [2L].

Text Book:

1. Saliva Hanan S, Digital Circuits and Design,Oxford
2. Morries Mano- Digital Logic Design-PHI

Reference Book:

1. R.P.Jain—Modern Digital Electronics, 2/e, Mc GrawHill
2. Digital Fundamentals – A Systems Approach – Thomas L. Floyd,Pearson

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	1	-	-	1	-
CO2	3	3	-	2	-	-	2	-	-	1	-	-
CO3	3	3	-	-	-	-	-	2	-	2	-	2
CO4	-	-	3	3	3	-	-	-	2	-	-	-
CO5	3	2	-	-	-	2	-	-	2		2	-

Course Name: Computer Organization and Architecture Lab
Course Code: CS391
Contact: 0:0:3
Credits: 1.5

Prerequisites:
Knowledge of designing different circuits in Computer Organization Lab

Course Outcomes (COs):
After attending the course students should be able to

CO1	Illustrate and use proper syntax in appropriate platforms for developing programs to solve problems related to Mathematics and Engineering fields leading to lifelong learning.
CO2	Apply the knowledge of algorithms in the computational area to efficient programming codes to design the problem using modern tools for solving complex engineering problems.
CO3	Outline different types of digital electronic circuits such as adder, subtract or, encoder decoder, multiplexer, demultiplexer, flip-flops, register, counter using various mapping and modern tools to prepare the most simplified circuit and optimize using various mapping and mathematical methods for solving the problem as a professional engineering practice as a team.
CO4	Apply the knowledge of digital electronic circuits to design memory and ALU and analyze the same to solve engineering-related computational problems as a team.
CO5	Interpret the result of the experiments, prepare laboratory reports based on observed output and analyze it to validate professional ethics and responsibilities and norms of the engineering Practice.

List of Experiment:

1. Implement different types of Basic gates and simulate for truth table verification.
2. Implement half adder circuit and simulate for truth table verification.
3. Implement full adder circuit and simulate for truth table verification.
4. Implement half subtractor circuit and simulate for truth table verification.
5. Implement a full subtractor circuit and simulate for truth table verification.
6. Implement Multiplexer, De-Multiplexer circuit and simulate for truth table verification.
7. Implement Encoder, Decoder circuit and simulate for truth table verification.
8. Implement different types of flip flop and simulate for truth table verification.
9. Implement different types of parallel circuits (SISO, SIPO, PISO, PIPO) and simulate the result.
10. Implement ALU and simulate the result.
11. Implement a RAM chip and simulate the result.
12. Innovative Experiments.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	-	-	-	3	-	-	-
CO2	3	3	3	3	3	-	-	-	3	-	-	-
CO3	3	3	3	3	3	-	-	-	3	-	-	-
CO4	3	3	3	3	3	-	-	-	3	-	-	-
CO5	3	3	3	3	3	-	-	-	3	-	-	-

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Design & Analysis of Algorithm Lab
Course Code: CS392
Contact: 0:0:3
Credit: 1.5

Prerequisite:
Programming knowledge

Course Outcomes (COs):

After attending the course students should be able to

CO1	To identify and prove the correctness and analyze the running time of the basic algorithms forthose classic problems in various domains.
CO2	To understand and illustrate methods for analyzing the efficiency and correctness of algorithms (such as exchange arguments, recurrence, induction, and average case analysis)
CO3	To analyze and design algorithms using the dynamic programming, greedy method, Backtracking, Branch and Bound strategy, and recite algorithms that employ this strategy.
CO4	To understand, compare, contrast, and choose appropriate implementation of the algorithmic design techniques to present an algorithm that solves a given problem.
CO5	To Identify and analyze criteria and specifications appropriate to new problems.

Course Content:

A. Implementation of various Divide & Conquer Methods; viz. Matrix Multiplication.
B. Implementations of various Dynamic Programming Methods, viz. Matrix Chain Multiplication Method, Travelling Salesman Problem etc.
C. Implementations of various Branch & Bound Techniques, viz.
D. Implementations of various Backtracking Methods, viz. n-Queen Problem.
E. Implementations of Greedy Method, viz. Fractional Knapsack Problem, Job Sequencing Problem etc.
F. Implementations of String-matching Algorithm viz. Naïve Algorithm, String Matching with Finite Automata etc.
G. Implementations of Various Graph Algorithms, viz. Dijkstra‘s Algorithm, Floyd Algorithm etc.
H. Implementation of some Real-Life Problems

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	-	3	-	-	3
CO2	3	3	3	2	3	-	-	-	3	-	-	3
CO3	3	3	2	3	3	-	-	-	3	-	-	3
CO4	3	3	2	2	3	-	-	-	3	-	-	3
CO5	3	3	3	2	3	-	-	-	3	-	-	3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Digital Electronics Lab
Course Code: EC (CS)391
Contact: 0:0:3
Credit: 1.5

Prerequisite:
Basic concepts of Logic gates, Truth Tables, function realization –minimization of Logic expressions by K-map, Concept of basic components of a digital computer, Binary Arithmetic

Course Outcomes (COs):
After attending the course students should be able to

CO1	Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
CO2	Analyze the characteristics of Junction Diode, Zener Diode, BJT & FET and different types of Rectifier Circuits.
CO3	Determination of input-offset voltage, input bias current and Slew rate, Common- mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode, BJT &OPAMP.
CO5	Familiarization and basic knowledge of Integrated Circuits

Course Content:

1. A) Realization of basic gates and universal gates.
B) Realization of basic gates using universal gates.
2. Design a Half adder and Full Adder circuit using basic gates and verify its output.
3. Design a Half subtractor and Full Subtractor circuit using basic gates and verify its output
4. Design an Adder/Subtractor composite unit.
5. Design of a _Carry-Look-Ahead Adder circuit.
6. Realization of a)Encoder, b)Decoder c) Multiplexer, d) De-mux, e)Comparator and their Truth Table verification.
7. Realization of RS / JK / D flip flops using logic gates.
8. Design of Shift Register using J-K / D Flip-flop.
9. Realization of Synchronous Up/Down counters.
10. Design of MOD- N Counter
11. Study of DAC
12. Study of logic families and PLDs

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	-	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2		2
CO4	2	2	2
CO5	2	2	2

Course Name: IT Workshop Lab (SciLab/MATLAB/C++)
Course Code: CS393
Contact: 0:1:3
Credits: 2.5

Prerequisite
Computer Fundamentals and principles of computer programming

Course Outcomes (COs):

After attending the course students should be able to

CO1	Demonstrate a thorough understanding of modular programming by designing programs that require the use of programmer-defined functions.
CO2	Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
CO3	Demonstrate a thorough understanding of the object-oriented programming concepts of encapsulation, data abstraction and composition by designing and implementing classes including the use of overloaded functions and constructors.
CO4	Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.
CO5	Demonstrate an understanding of the differences between C and C++ in the areas of strings, pass by reference/passing pointers, and structs by designing and implementing programs that use C strings, C++

Course Content:

1. Introduction of UNIX/Linux Operating System which includes preliminary commands, start-up & shutdown methodology, file.
2. Handling as well as introduction to editors like Vi editor, introduction to GNU C & C++ compiler, as well as introduction to GNU & GDBscript.
3. Introduction to C++, basic loop control, executing programs.
4. Writing functions, selection statements, review of functions and parameters, command line arguments, recursion, I/O streams, arrays and string manipulation, pointers, structures &unions.
5. Object-Oriented Programming in C++, fundamentals of classes, constructors-destructors.
6. Dealing with member functions, operator overloading and polymorphism (both static &dynamic).
7. Dealing with inheritance, derived class handling.
8. Abstract class, virtual class, overriding, template class, name-space & exception handling.
9. Dynamic memory allocation, implementation of Linked Lists, using C++.
10.MATLAB Environment, variable, constant, operators, loop, function.
11.MATLAB Toolbox, MATLAB Graphic function.
12. Reading and Writing to file, Numerical simulation.
13. Innovative experiments/Projects

Text Books

1. The C++ Programming Language by Bjarne Stroustrup Addison-Wesley publisher
2. Object-Oriented Programming in C++ b by Robert Lafore Publisher:Sams

Reference Books

1. Object Oriented Programming with C++ by Balaguruswamy McGraw Hill Education; Sixth edition Addison- Wesley publisher
2. C++ Programming Language (4th Edition) by Bjarne Stroustrup- Pearson publisher

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	3	-	-	-
CO2	3	2	2	2	2	-	-	-	3	-	-	-
CO3	3	3	3	2	2	-	-	-	3	-	-	-
CO4	3	3	3	2	2	-	-	-	3	-	-	-
CO5	3	3	3	2	2	-	-	-	3	-	-	-

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

2nd Year 4thSemester									
Sl No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	CS401	Operating Systems	3	0	0	3	3
2	ENGG	Major	CS402	Computer Networks	3	0	0	3	3
3	ENG	Major	CS403	Formal Language and Automata Theory	3	0	0	3	3
4	SCI	Minor	M(CS)401	Probability and Statistics	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU(CS)401	Principles of Management	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	CS491	Operating Systems Lab	0	0	3	3	1.5
2	ENGG	Major	CS492	Computer Networks Lab	0	0	3	3	1.5
3	ENGG	Major	CS493	Programming using Python	0	0	3	3	1.5
4	ENGG	Minor	M(CS)491	Numerical Methods Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU(CS)491	Soft Skill & Aptitude	2	0	0	2	1
Total of Theory, Practical								28	21

Paper Name: Operating System
Paper Code: CS401
Contact Hours/Week: 3
Credit: 3
Total Contact Hours: 36L

Prerequisites:
1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):
After attending the course students should be able to

CO1	Understand the fundamental concepts of Operating System, Protection & Security and differentiate different types of Operating System.
CO2	Understand and implement process & thread; understand, apply, compare different process synchronization algorithm and inter process communication to solve engineering problems
CO3	Understand/explain/analyze different synchronization techniques, critical section problems and deadlock and apply them to solve engineering problems.
CO4	Understand/explain different memory management techniques including virtual memory management; also able to apply, compare, and implement different page replacement algorithms to solve engineering problems.
CO5	Understand/explain different I/O mechanisms, File structures and disk management techniques and solving engineering problems applying different disk scheduling algorithms.

Course Content:

Module – 1:[3L]
Functionalities of Operating System, Evolution of Operating System.
Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel, Structural overview, Protection & Security.[3L]

Module – 2: [9L]
Processes: Concept of processes, process states, PCB, process scheduling, co-operating processes, independent process, suspended process, Interaction between processes and OS, [2L]
Threads: overview, benefits of threads, user and kernel level threads. [1L]
CPU scheduling: Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling). [6L]

Module – 3: [10L]

Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization (producer-consumer, readers-writer, dining philosophers, etc), semaphores.[5L]
Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.[5L]

Module 4: [6L]

Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, Segmentation, TLB. [3L]
Virtual Memory: background, demand paging, page replacement algorithms (FCFS, LRU, Optimal), thrashing, Working set model. [3L]

Module 5: [8L]

Disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK etc), disk reliability, disk formatting, boot block, bad blocks. [2L]
File: File concept, access methods, directory structure, file system structure, UNIX file structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector). [2L]
I/O: I/O hardware, polling, interrupts, DMA, caching, buffering, blocking-non blocking I/O. [1L]
Case Study : Inter-process communication: Message passing. Thread models, monitors [3L]

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts.
2. Operating systems: concepts and design by Milan Milenkovič- Mc. Graw-Hill Publication

Reference Book:

1. Dietel H. N., ―An Introduction to Operating Systems‖, Addison Wesley.
2. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall.
3. William Stallings, Operating Systems, Prentice Hall.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								3
CO2	3	3	3	3								3
CO3	3	3	3	3								3
CO4	3	3	3	3								3
CO5	3	3	3	3								3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Computer Networks
Course Code: CS402
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
1. Familiarity and knowledge of Operating Systems and Computer Architecture.
2. Also require a little bit of programming languages concepts like C, Java**.**

Course Outcomes (COs):
After attending the course students should be able to

CO1	Understand basics of computer network and different architecture and topologies of computer network and analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
CO2	Understand/analyze different protocols of the data link layer and apply them to solve engineering problems.
CO3	Understand/analyze different protocols of Network and Transport Layer and apply them to solve engineering problems.
CO4	Understand/analyze different protocols of session and application layer and apply them to solve engineering problems.
CO5	Develop, Analyze, specify and design the topological and routing strategies using socket programming.

Course Contents:

Module 1: Introduction [6L]
Introduction (3L):
Introduction: Computer Network, data communication, topology, OSI & TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network.
Physical Layer: [3L]

Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network;

Module 2: Data Link Layer [9L]

Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub-layer, The Channel Allocation.[5L] Multiple Access Protocols**:** ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx, Bluetooth, RFID, Bridges, Virtual LANs, Switching**.**[4L]

Module 3: Network Layer [10L]

IP Addressing, IPv4and IPv6. Difference IPv4and IPv6, Conversion ofIPv4and IPv6, Subnetting, Supernetting, Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, ARP, IP, ICMP, IPV6, BOOTP and DHCP–Delivery protocols Other Protocols such as mobileIP in wireless Network. [5L]

Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing: RIP, OSPF, BGP; Routing for Mobile Hosts. [5L]

Module 4: Transport layer: [5L]

Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion control in TCP: Congestion Control: Open Loop, Closed Loop packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.[4L]

Advanced topic such as Remote Procedure Call, Delay Tolerant Networks. [1L]

Module 5: Application Layer [5L]

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

Module 6: Socket Programming [1L]

Introduction to Socket Programming, UDP socket and TCP Socket

Text books:

1. B. A. Forouzan –-Data Communications and Networking (3rdEd.)-– TMH
2. S. Tanenbaum –-Computer Networks (4th Ed.)|–Pearson Education/PHI

Reference books:

1. W. Stallings –-Data and Computer Communications (5th Ed.)|– PHI/Pearson Education
2. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
3.Comer–-Internetworking with TCP/IP, vol. 1,2,3(4th Ed.)|– Pearson Education/PHI

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2				2	2		3
CO2	3	3	3	3	3				2	2		3
CO3	3	3	3	3	3				2	2		3
CO4	3	3	3	3	3				2	2		3
CO5	2	3	3	3	3				2	2		3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Formal Language and Automata Theory
Course Code: CS403
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. Digital Logic
2. Computer organization
3. Computer Fundamentals

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the fundamental concepts of Finite State Automata to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Regular Expressions and its relation with DFA so that they can Develop regular expression for a specified language and Validate it.
CO3	Understand the fundamental concepts of Context Free Grammar so that they can Design grammar for a specified language and Validate it.
CO4	Explain or Illustrate the fundamental operating principles of Push Down Automata and Use it appropriately to Solve problems.
CO5	Understand the operating principles of Turing Machine and Design Turing Machines to Proposesolutionstotherelatedproblemsappropriatelyandvalidatetheeffectivenessaswell as limitations of computations making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Contents:

Module-1: [9L]

Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram, **[1L]**
Introduction to Finite State Model (FSM), Design of sequence detector, Finite State Machine, Finite Automata, Deterministic Finite Automation (DFA) and Non-deterministic Finite Automation (NFA), Transition diagrams, Transition tables and Language recognizers. **[3L]**
NFA with empty transitions, Equivalence between NFA with and without empty transitions. NFA to DFA conversion. **[2L]**
Minimization of FSM: Minimization Algorithm for DFA, Introduction to Myhill-NerodeTheorem **[2L]**
Limitations of FSM, Application of Finite Automata**[1L]**

Module-2: [7L]

Finite Automata with output − Moore & Mealy machine. Representation of Moore & Mealy Machine, Processing of the String through Moore & Mealy Machine, Equivalence ofMoore&MealyMachine–Inter-conversion.**[2L]**
Equivalent states and Distinguishable States, Equivalence and k-equivalence, Minimization of Mealy Machine**[1L]**
Minimization of incompletely specified machine−Merger Graph, Merger Table, Compatibility Graph [2L]
Lossless and Lossy Machine – Testing Table, Testing Graph **[2L]**

Module-3: [5L]
Regular Languages, Regular Sets, Regular Expressions, Algebraic Rules for Regular Expressions, Arden‘sTheorem statement and proof**[1L]**
Constructing Finite Automata (FA) for given regular expressions, Regular string accepted by FA**[2L]**
Constructing Regular Expression for a given Finite Automata**[1L]**
Pumping Lemma of Regular Sets. Closure properties of regular sets**[1L]**

Module-4: [9L]

Grammar Formalism-Context Free Grammars, Derivation trees, sentential forms. Right most and left most derivation of strings, Parse Tree, Ambiguity in context free grammars. **[1L]**
Minimization of Context Free Grammars. **[1L],** Removal of null and unit production **[1L]** Chomsky normal form and Greibach normal form. **[1L]**
Pumping Lemma for Context Free Languages. **[1L]**

Enumeration of properties of CFL, Closure property of CFL, Ogden‘s lemma & its applications **[1L],** Regular grammars−right linear and left linear grammars**[1L]**
Pushdown Automata: Pushdown automata, definition. Introduction to DCFL, DPDA, NCFL, NPDA**[1L]** Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. **[1L]** Equivalence of CFL and PDA, inter-conversion. [**1L]**

Module-5: [5L]

Turing Machine: Definition, model**[1L]**
Design of Turing Machine, Computable functions **[1L],** Church ‘s hypothesis, counter machine **[1L]** Types of Turing machines**[1L]**
Universal Turing Machine, Halting problem**[1L]**

Textbook:

1. Introduction to Automata Theory Languages and Computation‖, Hopcroft.E. and Ullman J.D., Pearson Education.

Reference Books:

1. Formal Languages and Automata Theory‖,C. K. Nagpal, Oxford
2. -Switching and Finite Automata Theory|,ZviKohavi, 2nd Edition, TataMcGrawHill

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								3
CO2	2	2	2	2								3
CO3	3	3	3	3								3
CO4	3	3	3	3								3
CO5	3	3	3	3					2	2		3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Probability and Statistics
Course Code: M(CS)401
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard algebra and calculus.

Course Outcome(s):

After completion of the course students will be able to
CO1: Recall the distinctive principles of probability and statistics.
CO2: Understand the theoretical workings of theory of probability and tests of hypotheses.
CO3: Apply statistical methods to compute and explain point estimators and interval estimators for mean, variance and proportion.
CO4: Analyze statistical data from engineering experiments.

Course Content

Module 1 (Probability and Random Variables) [15L]

The axioms of probability , Conditional probability, Baye_s theorem, Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, Moments, Moment generating functions, Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

Module 2 (Two dimensional random variables) [5L]

Joint distributions, Marginal and conditional distributions, Covariance , Correlation and linear regression , Transformation of random variables , Central limit theorem (for independent and identically distributed random variables).

Module 3 (Sampling Distribution) [3L]

Distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems

Module 4 (Estimation) [4L]

Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, problems.

Module 5 (Testing of Hypotheses) [9L]

Nullandalternativehypotheses,thecriticalandacceptanceregions,twotypesoferror,powerofthetest,the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi square goodness of fit test and its applications, problems.

Project Domains:

1. Construction of Univariate and Bivariate frequency tables
2. Diagrammatic and Graphical representation of data.
3. Fitting of discrete and Continuous distributions
4. Regression Analysis
5. Curve Fitting
6. Tests of significance with regard to Single Mean, Two Means
7. Construction of Confidence intervals for Mean, Variance and Proportion

Textbook:

1.Sheldon M.Ross,-IntroductiontoProbabilityandStatisticsforEngineersandScientists|,Academic Press,(2009).
2. D.C.Montgomeryand G.C.Runger, -AppliedStatisticsandProbabilityforEngineers|,5th edition, John Wiley & Sons,(2009).

Reference Books:

1. Robert H.Shumway andDavid S. Stoffer,-Time Series Analysis and Its Applications with R Examples|, Thirdedition, Springer Texts inStatistics, (2006).
2. N. G. Das: Statistical Methods,TMH.
3. Sancheti , *D. S.* &Kapoor ,*V.K. : Statistics Theory , Method & Application*, Sultan chand & sons , New Delhi**,** N.K. Dutta (2004). Fundamentals of Biostatistics, Kanishka Publishers.

CO-PO Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	3	-	-	-	-	-	-	-	2

Course Name: Principles of Management
Course Code: HU(CS)401
Contacts: 2:0:0
Total Contact Hours: 24
Credits: 2

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic concepts and technologies used in the field of management information Systems
CO2	Have the knowledge of the different types of management information systems
CO3	Understand the processes of developing and implementing information systems.
CO4	Be aware of the ethical, social, and security issues of information systems.
CO5	An ability to effectively integrate IT-based solutions into the user environment

Course Content:

Module-1:

Management Concepts: Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow**(4L)**

Module - 2:
Planning and Control: Planning: Nature and importance of planning, -types of planning, Levels of planning - The Planning Process. –MBO, SWOT analysis, McKinsey's7S Approach.
Organizing for decision making: Nature of organizing, span of control, Organizational structure –line and staff authority.Basic control process -control as a feedback system – Feed Forward Control –Requirements for effective control – control (**4L)**

Module - 3:
Group dynamics: Types of groups, characteristics, objectives of Group Dynamics. Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership(**4L)**

Module – 4:
Work Study and work measurement: Definition of work study**,** Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim & Objectives, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types. Calculation of Standard Time. Work sampling**(4L)**

Module - 5:
Marketing Management: Functions of Marketing, Product Planning and development, Promotional Strategy (**2L)**

Module - 6:
Quality management: Quality definition, Statistical quality control, acceptance sampling, Control Charts – Mean chart, range chart,c chart,p chart,np chart, Zero Defects, Quality circles,, Kaizen & Six Sigma,ISO -9000 Implementation steps, Total quality management(6L)

Text Books:

1. Essentials of Management, by Harold Koontz & Heinz Weihrich TataMcGraw
2. Production and Operations Management-K.Aswathapa,K .Shridhara Bhat,Himalayan PublishingHouse

References:

1. Organizational Behavior, by Stephen Robbins Pearson Education, NewDelhi
2. New era Management, Daft, 11th Edition, Cengage Learning
3. Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearson publication

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2							3	
CO2	3	2	2	2							3	
CO3	3	3	2	2							3	
CO4	3	2	2	2							3	
CO5	3	2	2	2							3	

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course Name: Operating Systems Lab
Course Code: CS491
Allotted Hours: 36L

Prerequisites:

1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes:
On successful completion of the learning sessions of the course, the learner will be able to

CO1	Analyze different aspects of Linux
CO2	Create or design different scripts using shell programming.
CO3	Implement process, thread, and semaphore concept of operating system.
CO4	Create shared memory with the implementation of reading from, write into shared memory.

Course Content:

1. **Essential Linux Commands[9P]:** Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, kill, ps, who, sleep, grep, fgrep, find, sort, cal, banner, touch, file related commands – ws, sat, cut, grep etc. Mathematical commands –expr, factor, units, Pipes(use functions pipe, popen, pclose), named Pipes (FIFOs, accessing FIFO)

2. **Shell Programming [6P]:** Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).
3. **Process [3P]**: Starting new process, replacing a process image, duplicating a process image.

4. **Semaphore [3P]:** Programming with semaphores (use functions semget, semop, semaphore_p, semaphore_v).
5. **POSIX Threads[6P]:** Programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel).
6. **Shared Memory [9P]:**Create the shared memory , Attach the shared memory segment to the address space of the calling process, Read information from the standard input and write to the shared memory, Read the content of the shared memory and write on to the standard output, Delete the shared memory

Text Books:

1. Yashavant P. Kanetkar, UNIX Shell Programming, 1st edition, BPB Publications
2. W. Richard Stevens, UNIX Network Programming, 2nd edition, Prentice Hall

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3				3			
CO2	3	3	3	3	3				3			
CO3	3	3	3	3	3				3			
CO4	3	3	3	3	3				3			
CO5	3	3	3	3	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Computer Networks Lab
Course Code: CS492
Allotted Hours: 36L

Prerequisites:

1. Familiarity and knowledge of Computer Network and Computer Architecture
2. Also require strong knowledge of programming languages like C, Java and UNIX or Linux environment.

Course Outcomes (COs):

After attending the course students should be able to

CO1	To design and implement small size network and to understand various networking commands.
CO2	To provide the knowledge of various networking tools and their related concepts.
CO3	To understand various application layer protocols for its implementation inclient/server environment
CO4	Understand the TCP/IP configuration for Windows and Linux
CO5	Learn the major software and hardware technologies used on computer networks

Course Contents:

1. Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking Operating Systems - Configurations.**[6L]**

2. Socket Programming using TCP and UDP**[18L]**

3. Implementing routing protocols such as RIP, OSPF.**[2L]**

4. FamiliarizationofadvancedsimulatorslikePacketTracer,NS2/NS3,OMNET++,TinyOS **[4L]**

5. Server Configuration: only web server (If time permit, Instructor can do more than that) **[6L]**

Textbooks:

1. TCP sockets in C Programs-Practical guide for Programmers By Micheal, J Donahooand Kenneth L Calvert.
2. Socket Programming by Raj Kumar Buyaa.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3							2
CO2	3	3	3	3	3							2
CO3	3	3	3	3	3							2
CO4	3	3	3	3	3							2
CO5	2	3	2	2	3							2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Programming using Python
Course Code: CS493
Allotted Hours: 36L

Prerequisites:
Knowledge of Mathematics and basic concepts of Programming

Course Outcome(s):
After completion of the course students will be able to
CO1: Understand basic of Python Programming Language
CO2: Understand the use of Conditional statement and Loops
CO3: Learn functions in python and represent collection type data using List and Dictionary
CO4: Read and write data from & to files in Python
CO5: Understand Numpy array and numerical operations on Numpy array.

Course Contents:

1. **Basics of Python:** Python Installation, python variables, data types and Operator.
2. **Loops: While and For loops, Python Syntax, Colon & Indentation, Conditional Statements: if, elif and else.**
3. **Functions:** Defining Functions in python; passing arguments.
4. **String:** Python Programming to explore string functions
5. **Lists**: Python programs using Lists; understand the use of List methods, Slicing on List.
6. **Sets**: Working with Sets; Write programs to show different set operations.
7. **Dictionary**: Demonstrate the use of Dictionaries
8. **File handling: Reading & Writing data from a file, Redirecting output streams to files.**
9. **Basics of Module & Package:** Creation, Updation, Deletion.
10. **Numpy**: Numerical operations using Numpy array; slicing numpy array; stacking numpy arrays; Write programs to show different numerical operations on numpyarray;.
11. **Pandas**: Numerical operations using Pandas array; slicing Pandas array; stacking Pandas arrays; Write programs to show different numerical operations on Pandas;.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	2	-	-	-	-	-	-	-	1
CO2	2	3	-	2	-	-	-	-	-	-	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	1
CO4	2	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2

Course Name: Numerical Methods Lab
Course Code: M(CS)491
Allotted Hours: 30L

Prerequisite: Any introductory course on programming language (example. C/ Matlab).

Course Outcomes (COs):

After attending the course students should be able to

CO1	Describe and explain the theoretical workings of numerical techniques with the help of C
CO2	Compute basic command and scripts in a mathematical programming language
CO3	Apply the programming skills to solve the problems using multiple numerical approaches.
CO4	Analyze if the results are reasonable, and then interpret and clearly communicate the
CO5	Apply the distinctive principles of numerical analysis and the associated error measures.

Course Content:

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Tri diagonal matrix algorithm, Gauss-Seidel iterations. LU Factorization method.
4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method
5. Assignments on ordinary differential equation: Euler's method, Euler's modified method, Runge-Kutta methods, Taylor series method and Predictor-Corrector method.

   Implementation of numerical methods on computer through C/C++ and commercial Software Packages:Matlab/Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group) /Python.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2			3			
CO2	3	3	2	2	3	2			3			
CO3	3	3	2	2	3	2			3			
CO4	3	3	2	2	3	2			3			
CO5	3	3	2	2	3	2			3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

3rd Year 5th Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS 501	Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	CS 502	Database Management Systems	3	0	0	3	3
3	ENGG	Major	CS 503	Object Oriented Programming using Java	3	0	0	3	3
4	ENGG	Major	CS 504 A CS 504 B CS 504 C	Compiler Design Cryptography and Network Security Computer Graphics	3	0	0	3	3
5	HUM	Minor	HU(CSE)501	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	CS 591	Artificial Intelligence Lab	0	0	3	3	1.5
7	ENGG	Major	CS 592	Database Management Systems Lab	0	0	3	3	1.5
8	ENGG	Major	CS 593	Object Oriented Programming using Java Lab	0	0	3	3	1.5
9	PRJ	Internship	CS581	Internship	0	0	2	2	2
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

Course Name: Artificial Intelligence
Course Code: CS501
Contact:3:0:0
Total Contact Hours: 36
Credits:3

Prerequisite:

Data Structure, Design and Analysis of Algorithms, Statistics

Course Objective(s):

- The objective of the course is to enable students to
- ComprehendthefundamentalconceptsofKnowledgeRepresentationandInferencinginArtificialIntelligenceand its utilitarian importance in current technological context
- FormulateaproblemasState-SpaceExplorationFrameworkoranInferencingFrameworkofArtificialIntelligence.
- Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
- Design AI-Frameworks for Inferencing based on knowledgebase.
- AnalyzetheeffectivenessofanAI-InferencingModelinofferingsolutionstotherespectiveproblem.

Course Outcomes(s):

CS501.1 To Understand and explain the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CS501.2 To Identify and formulate an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing Agent Design Framework within the scope of Artificial Intelligence paradigm.

CS501.3 To Explore relevant literature and apply the concept of Heuristic Techniques or Inferencing Models of Artificial Intelligence to solve problems.

CS501.4 To Develop Inferencing Models for proposing solutions to the problems of Artificial Intelligence

CS501.5To Implement Inferencing Models of Artificial Intelligence through developing feasible algorithms and investigate their effectiveness by analyzing their performances in solving the relevant problems.

Course Content:

Module-1:Introduction to Artificial Intelligence[1L]
Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence

Module-2: Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching [5L]

Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionaries andCannibalsProblems,Farmer-Wolf-Goat-CabbageProblem,8-PuzzleProblem,ConstraintSatisfactionProblem and Production System for Goal Searching.
Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-directional Search.

Module-3: Heuristic Techniques for Goal Searching[8L]

Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search. Best First Search, A* Search, Memory-bounded heuristic search: Iterative-deepening A*Search, Recursive Best First Search, Simplified Memory Bounded A*Search.
Simulated Annealing Based Stochastic Search, Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization.

Module-4:AdversarialSearchforGamePlaying[2L]

Basic Concepts, Minimax Search, Alpha-Beta Pruning.

Module-5:KnowledgeRepresentationandInferenceusingPropositionalLogicandPredicateLogic[5L]

PropositionalLogic:KnowledgeRepresentationandInferenceusingPropositionalLogic
PredicateLogic:KnowledgeRepresentation,InferenceandAnswerExtractionusingFirstOrderPredicateLogic

Module-6:Slot-and-FillerStructureforKnowledgeRepresentation [2L]

WeakSlot-and-FillerStructureforKnowledgeRepresentation:SemanticNetsandFrames.
StrongSlot-and-FillerStructureforKnowledgeRepresentation:Conceptual Dependency and Script.

Module-7:ReasoningunderUncertainty[5L]

BayesianInferencingandBayesianBeliefNetwork,Dempster-ShaferTheory,OverviewofFuzzyLogicandInferencing, Overview of Hidden Markov Model.

Planning [5L]

Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms forPlanning:GoalStack,NonlinearPlanningUsingConstraintPosting,HierarchicalPlanning,AlgorithmsforPlanningasState-SpaceSearch,Heuristicsforplanning,PlanningGraphsandGRAPHPLANAlgorithm.

Introduction to Natural Language Processing[1L]

Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and SemanticAnalysis,DiscourseIntegrationandPragmaticAnalysis,ApplicationsofNaturalLanguageProcessing.

Module-8:Introduction to Machine Learning [2L]

BasicconceptsofMachineLearningModel,SupervisedLearning,UnsupervisedLearning,andReinforced Learning, Overview of Artificial Neural Network

Textbook:

1. Russell,S.andNorvig,P.2015.ArtificialIntelligence-AModernApproach,3rdedition,PrenticeHall.
2. Rich,E.,Knight,KandShankar,B.2009.ArtificialIntelligence,3rdedition,TataMcGrawHill.

ReferenceBooks:

1. Padhy,N.P.2009.ArtificialIntelligenceandIntelligentSystems,OxfordUniversityPress.
2. Deepak Khemani,“AFirstCourseinArtificial Intelligence”,McGrawHill.

CO PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										3			
CO2	2	3													
CO3	2	2	3	2											
CO4	2	2	2	3								2			
CO5	2	2	3	3	2							2			

Course Name: Database Management System
Paper Code: CS502
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcome(s):

On completion of the course students will be able to:
CO1 To understand the basic concepts and utility of Database management system
CO2 To Design an Entity Relationship (E-R) Diagram and relational model for an application.
CO3 ToAnalyzeandcreate therelationaldatabasebasedonnormalization
CO4 To determine whether the transaction satisfies the ACID properties.
CO5 To Implement and maintain the database of an organization

Module1:

Introduction[3L]

Concept&OverviewofDBMS,DataModels,DatabaseLanguages,DatabaseAdministrator,Database Users, Three Schema architecture of DBMS.

Module2:

Entity-Relationship and Relational Database Model[11L]

Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, RelationalAlgebra,RelationalCalculus,ExtendedRelationalAlgebraOperations,Views,Modificationsof the Database.

Module3:

SQL and Integrity Constraints[6L]

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values,DomainConstraints,ReferentialIntegrityConstraints,assertions,views,NestedSubqueries,Datab asesecurity application development using SQL, Stored procedures and triggers.

Module4:

Relational Database Design [8L]

FunctionalDependency,DifferentanomaliesindesigningaDatabase.,Normalizationusingfunctionaldependencies,Decomposition,Boyce-CoddNormalForm,3NF,Normalizationusingmulti-valueddependencies, 4NF, 5NF, Case Study

Module5:

InternalsofRDBMS[9L]

Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization.Transactionprocessing,ConcurrencycontrolandRecoveryManagement:transactionmodel properties,stateserializability, lockbaseprotocols; twophaselocking,DeadLock handling.

Module6:

File Organization &Index Structures[6L]

File&RecordConcept,PlacingfilerecordsonDisk,FixedandVariablesizedRecords,TypesofSingle-LevelIndex(primary,secondary, clustering),Multilevel Indexes

TextBooks:

1. HenryF.KorthandSilberschatzAbraham,"DatabaseSystemConcepts",Mc.GrawHill.
2. ElmasriRamezandNovatheShamkant,"FundamentalsofDatabaseSystems",BenjaminCummingsPublishing. Company.

Reference:

1. "FundamentalsofDatabaseSystems",RamezElmasri,ShamkantB.Navathe,AddisonWesleyPublishing.
2. Ramakrishnan:DatabaseManagementSystem,McGraw-Hill

CO-PO Mapping:

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2							
CO2	3	3	3	2	2							
CO3	3	3	3	3	3	2	1					
CO4	3	3	3	2	3	2	2					
CO5	3	2	3	2	3	2	2				1	1

Course Name: Object Oriented Programming using Java

Course Code: CS503
Contact:3:0:0
Total Contact Hours: 36
Credits:3
Prerequisite: Partial Object Oriented Programming using C++

Course Outcome(s):

CO1: Design the process of interaction between Objects, classes & methodsw.r.t.Object Oriented Programming.
CO2: AcquireabasicknowledgeofObjectOrientationwithdifferentpropertiesaswellasdifferentfeatures of Java.
CO3: Analyzevariousactivities of different string handling functions with various I/O operations.
CO4: Discuss basic code reusability feature w.r.t. Inheritance, Package and Interface.
CO5: ImplementExceptionhandling,MultithreadingandApplet(Webprograminjava)progr ammingconcept in Java.

Course Contents:

Module 1: [2L]Introduction:
Object Oriented Analysis (OOA) & Object Oriented Design (OOD) - Concepts of object orientedprogramminglanguage,Relationshipsamongobjectsandclasses-Generalization,Specialization,Aggregation,Association,Composition,links,Meta-class.**[1L];**ObjectOrientedProgrammingconcepts-Differencebetween JavaandC++; Different features of Java**[1L];**

Module 2: [10L]Java Basics:
Basicconceptsofjavaprogramming-Advantagesofjava,Byte-code&JVM,Datatypes,DifferenttypesofVariables.**[1L];**JavaOperators&Controlstatements**[1L];**Javalo ops.**[1L];**Array.**[1L]**
;Creation of class, object, method. **[1L];** Constructor- Definition, Usage of Constructor, DifferenttypesofConstructor.**[1L];**finalizemethodandgarbagecollection,Method&Constructoroverloading. **[1L];** this keyword, use of objects as parameter & methods returning objects. **[1L];** Callbyvalue &call by reference. **[1L];**Static variables& methods.Nested & innerclasses.**[1L].**

Module3:[5L]
Basic String handling & I/O:
Basic string handling concepts- Concept of mutable and immutable string, Methods of String class-charAt(),compareTo(),equals(),equalsIgnoreCase(),indexOf(),length(),substring().**[1L];**toCharArray( ), toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods, Methods ofString buffer class- append(), capacity(), charAt(), delete(), deleteCharAt(). **[1L];**ensureCapacity(),getChars(),indexOf(),insert(),length(),setCharAt(),setLength(),substring(),toSt ring().**[1L]**
;Commandlinearguments,basicsofI/Ooperations–keyboardinputusingBufferedReader**[1L];** ScannerclassinJavaI/O operation**[1L];**

Module4:[8L]
InheritanceandJavaPackages:

Inheritance-Definition,Advantages,Differenttypesofinheritanceandtheirimplementation.**[1L] ;**Super and final keywords, super() method. **[1L];** Method overriding, Dynamic method dispatch.**[1L];** Abstract classes & methods. **[1L];** Interface - Definition, Use of Interface. **[1L];** Multipleinheritance by using Interface. **[1L] ;**Java Packages -Definition, Creation of packages. **[1L];** JavaAccess Modifiers - public, private, default and protected, Importing packages, member access forpackages.**[1L]**

Module5:[11L]

Exceptionhandling,MultithreadingandAppletProgramming:

Exception handling - Basics, different types of exception classes. Difference between Checked &Unchecked Exception. **[1L];** Try & catch related case studies.**[1L];** Throw, throws & finally. **[1L];**Creation of user defined exception. **[1L];** Multithreading - Basics, main thread **[1L];** Thread lifecycle.**[1L];**Creationofmultiplethreads-yield(),suspend(),sleep(n),resume(),wait(),notify(),join(),isAlive().**[1L];**Threadpriorities,threadsynchronization.**[1L];**Interthreadcommunication,deadlocksfor threads**[1L];**AppletProgramming-Basics,appletlife cycle, difference betweenapplication& applet programming**[1L];**Parameterpassing in applets.**[1L]**

Textbooks:

1. HerbertSchildt – "Java:TheCompleteReference"– 9th Ed.–TMH
2. E.Balagurusamy –" ProgrammingWith Java:APrimer"–3rd Ed.– TMH.

ReferenceBooks:

1. R.KDas–"CoreJava forBeginners"–VIKASPUBLISHING.

Rambaugh,JamesMichael,Blaha–"ObjectOrientedModellingandDesign"–PrenticeHall,India.

CO-POMapping:

PO / CO	CO&PO Mapping											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	3	2	-	-	-	-	-	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	-	-
CO3	3	3	2	3	-	-	2	-	1	-	-	-
CO4	2	-	2	2	-	-	-	-	-	-	-	-
CO5	2	-	3	1	2	-	-	-	2	-	2	-

Course Name: Compiler Design
Course Code: CS504A
Contact: 3:0:0
Total Contact Hours: 36
Credit:3

Prerequisites:

1. Mathematics
2. Concept of programming languages
3. Data structures
4. Computer architecture
5. Formal languages and automata theory
6. Some advanced math might be required if you adventure in code optimization.

Course Objective(s):

- To make the student understand the process involved in a compiler
- Tocreateanoverallviewofvarioustypesoftranslators,linkers,loaders,andphasesofacompiler
- Tounderstandtheconceptsofsyntaxanalysis,varioustypesofparsersespeciallythetop-downapproach
- Tocreateawarenessamongstudentsaboutvarioustypesofbottom-upparsers,
- To understand the syntax analysis and, intermediate code generation, type checking, the role of symbol table and its organization, Code generation, machine independent code optimization and instruction scheduling

Course Outcome(s):

After the completion of the course, the students will be able to
CO1:Illustratethebasicconceptofcompilersanddiscussonthecomponentsaswellasthestrength sandweaknessesofvariousphases of designing compiler.[CO1]
CO2:Explaintheroleoffiniteautomataincompilerdesign.[CO2]
CO3:Designandanalysealgorithmsforsyntacticorparsingtechniquesandsemanticanalysisoftheprocess ofdesigning compilers.[CO3]
CO4:FormulatethetheoriesofcreatingsimplecompilersusingCprogramminglanguages.[CO4]

Course Contents:

Module-1[7L]

Compilers,CousinsoftheCompiler,Analysis-synthesismodel,Phasesofthecompiler,Roleofthelexicalanalyser,Tokens,Patterns,Lexemes,Inputbuffering,Specificationsofatoken,Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to DFA, Design of a lexical analyser generator (Lex).

Module-2[10L]

Theroleofaparser,Contextfreegrammars,Writingagrammar,TopdownParsing,Non-recursivePredictiveparsing(LL),Bottomupparsing,Handles,Viableprefixes,Operatorprecedence parsing, LR parsers (SLR, LALR, Canonical LR), Parser generators (YACC), ErrorRecovery strategies for different parsing techniques, Syntax directed translation: Syntax directeddefinitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributeddefinitions,Bottom-upevaluationof inherited attributes.

Module-3[7L]

Type systems, Specification of a simple type checker, Equivalence of type expressions, Typeconversions,Sourcelanguageissues(Activationtrees,Controlstack,scopeofdeclaration,Bindingo fnames), Symbol tables, dynamicstorageallocationtechniques.

Module-4[4L]

Intermediate languages, Graphical representation, Three-address code, Implementation of threeaddressstatements (Quadruples,Triples,Indirecttriples).

Module-V[8L]

ConsiderationforOptimization,scopeofoptimization,localoptimization,loopoptimization,folding, DAG representation, Flow Graph, Data flow equation, global optimization, redundant subexpression elimination, induction variable elimination, copy propagation, basic blocks & flowgraphs, transformation of basic blocks, DAG representation of basic blocks, peephole optimization,Objectcodeforms,machinedependentcodeoptimization,registerallocationand assignment,genericcodegenerationalgorithms, DAGforregisterallocation.

TextBooks

1. Aho,A.V.,Sethi,R.,&Ullman,J.D.Addison-Wesley,2007.Compilers-Principles,Techniques,andTools.
2. Holub,A. I.(1990).CompilerdesigninC(Vol.5).EnglewoodCliffs,NJ:Prentice Hall.

ReferenceBooks

1. Chattopadhyay,S.(2005).CompilerDesign.PHILearningPvt.Ltd.
2. Tremblay,J.P.,&Sorenson,P.G.(1985).TheoryandPracticeofCompilerWriting.McGraw-Hill,Inc.
3. Appel,A.W.(2004).ModerncompilerimplementationinC.Cambridgeuniversity press.
4. Barrett, W.A.,Bates,R.M.,Gustafson,D.A.,&Couch,J.D.(1986).Compiler construction:theoryandpractice.SRA SchoolGroup.

CO-POMapping:

	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	3	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-

Course Name: Cryptography and Network Security
Course Code: CS504B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites

1. Knowledge of Computer Networks and Operating Systems fundamentals
2. Understanding of Discreet Mathematics concepts

Course Objective(s):

- To impart concepts on cryptography and Network security
- To gain knowledge of the standard algorithms used to provide confidentiality, integrity, and authenticity
- To recognize the various key distribution and management systems for security of a cryptosystem

Course Outcomes:

After completion of course, students would be able

CS504B.1: To understand the basic concepts in cryptography
CS504B.2: To apply the deployment of different encryption techniques to secure messages in transit across data networks
CS504B.3: To discuss various techniques used to assure Integrity and Authentication
CS504B.4: To analyze diverse security measures and issues in practice.

Course Contents

Module-1 [7L]

Introduction - Services, Mechanisms, and Attacks, OSI security architecture, Network security model[1L]
Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography) [3L]
Finite Fields and Number Theory: Groups, Rings, Fields, Modular arithmetic, Euclid's algorithm[1L]
Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem[1L]
Testing for primality -The Chinese remainder theorem - Discrete logarithms [1L]

Module-2 [9L]

Data Encryption Standard- Block cipher principles, block cipher modes of operation[2L]
Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm[3L]
Public key cryptography: Principles of public key cryptosystems, The RSA algorithm[2L]
Key management - Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography [2L]

Module-3 [6L]

Authentication requirement, Authentication function, MAC, Hash function [2L]
Security of hash function and MAC, MD5, SHA, HMAC, CMAC [2L]
Digital signature and authentication protocols, DSS, ElGamal, Schnorr [2L]

Module-4 [7L]

Authentication applications, Kerberos, X.509 [1L]
Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles [1L]
SET for E-Commerce Transactions [1L]
Intruder, Intrusion detection system [1L]

Virus and related threats, Countermeasures [1L]
Trusted systems, Practical implementation of cryptography and security [2L]

Module-5 [7L]
E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source [1L]
Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME [2L]
IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP) [1L]
Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding) [1L]
Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication [1L]
PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction [1L]

Textbooks
[1] Kahate, A. (2013). Cryptography and network security.Tata McGraw-Hill Education.
[2] Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security. New York, NY: Mc Graw Hill Education (India) Private Limited.

Reference Books
[1] Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.
[2] Daras, N. J., &Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security (pp. 253-287).Springer.
[3] Kumar, A., & Bose, S. (2017). Cryptography and network security.Pearson Education India.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS504B .1	3	1	2	1	1	-	-	-	3	2	1	1	3	1	1
CS504B .2	3	2	3	2	3	-	-	-	2	1	1	1	3	1	1
CS504B .3	1	3	2	3	2	-	-	-	2	3	1	1	3	1	3
CS504B .4	2	3	1	3	1	-	-	-	1	1	1	1	3	1	3

Course Name: Computer Graphics
Course Code: CS504C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Mathematics,ComputerFundamentals&PrincipleofComputerProgramming

Course Outcomes
On successful completion of the learning sessions of the course, the learner will be able

CS504C**.1:** To remember the foundations of computer graphics and different display technology and devices.
CS504C**.2:** To analyze the concept of geometric, mathematical and algorithmic approach necessary for programming computer graphics.
CS504C**.3:** To explain clipping with the comprehension of windows, view-ports in relation to images display on screen.
CS504C**.4:** To experiment and compare different hidden surface illumination methods

Course Content:

Module – 1: [4L] Introduction: Objective, applications, GKS/PHIGS, normalized co-ordinate system, aspect ratio.
Module -2:[4L] Graphics System: Vector and raster graphics, various graphics display devices, graphics interactive devices, segmented graphics, attribute table.
Module -3 :[4L] Raster Scan Graphics: Line drawing algorithms, circle/ellipse drawing algorithms, polygon filling algorithms.
Module -4 :[4L] Geometric Transformation: Homogeneous co-ordinate system, 2D and 3D transformations, projection— orthographic and perspective.
Module – 5 :[4L] Curves and Surfaces: Curve approximation and interpolation, Lagrange, Hermite, Bezier and BSpline curves/surfaces and their properties, curves and surface drawing algorithms.
Module – 6 :[4L] Geometric modelling: 3D object representation and its criteria, edge/vertex list, constructive solid geometry, wire-frame model, generalized cylinder, finite element methods.
Module – 7 :[4L] Clipping :Window and viewport, 2D and 3D clipping algorithms.
Module –8:[4L] Hidden Lines and Hidden Surfaces:Concept of object- and image-space methods, lines and surface removal algorithms.
Module – 9 :[4L] Intensify, Coloring and Rendering:RGB, YIQ, HLS and HSV models and their conversions, gamma correction, halftoning. Illumination models, polygon mesh shading, transparency, shadow, texture.

Text Books
1. D. Hearn and P. M. Baker: Computer Graphics, 2nd ed. Prentice Hall of India, New Delhi, 1997.
2. W. M. Newman and R. F. Sproull: Principles of Interactive Computer Graphics, McGraw Hill, New Delhi, 1979.

Reference Books
1. F. S. Hill: Computer Graphics, McMillan, New York, 1990.
2. D. P. Mukherjee: Fundamentals of Computer Graphics and Multimedia, Prentice Hall of India, New Delhi, 1999.

3. J. D. Foley et al.: Computer Graphics, 2nd ed., Addison-Wesley, Reading, Mass., 1993.
4. W. K. Giloi: Interactive Computer Graphics: Data Structure, Algorithms, Languages, Prentice Hall, Englewood Cliffs, 1978.

CO–POMapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS504C .1	3	1	3	3	2	-	-	-	-	-	3	3	3	3	3
CS504C .2	3	3	3	2	1	-	-	-	-	-	2	1	2	3	2
CS504C .3	-	2	2	2	2	-	-	-	-	-	1	3	3	3	3
CS504C .4	2	3	1	3	1	-	-	-	-	-	1	3	3	3	3

Course Name: Economics for Engineers
Course Code: HU(CSE)501
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Pre-requisites:
MATH–College Algebra, Pre-Calculus Algebra and Trigonometry.
Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

HU(CSE)501.1: Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
HU(CSE)501.2: Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.
HU(CSE)501.3: Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
HU(CSE)501.4: Evaluate the profit of a firm, carry out the break even analysis and employ this tool to make production decision.
HU(CSE)501.5: Discuss and solve advanced economic engineering analysis problems including taxation and inflation.

Course Contents:

Module1: Introduction[3L]
ManagerialEconomics-Relationshipwithotherdisciplines-Firms: Types,Objectivesandgoals-ManagerialDecisions-Decision Analysis.

Module2:**DemandandSupplyAnalysis**[5L]
Demand-Typesofdemand-determinantsofdemand-Demandfunction-DemandElasticity-Demandforecasting-Supply-Determinantsof supply-Supplyfunction-Supply Elasticity.

Module3:Cost Analysis[5L]
Elementof costs, Marginalcost,MarginalRevenue,Sunkcost,Opportunitycost,Break-evenanalysis –PVratio.

Module4:**ElementaryeconomicAnalysis[4L]**
Inflation-Meaningofinflation,types,causes,measurestocontrolinflation.
National Income-Definition,Conceptsofnationalincome,Methodofmeasuringnationalincome.

Module5:FinancialAccounting [5L]
ConceptsandDefinitionofAccounting,Journal,Ledger,TrialBalance.TradingA/C,Profit& Loss A/C and BalanceSheet.

Module6:InvestmentDecision[2L]
Time value of money-Interest- Simple and compound, nominal and effective rate of interest,Cashflow diagrams, Principles of economic equivalence. Evaluation of engineering projects-Present worthmethod, Future worth method, Annual worth method, Internal rate of return method, Cost benefitanalysisforpublicprojects.

Textbooks:
1. Riggs,BedworthandRandhwa,"EngineeringEconomics",McGrawHillEducationIndia
2. PrinciplesofEconomics,DevigaVengedasalam;KarunagaranMadhavan,OxfordUniversityPress

ReferenceBooks:
1. EngineeringEconomybyWilliamG.Sullivan,ElinM.Wicks,C.PatricKoelling,Pearson
2. R.PaneerSeelvan,"EngineeringEconomics", PHI
3. Ahuja,H.L.,"PrinciplesofMicroEconomics",S.Chand&CompanyLtd
4. Jhingan,M.L.,"MacroEconomicTheory"
5. MacroEconomicsbyS.P.Gupta,TMH
6. HaniffandMukherjee,Modern Accounting,Vol-1,TMG
7. ModernEconomicTheory –K.K.Dewett(S.Chand)

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU(CSE)501.1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
HU(CSE)501.2	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-
HU(CSE)501.3	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-
HU(CSE)501.4	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
HU(CSE)501.5	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-

Course Name: Artificial Intelligence
LabCourseCode:CS591
Contact:0:0:3
Total Contact Hours: 36
Credits:1.5

Prerequisite:

Data Structure,Design and Analysis of Algorithms, Statistics

Course Objective(s):

Theobjectiveofthecourseisto enablestudents to

- GainfoundationalknowledgeofPROLOGtoimplementanArtificialIntelligentAgenta sanexecutablecomputer program forKnowledgeRepresentation andInferencing
- Formulateaproblem by analyzing its characteristics to fit a State-Space ExplorationFrameworkor anInferencingFrameworkofArtificialIntelligence.
- ApplytheconceptsofArtificialIntelligencetosolveaproblembyimplementingwell-knownArtificialIntelligencestrategiesusing proper techniquesand tools ofPROLOG.
- Buildexpertsystemsofferingsolutionstothechallengingproblemsof Artificial Intelligence.
- ImplementArtificialIntelligencebasedideasasexecutablePROLOGprogramsthrough developingintelligent heuristicstrategies.

Course Outcomes(s):

CO1 : To **Acquire** foundational knowledge of PROLOG to**implement** an Artificial IntelligentAgentasanexecutablecomputerprogramforKnowledgeRepresentationandInferenci ngand**understand**the workingprinciple of theagentand**assess**itsutilitarian importance incurrenttechnologicalcontext leading towards lifelong learning.

CO2: To **Identify** and **formulate** an engineering problem by analyzing its characteristics to fit aState-Space Exploration Frame work or an Inferencing Agent Formulation Frame work of Artificial Intelligence.

CO3 : To **Explore** relevant literature and **apply** the concepts of Artificial Intelligence to **solve** aproblem by **implementing** well-known Artificial Intelligence strategies using proper techniques andtoolsof PROLOG..

CO4 : To **Develop** ideas and **propose** expert systems offering solutions to the challenging problemsofArtificialIntelligence.

CO5 : To **Plan and Implement** Artificial Intelligence based ideas as executable PROLOG programs through **developing** intelligent heuristic strategies or expert systems with adequate documentation in collaborative environment for successfully carrying out projects on Artificial Intelligence Problems and **investigate** their effectivenessby**analyzing**the performances using proper techniques and tools.

CourseContent:

WEEK-1:IntroductiontoPROLOGProgrammingalongwiththeIDEanditsBasicComponents

AssignmentsforunderstandingtheBasicComponentsofKnowledgeRepresentationandInferen

cinginArtificialIntelligenceusingPROLOGProgramminganditsworkingstrategy.

WEEK-2:Arithmetic,BooleanExpression,DecisionMakingStrategies

Assignments for understanding implementation of Arithmetic Expression, Boolean Expression, andDecision-MakingStrategies.

WEEK-3:RecursionandLoopingthroughRecursion

AssignmentsforunderstandingimplementationofRecursionandLoopingthroughRecursion.

WEEK-4:ListofDataItemsinPROLOG

AssignmentsforunderstandingtheutilityofListinsolvingvariousproblems.

WEEK-5:BlindSearchTechniques–BFS,DFS

ImplementationofBFSandDFSAlgorithmsforGoalSearchingtosolvePuzzles(8-Puzzle,WaterJugPuzzle)

WEEK-6:HeuristicSearchTechniques–A*Search

ImplementationofA*SearchAlgorithmforGoalSearchingtosolvePuzzles(8-Puzzle,RouteFindingPuzzle)

WEEK-7:ConstraintSatisfactionProblemSolving

ImplementationofBacktrackingStrategiestosolveConstraintSatisfactionProblems(GraphColoringProblem, 8-QueensProblem)

WEEK-8:GamePlaying

ImplementationofAdversarialSearchAlgorithmwithalpha-betapruningstrategyforGamePlaying(Tic-Tac-Toe)

WEEK-9:DiscussiononProjectProblemsandAllocation(ProblemDescriptionReportSubmission)

WEEK-10:DesigningSolutionModelandProposalReportSubmissionWEEK-11:ProjectImplementation,VerificationandDocumentation

WEEK-12:ProjectDemonstrationandProjectReportReview

Textbook:

1. IvanBratko,PrologProgrammingforArtificialIntelligence,4thEdition, Addison-Wesley
2. Russell,S.andNorvig,P.2015.ArtificialIntelligence-AModernApproach,3rdedition,PrenticeHall.
3. Rich,E.,Knight,KandShankar,B.2009.ArtificialIntelligence,3rdedition,TataMcGrawHill.

ReferenceBooks:

1. Padhy,N.P.2009.ArtificialIntelligenceandIntelligentSystems,OxfordUniversityPress.
2. DeepakKhemani,“AFirstCourseinArtificial Intelligence”,McGrawHill.

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	3
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-
CO4	2	2	2	3	-	-	-	-	-	-	-	2
CO5	2	2	3	3	2	2	2	2	2	2	2	2

Course Name: Database Management System
Course Code: CS592
Contact:3P/Week
Credits:1.5

Prerequisite:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objective(s):

- Tolearnthedatamodels,conceptualizeanddepicta databasesystem
- Tolearnthefundamentalconceptsof SQLqueries.
- Tounderstandtheconcept ofdesigningadatabasewiththenecessaryattributes.
- ToknowthemethodologyofAccessing,ModifyingandUpdatingdata&informationfromtherelational databases
- Tolearndatabasedesign aswellas todesignuserinterfaceandhowto connectwithdatabase.

Course Outcome(s):

Oncompletion ofthecoursestudents willbe able to
CO1:Understandthedatabase managementsystemand databaselanguage
CO2:UnderstandandapplytheSQLqueriesrelatedtomanagementofdataandtransactionprocessing.
CO3:Explainaboutqueryprocessing techniquesinvolvedinquery optimization
CO4:UnderstandPL/SQLprogramming,theconceptof CursorManagement,ErrorHandling,Package and Triggers
CO5:Designand build the commercialdatabasesystems.

Module1
ConceptualDesigningusingERDiagrams(Identifyingentities,attributes,keysandrelationshipsbetwe enentities, cardinalities, generalization,specialization etc.)

Module2
ConvertingERModeltoRelationalModel(RepresententitiesandrelationshipsinTabularform,Repres entattributesascolumns,identifyingkeys)andapply thenormalizationtechniques.

Module3
CreationofTablesusingSQL-
OverviewofusingSQLtool,DatatypesinSQL,CreatingTables(alongwith Primary andForeign keys), AlteringTables and Dropping Tables.

Module4
PracticingDMLcommands- Insert,Select,Update,Delete.

Module5
Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT,CONSTRAINTSetc.,PracticingSubqueries(Nested,Correlated) andJoins(Inner,OuterandEqui).

Module6

PracticeQueriesusingCOUNT,SUM,AVG,MAX,MIN,GROUPBY,HAVING,VIEWS CreationandDropping,PracticingonTriggers-creationoftrigger,Insertionusingtrigger,Deletionusingtrigger, Updatingusing trigger

Module7

Procedures-CreationofStoredProcedures,ExecutionofProcedure,andModificationofProcedure,PL/SQL,Cursors-DeclaringCursor, OpeningCursor,Fetching thedata,closingthe cursor.

Table2:MappingofCourseOutcomeswithPos(&PSOs)

CO#	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	2									
CO2	3	3	3	3	2	1					1	1			
CO3	3	3	2	3	3	2				1	1	1			
CO4	3	3	3	3	3	1	1			1	1	1			
CO5	3	3	3	3	3	2	1	1	3						

Course Name: Object Oriented Programming using Java
Course Code : CS593
Contact:0:0:3
Credits:1.5

Prerequisites:

1. ComputerFundamentals
2. BasicunderstandingofComputerProgrammingandrelatedProgrammingParadigms
3. ProblemSolvingTechniqueswithproperlogic Implementation.

Course Objective(s):

- It demonstrates that how can you change the implementation of an object without affectinganyothercodebyincreasingdatasecurityandprotectingunwanteddataaccess.(Encapsulation).
- It allows you to have many different functions, all with the same name, all doing the samejob,but depending upon different data. (Polymorphism).
- Itguidesyoutowritegenericcode:whichwillworkwitharangeofdata,soyoudon'thavetowritebasic stuffover,and over again. (Generics).
- It lets you write a set of functions, then expand them in different direction without changingorcopying them in anyway. (Inheritance)

Course Outcome(s):

CO1: Createtheprocedureof communicationbetweenObjects, classes&methods.
CO2: UnderstandtheelementaryfactsofObjectOrientationwithvariouscharacteristicsaswellassevera l aspects of Java.
CO3: AnalyzedistinctfeaturesofdifferentstringhandlingfunctionswithvariousI/Ooperations.
CO4: DiscusssimpleCodeReusabilitynotionw.r.t.Inheritance,PackageandInterface.**CO5:**
Apply Exception handling, Multithreading and Applet (Web program in java)programming concept in Java.

Course Contents:

Module1:Java Basics:

1. SimpleJavaprogrammingusingoperators,controlstatements&loops,array.
2. Programmingonclass,object,andmethod,access specifier.
3. Programmingonconstructor,method/constructoroverloading.
4. Programmingonthiskeyword,callbyvalue&callbyreference,staticvariables&methods,innerclas ses.

Module2: BasicString handling &I/O:

1. Programming to show the use of String class methods - charAt(), compareTo(), equals(),equalsIgnoreCase(),indexOf(),length(),substring(),toCharArray(),toLowerCase(),toString(),toUpperCase(), trim(), valueOf() methods.
2. Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(),delete(),deleteCharAt(),ensureCapacity(),getChars(),indexOf(),insert(),length(),setCharAt(),setLength(),substring(), toString()methods.
3. ProgrammingonCommandlinearguments.
4. Programmingusingkeyboardinputbyimplementing BufferedReader&Scannerclasses.

Module3:Inheritance, InterfaceandJavaPackages:

1. ProgrammingonSimpleInheritance,super andfinalkeywords,super()method.
2. Programming on method overriding, dynamic method dispatch,abstract classes & methods,multipleinheritanceby using interface.
3. Programming on importing system package, creating user-defined package, importing user-definedpackage,usingprotectedaccessspecifier,subclassinganimportedclassofapackage, using same names for classes of different packages, adding multiple public classestoa package.

Module4:Exceptionhandling,MultithreadingandAppletProgramming:

1. Programmingonexceptionhandlingusingtry-catchblock,implementingthrowandthrowskeywords,using finally block, creating user-defined exception.
2. Programmingoncreatingchildthreadsi)byextendingthreadclassii)byimplementingrunnableinterface, creating child threads by assigningthread priorities.
3. Programmingoncreatingsimpleapplettodisplaysomemessage,creatingapplettwoadd2integers,creating applet to do GUIbased programming.

Textbooks:

1. HerbertSchildt – "Java:TheCompleteReference"– 9th Ed.–TMH
2. E.Balagurusamy– "Programming WithJava:APrimer " – 3rdEd.– TMH.

ReferenceBooks:

1.R.KDas–"CoreJava forBeginners" –VIKASPUBLISHING.
Rambaugh,JamesMichael,Blaha–"ObjectOrientedModellingandDesign"–PrenticeHall,India

CO-POMapping:

COs	ProgrammeOutcomes(POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	-	-	-	1	-	-	1
CO2	3	2	2	-	1	-	-	-	1	-	-	2
CO3	2	3	2	3	-	-	-	-	2	-	-	-
CO4	1	-	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	-	1	-	-	-	2	-	-	2

3rd Year 6th Semester									
Sl. No.	**Broad Category**	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	CS 601	Web and Internet Technology	3	0	0	3	3
2	ENGG	Major	CS 602	Machine Learning	3	1	0	4	4
3	ENGG	Major	CS 603	Software Engineering	3	0	0	3	3
4	ENGG	Major	CS 604 A CS 604 B CS 604 C	Mobile Computing Natural Language Processing Cloud Computing	3	0	0	3	3
5	ENGG	Minor	CS 605	Cyber Law and Ethics	3	0	0	3	3
B.PRACTICAL									
6	ENGG	Major	CS 691	Web and Internet Technology Lab	0	0	3	3	1.5
7	ENGG	Major	CS 692	Machine Learning Lab	0	0	3	3	1.5
8	ENGG	Major	CS 693	Software Engineering Lab	0	0	3	3	1.5
Total of Theory, Practical and Mandatory Activities/Courses								25	20.5

Course Name: Web and Internet Technology
course Code: CS601
Contact (Periods/Week):3L/Week
CreditPoint:3
No.ofLectures:36

Course Objective(s):

• Toimpartthedesign,development,andimplementationofStaticandDynamicWebPages.
• TodevelopprogramsforWebusing ScriptingLanguagesand.netframework.
• TogiveanoverviewofServerSideProgramminginWeb.

Course Outcome(s):

CO1TounderstandthenotionsofWorldWideWeb(www),Internet,HTTPProtocol,Client-Server,etc.
CO2Todevelopinteractivewebpagesusing HTML,DHTML,CSSandinformationinterchangeformatslike XML
CO3Todesignwebapplicationsusingscriptinglanguageslike JavaScript,CGI.
CO4 To produce the server-side programming concepts using servlet, JSP.CO5Toacquiretheknowledgeonsecurityrelatedconceptand webcrawler

CourseContents:

Module1:[6L]

Introduction(1L):Overview,NetworkofNetworks,Intranet,Extranet,andInternet.
World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP.ReviewofTCP/IP(1L):Features,Segment,Three-WayHandshaking,FlowControl,ErrorControl,Congestioncontrol, IP Datagram,IPv4 andIPv6.
IPSubnettingandaddressing(1L):ClassfulandClasslessAddressing,Subnetting.NAT,IPmasquerading,IP tables.
InternetRoutingProtocol(1L):Routing-IntraandInterDomainRouting,UnicastandMulticastRouting,Broadcast.
ElectronicMail(1L):POP3, SMTP,Clients -ServersCommunication.

Module-2:[9L]

HTML, DHTML &CSS : Introduction, Elements, Attributes, Heading, Paragraph. Formatting[1L];Link, Table, List, Block, Layout, Html Forms, and input [1L]; Iframe, Colors[1L], Image Mapsandattributesof image area[1L];
Introduction to CSS, basic syntax and structure of CSS, different typesinternal, external and inlineCSS [1L];
BasicIntroductionofDHTML,DifferencebetweenHTMLandDHTML,DocumentaryObjectModel (DOM)[1L].
ExtendedMarkupLanguage(XML):Introduction,DifferencebetweenHTML&XML,XML-Tree[1L];Syntax, Elements, Attributes, Validation and parsing, DTD[2L].

Module3:[15L]

Java Scripts: Basic Introduction, Statements, comments, variable, operators, datatypes[1L];condition,switch, loop,break[1L];Javascriptfunctions, objects,and events[1L].
CGIScripts:Introduction,EnvironmentVariable,GETandPOSTMethods[1L].
Java Servlet: Servlet environment and role, Servlet life cycle [1L]; Servlet methods-Request,Response,Get and post [1L]; Cookies and Session[1L].

JavaServerPage(JSP):
JSP Architecture [1L]; JSP Servers, JSP Life Cycle [1L]; Understanding the layout of JSP, JSPScriptletTag[1L];JSPimplicitobject(requestandresponse)[1L];Variabledeclaration,methodsinJSP[1L];JSPdirective(TaglibandInclude),JavaBean-insertingJavaBeaninJSP[1L];JSPActiontags(Forward&Include)[1L];CreatingODBCdatasourcename, IntroductiontoJDBC,preparedstatementand callable statement [1L].

Module-4:[6L]

Threats[1L]:Maliciouscode-viruses,Trojanhorses,worms;eavesdropping,spoofing,modification,denialofserviceattacks.
Networksecuritytechniques:PasswordandAuthentication;VPN,IPSecurity[1L],securityinelectronictransaction, SecureSocket Layer (SSL), SecureShell (SSH)[1L].
Firewall(1L):Introduction,Packetfiltering,Stateful,Applicationlayer,Proxy.
SearchEngineandWebCrawler:Definition,Metadata,WebCrawler[1L],Indexing,Pagerank,overviewofSEO[1L].

Textbooks:

1. “WebTechnology:ADeveloper'sPerspective”,N.P.GopalanandJ.Akilandeswari,PHI.

Learning,Delhi,2013.(Topicscovered:html,CSS,imagemap,xml)
2. “LearningPHP,MySQL&JavaScript”, RobinNixon, O’ReillyPublication.(Topicscovered:JavaScript)
3. “Head First Servlet’s & JSP”, Bryan Basham, Kathy Sterra, Bert Bates, O’Reilly Publication.(Topicscovered: Servlet,JSP)
4.CryptographyandNetworkSecuritybyWilliamStallingsPublisher:PearsonEducationIndia(Topicscovered: Threats, Security techniques, Firewall)

Recommended books:

1. "ProgrammingtheWorldWideWeb",Robert.W.Sebesta, FourthEdition,PearsonEducation,2007.
2. “Core Web Programming”- Second Edition-Volume I and II, Marty Hall and Larry Brown,PearsonEducation, 2001

CO– PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2		2	3	2								
CO3		2	2									
CO4	1	2	3	2								
CO5	1		3	2								

Course Name: Machine Learning
Course Code:CS602
Contact(Periods/Week):3L/Week
CreditPoint:4
No.ofLectures:36

Prerequisite:

1. Basicprogrammingskills,Algorithmdesign.
2. Probability, Axioms of Probability, Conditional Probability, Bernoulli Distribution, BinomialDistribution, Multinomial Distribution, Uniform Distribution, Normal (Gaussian) Distribution, Chi-Square Distribution, t Distribution, F Distribution. Probability Distribution and Density Functions,Joint Distribution and Density Functions, Conditional Distributions, Bayes' Rule, Expectation,Variance,Weak Law of LargeNumbers.
3. LinearAlgebra;ConvexOptimization;Statistics;Calculus.

Course Objective(s)

- Tolearntheconceptof howtolearnpatternsandconceptsfromdatawithoutbeing explicitlyprogrammed
- Todesignandanalyse variousmachinelearning algorithmsandtechniqueswitha modernoutlookfocusingon recent advances.
- Exploresupervisedandunsupervisedlearningparadigmsofmachinelearning.
- ToexploreDeeplearningtechniqueandvariousfeatureextractionstrategies.

Course Outcome(s)

CO1:Haveagoodunderstanding ofthefundamentalissues andchallengesofmachinelearning:data,model selection, model complexity, etc.
CO2:Haveanunderstandingofthestrengthsandweaknessesofmanypopularmachinelearningapproaches.
CO3:Understandhowtoevaluatemodelsgeneratedfromdata.
CO4:Applythe algorithmsto arealproblem, optimizethe modelslearnedand reporton theexpected accuracy that can beachieved byapplying the models

Module1:[8L]

Supervised Learning (Regression/Classification) • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes • Linear models: Linear Regression, Logistic Regression,Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • BeyondBinaryClassification: Multi-class/Structured Outputs, Ranking

Module2:[5L]

Unsupervised Learning • Clustering: K-means/Kernel K-means • Dimensionality Reduction: PCAand kernel PCA • Matrix Factorization and Matrix Completion • Generative Models (mixturemodelsand latent factormodels)

Module3:[4L]

EvaluatingMachineLearningalgorithmsandModelSelection,Introduction toStatisticalLearningTheory,EnsembleMethods (Boosting, Bagging, Random Forests)

Module4:[7L]

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and FeatureRepresentationLearning

Module5:[7L]

Scalable Machine Learning (Online and Distributed Learning) A selection from some otheradvanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning,InferenceinGraphical Models,Introductionto BayesianLearningandInference

Module6:[4L]

Recenttrendsinvariouslearningtechniquesofmachinelearning andclassificationmethods.

TextBook

1. KevinMurphy,MachineLearning:AProbabilisticPerspective,MITPress,2012
2. TrevorHastie,Robert Tibshirani,JeromeFriedman,TheElementsofStatisticalLearning,Springer

References:

1. ChristopherBishop,PatternRecognitionandMachineLearning,Springer,2007
2. Dr.RajivChopra,MachineLearning,KhannaPublishingHouse,2018

CO-POMapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3							2
CO2		3	3	2								1
CO3	2	3	3	3								1
CO4	2	2	3	3	2							

Course Name: Software Engineering
Course Code: CS 603
Contact:3:0:0
Total Contact Hours:
36Credits:3

Prerequisites:
ProgrammingforProblemSolving

Course Outcome(s):

CO1: To understand the basic concept of Software Engineering and mathematical knowledge andappthemindesigningsolutiontoengineeringproblemincludinghespecification,design,implementation, and testing of software systems that meet specification, performance, maintenanceandqualityrequirements

CO2: Toanalyze,elicitandspecifysoftwarerequirementsthroughaproductiveworkingrelationshipwithvariousstakeholdersoftheproject

CO3: To design applicable solutions in one or more application domains using software engineeringapproachesthatintegratesethical,social,legalandeconomicconcerns.

CO4: To develop the code from the design and effectively apply relevant standards and performtesting,andqualitymanagementandpracticeteamwork.

CO5: Identify and Use modern engineering tools necessary for software project management timemanagementandsoftwarereuse,andanabilitytoengageinlife-longlearning.

Course Content:

Module-1:[6L]
Introduction:SoftwareEngineering,Characteristics,Components,Application,Definitions.SoftwareProject Planning-Feasibility Analysis,TechnicalFeasibility, Cost-Benefit Analysis,Basics ofestimation: COCOMO(Basic,intermediate,Complete)model.

Module-2:[6L]
Evolution and impact of Software engineering, software life cycle models:Waterfall, prototyping,Evolutionary, and Spiral models. Feasibility study, Functional andNon-functional requirements,Requirementsgathering,Requirements analysis andspecification.

Module-3:[8L]
Basicissuesinsoftwaredesign,modularity,cohesion,couplingandlayering,function-orientedsoftware design: DFD and Structure chart, object modeling using UML, Object-oriented softwaredevelopment,user interfacedesign. Coding standards andCodereview techniques.

Module-4:[7L]
Fundamentals of testing, White-box, and black-box testing, Test coverage analysisand test casedesigntechniques,mutationtesting,Staticanddynamicanalysis,Softwarereliabilitymetrics,reliabilitygrowth modeling.

Module-5:[9L]

Software project management, Project planning and control, cost estimation, projectschedulingusing PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management,ISOandSEICMMI,PSPandSixSigma.Computeraidedsoftwareengineering,softwaremaintenance,softwarereuse, Component-based softwaredevelopment.

TextBooks:

1. FundamentalsofSoftwareEngineeringby RajibMall,–PHI-3rd Edition,2009.
2. SoftwareEngineering-PankajJalote(Wiley-India)

ReferenceBooks:

1. SoftwareEngineering–AgarwalandAgarwal(PHI)
2. SoftwareEngineering, byIanSommerville,PearsonEducation Inc.,New Delhi,(2009).
3. SoftwareEngineering: APractitioner"sApproach",byRogerS.Pressman,McGraw-Hill.(2005)

CO–POMapping:

CO–PO&PSOMapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**P**
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	
CO3	3	3	3	3	-	-	-	3	-	-	-	3	3	3	
CO4	3	3	3	3	-	-	-	-	3	-	-	-	3	3	
CO5	3	2	3	2	3	-	-	-	3	2	3	3	3	2	

Name of the Paper: Mobile Computing
Paper Code: CS604A
Contact: =3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:

1. Basic concept of computer network and communication engineering
2. Basic programming knowledge

Course Objective(s)

The objective of the course is to make the students able to –

- Understand and illustrate the basic concepts and principles in mobile computing
- Understand and demonstrate the various routing algorithms for both infrastructure based and ad hoc networks.
- Identify and develop mobility and bandwidth management in cellular network

- Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies
- Predictand explain the technical issues related to recent mobile computing environment

Course Outcome(s):

On completion of the course students will be able to

CS604A.1: Illustrate the concepts and working of modern communication technologies.

CS604A.2: Demonstrate the various routing algorithms for both infrastructure based and ad hoc networks.

CS604A.3: Develop mobility and bandwidth management in cellular network

CS604A.4: Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies

CS604A.5: Predict the technical issues related to recent mobile computing environment.

Course Content:

Module 1: Introduction [6L]:

Evolution of different types of wireless communication devices; Effects of mobility of devices; Cellular mobile networks – mobility management (call setup, handoff, interoperability and internetworking), bandwidth management, energy management, security; Brief introduction about different generations of wireless communication technology – 1G, 2G, 3G, 4G, 5G.

Module 2: Mobile Data Communication [5L]

Mobile Data Communication, WLANs (Wireless LANs) IEEE 802.11 standard, Bluetooth technology, Bluetooth Protocols, Ad hoc networks initialization, leader election, location identification, communication protocols, energy and security.

Module 3: Mobility Management in Cellular Networks [4L]

Call setup in PLMN (location update, paging), GPRS, Call setup in mobile IP networks; Handoff management; Mobility models- random walk, random waypoint, Brownian, map-based, group-based.

Module 4: Bandwidth Management in Cellular Mobile networks [3L]

Mathematical formulation of the channel assignment problem (CAP); CAP and generalized graph colouring; Benchmark instances; Lower bound on bandwidth, Genetic algorithms for channel assignment- concept of critical block in a hexagonal cellular network, coalesced CAP, fast near-minimal channel assignment algorithm.

Module 5: Localization of Nodes in a Mobile Network [4L]

Different approaches, Indoor and outdoor localizations, LOS and NLOS signals, Outdoor localization techniques – triangulation (TOA-based, AOA- based), errors due to inaccuracies in coordinates of beacon nodes and in measurements, selection of beacon nodes; Location region identification- computational geometric technique.

Module 6: Message Communication in Ad Hoc Networks [6L]

Collision avoidance mechanism (different schemes for a deterministic transmission schedule), collision resolution mechanism – successive partitioning approach; Time slot assignment based on location information, Point-to-point routing in ad hoc networks – proactive, reactive and hybrid approaches, different protocols - DSDV, DSR, AODV, TORA, ZRP

Module 7: Energy-efficient Communication [3L]

Energy efficiency at various layers - Physical layer, MAC layer, Network layer, Application layer, performance analysis in noisy channel environment.

Module 8: Secure Wireless Communication [4L]

Introduction-different types of attacks, internal attacks, external attacks; measures against attacks (authentication, intrusion detection, encryption); RC4 algorithm, Lightweight cryptographic algorithms; antijamming techniques.

Text books:

1. K. Sinha, S.Ghosh and B. P. Sinha, Wireless Networks and Mobile Computing. CRC Press : New York, 2015.
2. J. Schiller, Mobile Communication, Pearson
3. Yi-Bing Lin & Imrich Chlamtac, Wireless and Mobile Networks Architectures, John Wiley & Sons, 2001
4. Raj Pandya, Mobile and Personal Communication systems and services, Prentice Hall of India, 2001
5. 5. XiangYang Li, Wireless Adhoc and Sensor Networks, Cambridge University Press.

Recommended books:

1. Research articles published on secure wireless communication (authentication, mitigation of DoS, DDoS, eavesdropping) published in leading journals.
2. Mark Ciampa, Guide to Designing and Implementing wireless LANs, Thomson learning, Vikas Publishing House, 2001.
3. P.Stavronlakis, Third Generation Mobile Telecommunication systems, Springer Publishers.

CO-PO Mapping

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS604A.1	3	2	2	2	2	1	1			3	2	3			
CS604A.2	3	3	3	3	2	1	1			3	2	3			
CS604A.3	3	3	2	3	2	1	1			3	2	3			
CS604A.4	3	3	2	2	2	1	1			3	2	3			
CS604A.5	3	3	3	3	2	1	1			3	2	3			

Course Name: Natural Language Processing
Course Code: CS604B
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 35

Prerequisite:

1. Solid background in Linear algebra, Probability and Statistics, Artificial Intelligence and Neural Networks.
2. Good Exposure of Python packages.

Course Objective(s)

1. To explore Text Data using various industry standard tools.
2. To explore the Feature Engineering for Text Representation
3. To build the model for Clustering and Classifying Text
4. To implement Machine Learning and Deep Learning techniques.

Course Outcome(s)

On completion of the course, students will be able to

CS604B.1. Understand the basic concepts of text data using various industry standard tools.
CS604B.3. Understand the approaches to build models, Clustering and Classifying Text.
CS604B.4. Understand the different techniques in Machine learning and Deep Learning.

Module 1: Natural Language Processing Basics 8L

What is Natural Language Processing? Different Phases of Natural Language Processing; Linguistics: Language Syntax and Structure, Words, Phrases, Clauses, Grammar, Dependency Grammar, Constituency Grammar, Word-Order Typology; Lemmas and Word forms, Homonyms, Homographs and Homophones, Heteronyms and Heterographs, Polysemes, Capitonyms, Synonyms and Antonyms, Hyponyms and Hypernyms, Stemming and Lemmatization; Representation of Semantics; Text Corpora: Corpora Annotation and Utilities, Accessing Popular Corpora; Parts of Speech Tagging: Training and Building POS Taggers; HMM Part-of-Speech Tagging; NER-Tagging; Relationship Extraction, Temporal Information Extraction, Event Extraction, Template Filling; Conditional Random Fields (CRFs); Shallow Parsing, Chunking; Building Dependency and Constituency Parsers, Application of NLP.

Module 2: Feature Engineering for Text Representation 9L

Pre-processing the Text Corpus;N-gram Language Models, Smoothing; Traditional Feature Engineering Models; Extracting Features for New Documents; Topic Models in Gensim, LDA, LSI, Hierarchical Dirichlet process; Advanced Feature Engineering Models, Word Embedding, Word2Vec Model, The Continuous Bag of Words (CBOW) Model, The Skip-Gram Model; Semantic Analysis: Exploring WordNet, Understanding Synsets, Analyzing Lexical Semantic Relationships, Semantic Relationships and Similarity, Word Sense Disambiguation.

Module 3: Clustering and Classifying Text 9L

Clustering text: Text Similarity, Analyzing Term Similarity, Analyzing Document Similarity; Classifying text: Classification Models, Evaluating Classification Models, Building and Evaluating of the Text Classifier;Sentiment Analysis: Text Pre-processing and Normalization, Unsupervised Lexicon-Based Models, Classifying Sentiment with Supervised Learning, Text Summarization, Question & Answering

Module 4: Deep Learning Architectures for Sequence Processing 9L

Language Models Revisited; Getting words in order with convolutional neural networks (CNNs), Recurrent Neural Networks, Stacked and Bidirectional RNNs; LSTMs and GRUs; Attention, Transformers;Encoder-Decoder Model, Machine Translation; Beam Search; Text Classification using CNNs and LSTM; Chatbots

Text Books:

1. Bhargav Srinivasa-Desikan, “Natural Language Processing and Computational Linguistics", Packt Publishing
2. Dipanjan Sarkar, “Text Analytics with Python",Apress,ISBN-13 (pbk): 978-1-4842-4353-4
3.Daniel Jurafsky, James H. Martin, "Speech and Language Processing", Pearson Education India,Third Edition.
4. Sumit Raj, "Building Chatbots with Python",Apress,ISBN-13 (pbk): 978-1-4842-4095-3

Reference Books:

1. Francois Chollet, “Deep Learning with Python”, Manning Publications; 1st edition
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana, "Practical Natural Language Processing", OReily
3. Hobson Lane, Cole Howard, Hannes Max Hapke, "Natural Language Processing in Action", Manning Publications

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS604B.1	3	3	3	3	3	-	-	-	2	1	2	2
CS604B.2	3	3	2	2	3	-	1	-	1	-	2	2
CS604B 3	3	3	3	3	3	1	-	-	2	-	2	2
CS604B.4	3	3	3	3	3	3	1	1	2	2	3	2

Paper Name: Cloud Computing
Code: CS604C
Contacts: 3:0:0
Credits: 3
Total Contact hours: 36L

Prerequisite

1. Should have the basic knowledge of Operating Systems.
2. Should be aware of the fundamental concepts of Networking.
3. Should have knowledge of heterogeneous systems and resource management.

Course Objective(s):

- To learn the workflow of cloud business model and optimized resource allocation.
- To gain knowledge of cloud service and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.
- To learn virtualization techniques, load balancing, and work strategy of different cloud infrastructure.
- To know the security and privacy issues in cloud infrastructure

Course Outcomes:

After completion of course, students would be able:

CS604C.1: To identify the business model concepts, architecture and infrastructure of cloud computing, including cloud service models and deployment models.
CS604C.2: To journaling some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other business applications
CS604C.3: To articulate and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
CS604C.4: To categorize the core issues of cloud computing such as security, privacy, interoperability, and its impact on cloud application.

Course Contents:
Module 1: Definition of Cloud Computing and its Basics [8L]

Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and

advantages of Cloud Computing [3]

Cloud Architecture: Cloud Infrastructure, Architecture of each components, Virtualization versus Traditional Approach, Virtualization Model for Cloud Computing. [2]

Services and Applications by Type [3]
IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos.
PaaS – Basic concept, tools and development environment with examples
SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform
Identity as a Service (IDaaS) Compliance as a Service (CaaS)

Module 2: Use of Platforms in Cloud Computing [6L]
Concepts of Abstraction and Virtualization [2L]

Virtualization technologies: Types of virtualization, Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing; Classification of Virtualization Environment: Scheduling-based Environment, Load-Distribution-Based Environment, Energy Aware-Based Environment, Operational-Based Environment, Distributed Pattern-Based Environment, Transactional-Based Environment

Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine imaging (including mention of Open Virtualization Format – OVF) [2L]
Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance
Concepts of Platform as a Service [2L]
Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development.Use of PaaS Application frameworks.

Module 3: Cloud Service Models [6L]
Use of Google Web Services [2L]
Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service.

Use of Amazon Web Services [2L]

Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service

Use of Microsoft Cloud Services [2L]
Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

Module 4: Cloud Infrastructure [10L]

Types of services required in implementation – Consulting, Configuration, Customization and Support

Cloud Management [3L]
An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle)

Live Migration of Virtual Machines: [2L]
Need of Live Migration of Virtual Machine, A Designing Process of Live Migration, and Security Issues during live migration.

Concepts of Cloud Security [3L]
Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Identity and Access Management.
Auditing and Compliance in Cloud Environment: [2L]
Data Security in Cloud Computing Environment, Need for Auditing in Cloud Computing Environment, Third Party Service Provider, Cloud Auditing Outsourcing Lifecycle Phases, Auditing Classification.

Module 5: Concepts of Services and Applications [6L]
Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs [6]
Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs [2]
Cloud-based Storage: Cloud storage definition – Manned and Unmanned. [1]
Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services [1]

Textbooks:
1.Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India)PrivateLimited,2013
2. Fundamentals of Cloud Computing by P. K. Pattnaik, S. Pal, M. R. Kabat, Vikas Publications, 2014.

Reference Books:
1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Cloud Computing: A Practical Approach, Anthony T. Velte, Tata Mcgraw-Hill

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS604C .1	3	3	3	3	2	-	-	-	-	-	-	2	3	1	1
CS604C .2	3	3	3	3	3	-	-	-	2	-	-	-	3	1	1
CS604C .3	3	3	3	3	3	-	-	-	1	-	-	2	3	1	1
CS604C .4	3	2	2	3	3	-	-	-	1	-	-	1	3	1	2

Course Name: Cyber Law and Ethics
Course Code: CS605
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

1. Familiarity in computer Networking.
2. Basic concepts about network security.

Course Objective(s) :

- To understand, explore and acquire acritical understanding of Cyber Law.
- To learn the basics of a Cyber security
- To develop competencies fordealingwithfraudsanddeceptions (Confidence Tricks, Scams)

Course Outcomes:

On completion of the course students will be able

CS605.1: To understand the Social and Intellectual Property Issues Emerging From Cyberspace.
CS605.2: To gather the knowledge of information technology act and legal Frame Work of Right to Privacy, Data Security and Data Protection.
CS605.3: To implement the relationship between commerce and cyberspace
CS605.4: To review the different network security threats and countermeasures.
CS605.5: To adapt the advanced security issues and technologies.

Course Contents:
Module – 1: Introduction of Cybercrime [5]
Cybercrime, Forgery, Hacking, Software Piracy, Computer Network intrusion
Criminals plan attacks, passive attack, Active attacks, cyber stalking.

Module – 2: Cybercrime Mobile & Wireless devices[8]
Security challenges in mobile devices, cryptographic security for mobile devices, Attacks on mobile/cell phones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop.

Module -3: Tools and Methods used in Cyber-crime[7]
Proxy servers, Password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: Buffer over flowAttacks, Scripts Kiddies and Packaged Defense.
.
Module – 4: Cybercrime & Cyber security[6]
Phising methods, ID Theft; Online identity method Legal aspects, Indian laws, IT act, Public key certificate, Design of Cyber Security Policy of an Organization ,Unicitral Model Law
Jurisdiction to prescribe/Legislative Jurisdiction; Jurisdiction to adjudicate to enforce; Cyber Jurisdiction in Civil, Criminal & International Cases.

Module -5: Cyber Ethics[5]
The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

Text Books:

1. Cyber security by Nina Gobole&SunitBelapune; Pub: Wiley India.
2. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
3. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
4. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)

Recommended Books:

1. Kenneth J. Knapp, "Cyber Security and Global Information Assurance:
Threat Analysis and Response Solutions", IGI Global, 2009.
2. Jonathan Rosenoer, "Cyber law: the Law of the Internet", Springerverlag, 1997
3. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York,
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003) .

CO PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS605.1	1	3	1	1	1	3	-	3	-	-	-	3	-	1	-
CS605.2	3	3	1	2	3	-	-	3	-	-	-	3	1	2	-
CS605.3	2	3	3	3	1	1	-	1	-	1	-	3	2	2	1
CS605.4	2	2	3	3	2	-	-	-	-	-	-	3	2	3	2
CS605.5	3	2	3	3	3	1	-	2	-	-	-	3	3	3	2

Course Name: Web and Internet Technology Lab
Course Code:CS691
Contact (Periods/Week):3P/Week
Credit Point: 1.5
No. of Lectures:30

Prerequisite:

Fundamentals of Programming

Course Objective(s):

- ToimpartthedesignandimplementationofStaticandDynamicWebPages
- TodevelopprogramsforWebusing ScriptingLanguagesand.netframework
- TogiveanoverviewofServerSideProgramminginWeb

Course Outcome(s):

CO1:Todevelopinteractiveweb pagesusingHTML,DHTML, CSSandimagemapCO2:To procurethe knowledgeofinformation interchangeformatslike XML
CO3: To validate fields of web pages using scripting languages like JavaScriptCO4:To acquirethe server sideprogramming conceptsusing servlet, JSP

List of Experiments:

1. Write a single html program through which you can explain a) anchor tag, b)'img' tag with'src'attribute,c)paragraph d) heading.
2. Write a single html program through which you can draw a table which consists of 3 row and4columns where 1st row contains 4 different column fields of a student's information with redtextcolor and Calibri font style with font 12. Rest cells of whole table contain values with blue textcolorsandTimes newroman font style with font 10.
3. Write a single html program where 1st paragraph can collect its specified style from internalstylesheetdescribesinsidethathtmlprogramand2ndparagraphcancollectitsspecifieds tylefromanother file(external stylesheet).
4. Writeasinglehtmlprogramwhichimplements imagemapconceptusing'usemap'and<map>.
5. WriteahtmlprogramtofindoutCelsiustemperatureofagivenFahrenheittemperatureusing JavaScript.
6. Writeaxmlparsingtechniquethroughwhichparseatextstringintoan XMLDOMobjectande xtractstheinfo fromit with JavaScript.
7. Writeahtmlprogramtofindoutmtothepowern(m,nvalidintegerno)usingafunctionusingJa vaScript.
8. Writeasimple javascriptprogramtoprint theweekdayandtime.

9. WriteasimpleJSPprogramthroughwhichyoucanprintevenandoddnoseparatelywithinag ivenrange.
10. CreateanOnlineRegistrationform forindividualuserofanwebsiteusingServlet.

Textbooks:

1. "WebTechnology:ADeveloper'sPerspective",N.P.GopalanandJ.Akil andeswari,PHILearning,Delhi, 2013. (Topics covered:html, CSS, imagemap, xml)
2. "LearningPHP,MySQL&JavaScript",RobinNixon,O'ReillyPublication.(Topic scovered:JavaScript)
3. "HeadFirstServlet's&JSP",BryanBasham,KathySterra,BertBates,O'ReillyPu blication.(Topicscovered: Servlet,JSP)

Recommendedbooks:

1. "ProgrammingtheWorldWideWeb",Robert.W.Sebesta,FourthEdition,Pearso nEducation,2007.
2. "Core Web Programming"- Second Edition-Volume I and II, Marty Hall and Larry Brown,PearsonEducation, 2001.
3. "WebTechnologies",BlackBook,DreamtechPress

CO– PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2		2	3	2								
CO3		2	2									
CO4	1	2	3	2								
CO5	1		3	2								

Course Name: Machine Learning Lab

Course Code: CS692

Contact:0:0:3
Total Contact Hours: 36
Credits:1.5

Course Objective(s):

Thiscoursewill enablestudents to

- Makeuseof Datasetsinimplementingthemachinelearningalgorithms
- Implementthemachinelearningconceptsand algorithmsinanysuitablelanguageofchoice

CourseOutcome(s):

Thestudents should beable to:
CO1. Understand the implementation procedures for the machine learning algorithms.CO2.Design Java/Python programs forvarious Learning algorithms.
CO3.ApplyappropriateDatasetstotheMachineLearningalgorithms.
CO4.IdentifyandapplyMachineLearning algorithmstosolverealworldproblems.

ListofLabExperiments:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis basedonagiven set oftrainingdata samples. Readthe training data froma.CSVfile.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate theCandidate-Elimination algorithm to output a description of the set of all hypotheses consistent withthetraining examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use anappropriatedatasetfor buildingthedecision tree andapply thisknowledgeto classifyanew sample.

4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test thesameusing appropriatedata sets.

5. Write a program to implement the naÔve Bayesian classifier for a sample training data set storedasa.CSVfile. Computetheaccuracy oftheclassifier, consideringfew testdatasets.

6. Assuming a set of documents that need to be classified, use the naÔve Bayesian Classifier modelto perform this task. Built-in Java classes/API can be used to write the program. Calculate theaccuracy,precision, andrecall for your dataset.

7. Write a program to construct a Bayesian network considering medical data. Use this model todemonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can

useJava/PythonML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set forclustering using k-Means algorithm. Compare the results of these two algorithms and comment onthequality ofclustering.Youcan add Java/PythonML libraryclasses/APIin theprogram.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Printbothcorrectand wrongpredictions.Java/Python MLlibrary classescanbeusedforthisproblem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points.Selectappropriate data set for your experimentand draw graphs.

CO-POMapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	4	4								3	
CO2		4	4	3	4	3						
CO3		3		3	3	3						
CO4	3	4		4		3						

Course Name: Software Engineering Lab
CourseCode:CS 693
Contact:3:0:0
Total Contact Hours:
36Credits:1.5

Prerequisites:
ProgrammingforProblemSolving

CourseOutcome(s):

CO1: To understand the basic knowledge of how to apply Software Engineering and mathematicalknowledge anddesigning solution to software engineering problem including the specification,design, implementation, and testing of software systemsthat meet specification, performance,maintenanceandqualityrequirements

CO2: To analyze the cost-benefit trade-off, functional, non-functional and technical requirementsthroughaproductiveworkingrelationshipwithvarious stakeholdersoftheproject.

CO3: Designsolutions to theone or more application domains using softwareengineeringapproachesthatintegratesethical,social,legalandeconomicconcerns.

CO4: To develop the code from the design and effectively apply relevant standards and performtesting,andqualitymanagementandpracticeteamwork.

CO5: To identify and use of modern software engineering tools necessary for software projectmanagement,timemanagementandsoftwarereuse,andanabilitytoengageinlifelonglearning.

CourseContent:

Module-1:[6L]

Preparation of requirement document for standard application problems in standard format. (e.g.LibraryManagement System, Railway Reservation system, Hospital management System, UniversityAdmissionsystem) .DFDofstandardapplication problems.

Module-2:[6L]

Software Requirement Analysis: Describe the individual Phases/ **Module**s of the project, Identifydeliverables. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity,Costetc.) Estimation ofproject sizeusingFunction Point(FP) forcalculation.

CostEstimation models.L

Module-3:[6L]

Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare SoftwareDesignDocumentusingtoolslikeRationalRose.(Forstandardapplicationproblems

Module-4:[9L]

Software Development, Coding Practice and Debugging, Design Test Script/Test Plan(both BlackboxandWhiteBox approach)

Module-5:[9L]

Software project management,Project planning and control, configuration control, cost estimation,projectschedulingusingPERTandGANTTcharts,cost-timerelationsusingstandardtools.

TextBooks:

1. FundamentalsofSoftwareEngineering byRajibMall,–PHI-3rd Edition,2009.
2. SoftwareEngineering-PankajJalote(Wiley-India)

ReferenceBooks:

1. SoftwareEngineering–AgarwalandAgarwal(PHI)
2.SoftwareEngineering, byIanSommerville,PearsonEducation Inc.,New Delhi,(2009).
3. SoftwareEngineering: APractitioner"sApproach",byRogerS.Pressman,McGraw-Hill.(2005)

CO–POMapping:

CO–PO&PSOMapping															
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	3	-	-	-	3	3	3	2
CO4	3	3	3	3	-	-	-	-	3	-	-	-	3	3	3
CO5	3	2	3	2	3	-	-	-	3	2	3	3	3	2	2

4th Year 7th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 701	Neural Networks and Deep Learning	3	0	0	3	3
2	ENGG	Major	CS 702 A CS 702 B CS 702 C	Advanced Algorithms Advanced Computer Architecture Advanced Operating Systems	3	0	0	3	3
3	ENGG	Minor	CS 703 A CS 703 B CS 703 C	Information Theory and Coding Ad-Hoc and Sensor Networks Data Mining and Data Warehouse	3	0	0	3	3
4	HUM	Minor	HU(CSE)701	Human Resource Development and Organizational Behavior	2	0	0	2	2
B.PRACTICAL									
5	ENG G	Major	CS 791	Neural Networks and Deep Learning Lab	0	0	3	3	1.5
6	ENG G	Major	CS 792 A CS 792 B CS 792 C	Advanced Algorithms Lab Advanced Computer Architecture Lab Advanced Operating Systems Lab	0	0	3	3	1.5
7	PRJ	Project	CS 793	Major Project-I	0	0	12	12	6
Total of Theory, Practical and Mandatory Activities/Courses								29	20

Course Name: Neural Networks and Deep Learning
Course Code: CS701
Contact (Periods/Week): 3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Good Exposure of Python packages like, NumPy, Pandas, Matplotlib, Scikit-learn

Course Objective(s):
To introduce the fundamental techniques and principles of Neural Networks
To study the different models in ANN and their applications
To familiarize deep learning concepts with CNN and RNN

Course Outcome(s):
On completion of the course students will be able to
CS701.1: Understand the basic concepts in Neural Networks and Deep Learning and applications.

CS701.2: Understand the Shallow & Deep Neural Networks.
CS701.3: Understand the Convolution Neural Network models for Images.
CS701.4: Understand the Recurrent Neural Network models for Sequence data.

Module 1: Introduction to Neural Networks and Deep Learning [8L]
What is a Neural Network? Supervised Learning with Neural Networks, why is Deep Learning taking off? Binary Classification, Logistic Regression, Logistic Regression Cost Function, Gradient Descent, Derivatives, Computation Graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent, Vectorization, Vectorizing Logistic Regression, Vectorizing Logistic Regression's Gradient Output.

Module 2: Shallow Neural Network & Deep Neural Network [9L]
Neural Networks Overview, Neural Network Representation, computing a Neural Network's Output, Vectorizing Across Multiple Examples, Activation Functions, why do you need Non-Linear Activation Functions? Derivatives of Activation Functions, Gradient Descent for Neural Networks, Backpropagation Intuition, Random Initialization, Deep L-layer Neural Network, Forward Propagation in a Deep Network, getting your Matrix Dimensions Right, Building Blocks of Deep Neural Networks, Forward and Backward Propagation, Parameters vs Hyperparameters.

Module 3: Foundations of Convolutional Neural Networks [9L]
Computer Vision, Edge Detection Example, Padding, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, Why Convolutions? Classic Networks, ResNets, Why ResNets Work? Networks in Networks and 1X1 Convolutions, Inception Network, MobileNet Architecture, EfficientNet, Using Open-Source Implementation, Transfer Learning, Data Augmentation; Object Localization, Landmark Detection, Object Detection, Convolutional Implementation of Sliding Windows, Bounding Box Predictions, Non-max Suppression, Anchor Boxes, YOLO Algorithm, Semantic Segmentation with U-Net, Transpose Convolutions, U-Net Architecture.

Module 4: Sequence Models [9L]
Why Sequence Models? Notation, Recurrent Neural Network Model, Backpropagation Through Time, Different Types of RNNs, Language Model and Sequence Generation, Sampling Novel Sequences, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU),Long Short Term Memory (LSTM),Bidirectional RNN, Deep RNNs, Word Representation, Using Word Embeddings, Properties of Word Embeddings, Embedding Matrix, Learning Word Embeddings,Word2Vec,GloVe Word Vectors, Sentiment Classification, Debiasing Word Embeddings, Basic Sequence Models, Picking the Most Likely Sentence, Beam Search, Refinements to Beam Search, Error Analysis in Beam Search, Attention Model, Speech Recognition, Trigger Word Detection, Transformer Network Intuition, Self-Attention, Multi-Head Attention.

Text Books:
1. Charu C. Aggarwal,"Neural Networks and Deep Learning: A Textbook", Springer; 1st ed. 2018 edition
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, " Deep Learning", published by MIT Press

Reference Books:
1. Francois Chollet, "Deep Learning with Python", Manning Publications; 1st edition
2. Simon Haykin, "Neural Networks and Learning Machines", Pearson Prentice Hall, 3rd Edition
3. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, Orlando De Jess, "Neural Network Design (2nd Edition)".

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS701.1	-	2	3	3	3	-	-	-	-	-	1	2
CS701.2	-	2	2	2	1	-	-	-	-	-	-	1
CS701.3	-	2	3	3	3	3	-	-	-	-	2	-
CS701.4	3	2	2	2	1	3	2	-	-	-	3	2

Course Name: Advance Algorithm
Course Code: CS702A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Design & Analysis of Algorithm (CS402)

Course Objective(s):

The aim is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them

Through the complexity measures, different range of behaviors of algorithms and the notion of tractable and intractable problems will be understood.

Course Outcome(s):
After completion of the course students will be able to

CS702A.1 Analyze the complexity/performance of different algorithms.
CS702A.2 Determine the appropriate data structure for solving a particular set of problems.
CS702A .3 Categorize the different problems in various classes according to their complexity.
CS702A.4 Achieve an insight of recent activities in the field of the advanced data structure.
CS702A.5 Design and build solutions for a real-world problem by applying relevant distributions

Course Content:
Module-1 [4L]
Sorting:
Review of various sorting algorithms, topological sorting
Graph:
Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), DFS and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Module-2 [6L]
Matroids:
Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching:
Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Module-3 [16L]
Flow-Networks:
Maxflow-Mincut Theorem, Ford Fulkerson Method to compute Maximum Flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations:

Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition

Shortest Path in Graphs:
Floyd-Warshall algorithm and introduction to dynamic programming paradigm.More examples of dynamic programming.

Modulo Representation of integers/ polynomials:
Chinese Remainder Theorem, Conversion between base-representation and modulo-representation.Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT):
In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schönhage-Strassen Integer Multiplication algorithm

Amortized Analysis:
Aggregate, Accounting, and Potential Method

Module-4[10L]

Linear Programming:
Geometry of the feasibility region and Simplex algorithm

NP-completeness:
Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Problem Solving Application
Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Text book:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos. 4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

Reference Books:

1. "Algorithm Design" by Kleinberg and Tardos.
2. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS702A.1	3	3	3	3	-	-	-	-	-	-	-	2	2	2	3
CS702A.2 .2	3	3	3	3	-	-	-	-	-	-	-	2	2	3	3
CS702A.3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3
CS702A.4 .4	3	3	3	3	-	-	-	-	-	-	-	3-	3	2	3
CS702A.5 .5	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3

Course Name: Advanced Computer Architecture
Paper Code: CS702B
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. Familiarity with the functionalities of basic digital computer system.
2. Fundamentals of Computer Architecture.

Course Objective(s):
• To understand the Concept of Parallel Processing and its applications
• To implement the Hardware for Arithmetic Operations
• To analyse the performance of different scalar Computers
• To understand the Pipelining Concept for a given set of Instructions
• To learn the performance of pipelining and non-pipelining environment in a processor

Course Outcomes(s):
CS702B.1 To acquire the knowledge of parallelism and pipelining
CS702B.2 To develop knowledge of parallel processing
CS702B.3 To combine the concept and design techniques of interconnection network
CS702B.4 To acquire the knowledge of shared memory architecture
CS702B.5 To describe the fundamentals of embedded system architecture

Module 1: Introduction to Advanced Computer Architectures [5L]
Different types of architectural classifications – instruction vs. data (SISD, SIMD, MISD, MIMD), serial vs. parallel, pipelining vs. parallelism; Pipelining: Definition, different types of pipelining, hazards in pipelining.
Concept of reservation tables, issue of multiple instructions with minimum average latency (MAL).

Module 2: Parallel Processing & ILP [8L]
RISC architecture, characteristics of RISC instruction set & RISC pipeline, its comparisons with CISC, necessity of using optimizing compilers with RISC architecture, Review of instruction-level parallelism-Super pipelining, Superscalar architecture, Diversified pipelines and out of order execution, VLIW architecture, Dataflow and Control Flow Architectures, Loop Parallelization

Module 3: Interconnection Networks [13L]
Desirable properties of interconnection networks, static interconnection networks – path, cycle, double-loop, star, wheel, 2D mesh and its variants, multi-mesh, tree, shuffle-exchange, cube, cube connected cycles.
Dynamic interconnection networks: concepts of blocking, rearrangeable and blocking but rearrangeable networks, various types of multistage interconnection networks (MIN)- crossbar, clos,baseline, omega, Benes.

Module 4: Shared Memory Architecture [5L]
Fundamentals of UMA, NUMA, NORMA, COMA architectures, Performance measurement forparallel architectures –Amadahl's law, Gustafson's law.

Module 5: Embedded System Architecture [5L]
Definition, Example, Classification of Embedded system, Embedded System Design Issues:
Hardware issues (Processor, Memory, Peripherals) ,Software issues (Programming Languages, Time Criticality, RTOS).

Text Books:
1. J. L. Hennessey and D. A. Patterson: Computer Architecture: A Quantitative Approach, 5th edition, Morgan Kaufmann, 2012.
2. K. Hwang and F. A. Briggs: Computer Architecture and Parallel Processing, Tata McGraw Hill, New Delhi.

Reference Books:
1. Tse-yun Feng, A Survey of Interconnection Networks, IEEE, 1981.
2. Selim G. Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall, 1989.
3. Raj Kamal, Embedded Systems Architectures Programming and Design, Second Edition The MacGraw-Hill(for Embedded System).

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS702B.1	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**2**	**2**
CS702B.2	**3**	**3**	**1**	**-**	**-**	**3**	**-**	**-**	**2**	**2**	**-**	**3**
CS702B.3	**3**	**3**	**3**	**2**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**1**
CS702B.4	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**-**	**2**	**1**	**1**
CS702B.5	**3**	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**3**	**2**	**2**	**2**

Course Name: Advanced Operating Systems
Course Code: CS702C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Operating Systems

Course Outcome(s):
After completion of the course students will be able to

CS702C.1 Demonstrate understanding of design issues of advanced operating systems and compare different types of operating systems.
CS702C.2 Analyze the design aspects and issues of distributed operating systems.
CS702C.3 Demonstrate understanding of different architectures used in Distributed Operating System.
CS702C.4 Demonstrate understanding of different architectures used in Multiprocessor Operating System.
CS702C.5 Formulate the solutions to schedule the real time applications.

Course Content:

Module 1:
Architectures of Distributed Systems: System Architecture Types, 1L
Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.2L
Theoretical Foundations: Inherent Limitations of a Distributed System, 1L
Lamports Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection.2L

Module 2:
Distributed Mutual Exclusion: The classification of Mutual Exclusion Algorithms 2L
Non-Token-Based Algorithms: Lamports Algorithm 1L
The Ricart-Agarwala Algorithm, Maekawas Algorithm, 1L
Token-Based Algorithms: Suzuki-Kasamis Broadcast Algorithm, 1L
Singhals Heuristics Algorithm, Raymonds Heuristric Algorithm. 2L

Module 3:
Distributed Deadlock Detection: Preliminaries, 1L
Deadlock Handling Strategies in Distributed Systems 1L
Issues in Deadlock Detection and Resolution, 1L
Control Organizations for Distributed Deadlock Detection, 1L
Centralized- Deadlock – Detection Algorithms, 1L
Distributed Deadlock Detection Algorithms, 1L
Hierarchical Deadlock Detection Algorithms 1L

Module 4:
Multiprocessor System Architectures: Introduction, Motivation for multiprocessor Systems, 1L
Basic Multiprocessor System Architectures 1L
Multi Processor Operating Systems: Introduction, Structures of Multiprocessor Operating Systems 1L
Operating Design Issues, Threads, Process Synchronization. 2L
Processor Scheduling 1L
Distributed File Systems: Architecture, Mechanisms for Building Distributed File Systems, Design Issues 2L

Module 5:
Distributed Scheduling : Issues in Load Distributing, Components of a load Distributed Algorithm, 2L
Stability, Load Distributing Algorithm, Requirements for Load Distributing, Task Migration, Issues in task migration.2L
Distributed Shared Memory: Architecture and Motivation, Algorithms for Implementing DSM, 2L
Memory Coherence, Coherence Protocols, Design Issues 2L

Text book:
1. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.
2. Andrew S. Tanenbaum, Distributed Operating Systems, ACM Press.

Reference Books:
1.Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.
2.Jie Wu, Distributed Systems, CRC Press.
3.Hagit Attiya, Jennifer Welch, Distributed Computing: Fundamentals, Simulations and Advanced Topics, McGraw-Hill.
4.Sape Mullender (ed.), Distributed Systems, Addison-Wesley

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS702C.1	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**			
CS702C.2	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**			
CS702C.3	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**			
CS702C.4	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**			
CS702C.5	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**			

Course Name: Information Theory and Coding
Course Code: CS 703 A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Probability & Statistics

Course Objective(s):
The objective of the course is to make the students able to

- Understand the basic concept of information and apply this knowledge in designing solution.
- Understand the basic concept of coding theory and use this knowledge for designing and implementing problem.
- Understand the concept of channel models to determine the mutual information in the channels.
- Outline the concept of error detection techniques and design a model for building a new solution.
- Understand how convolutional theory works and develop a new approach.

Course Outcome(s):
After completion of the course students will be able to
CS 703 A.1: Understand the basic concept of information and apply this knowledge in designing solution for real life engineering problem.
CS 703 A.2: Understand the basic concept of coding theory and use this knowledge for designing and implementing mathematical and engineering problem leading to lifelong learning.
CS 703 A.3: Understand the concept of channel models to determine the mutual information in the channels.
CS 703 A.4: Outline the concept of error detection techniques and design a model for building a new solution as a professional engineering practice as a team.
CS 703 A.5: Understand how convolutional theory works and develop an approach to solve it by means of existing and new methods as a team work.

Course Content:

Module 1:
Information Theory [4L]
Introduction, Measure of Information, Average Information Content (Entropy) of a Zero Memory Source, Extension of Zero Memory Source, Entropy of a Source with Memory.

Module 2:
Source Coding [9L]
Introduction, Types of Codes, Prefix Codes, Source Coding Theorem, Shannon's Encoding Theorem, Huffman Coding, Arithmetic Coding, Lempel-Ziv Algorithm, Run Length Encoding, An Overview on Speech and Image Compression.

Module 3:
Information Channels[4L]
Introduction, Channel Models, System Entropies, Mutual Information (Trans information), Channel Capacity, Capacity of Channels, Continuous Channels.

Module 4:
Error Control Coding [8L]
Introduction, need for Error Control Coding, Types of Codes, Coding Gain, Linear Block Codes, The Hamming Codes, Probability of an Undetected Error Pattern for an LBC over a BSC, Equivalent Codes, Cyclic Codes, Golay Codes, Shortened Cyclic Codes.

Module 5:
Burst Error Correcting Codes [6L]
Introduction, Burst Errors, Interleaved Codes, Product Codes, Fire Codes, BCH Codes, Non-Binary BCH Codes and Reed-Solomon Codes.

Module 6:
Convolution Codes[5L]
Introduction, Convolution Encoder, Representation of Convolution Code, Transfer Function of a Convolution Code, Distance Properties of Convolution Codes, Decoding of Convolution Codes, Stack Algorithm, Known Good Convolution Codes.

Textbook:
1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.

Reference Books:
1.Introduction to Information Theory - M Mansurpur; McGraw Hill.
2. Information Theory - R B Ash; Prentice Hall.
3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

CO–PO Mapping:

COs	P	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 703 A1.1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CS 703 A.2	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
CS 703 A.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	1
CS 703 A.4	3	3	3	3	-	-	-	-	3	-	-	-	3	2	3
CS 703 A.5	3	3	3	3	-	-	-	-	3	2	-	-	3	2	3

Course Name: Ad-Hoc and Sensor Networks
Course Code: CS 703 B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Objective(s):
The student should be made to:
- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools

Course Outcome(s):
At the end of the course, the student would be able to:
CS 703 B.1:Know the basics of Ad hoc networks and Wireless Sensor Networks
CS 703 B.2:Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement
CS 703 B.3:Apply the knowledge to identify appropriate physical and MAC layer protocols
CS 703 B.4:Understand the transport layer and security issues possible in Ad hoc and sensor networks.

CS 703 B.5: Be familiar with the OS used in Wireless Sensor Networks and build basic **Module**s

Course Content:

Module1
AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS
Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

Module2
SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

Module3
WSN NETWORKING CONCEPTS AND PROTOCOLS
MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols, Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

Module4
SENSOR NETWORK SECURITY
Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

Module5
SENSOR NETWORK PLATFORMS AND TOOLS
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

Text Book:
1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.

REFERENCES:
1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication – 2002.
3. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005
4. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.
5. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

Online Resources:

1. www.wirelessnetworksonline.com
2. www.securityinwireless.com
3. www.ida.liu.se/~petel71/SN/lecture-notes/sn.pdf Practice Aspects 1. NS2 Simulator tool

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 703 B.1	-	3	-	2	-	-	-	3	-	-	-	-
CS 703 B.2	3	2	2	2	-	-	1	-	-	-	-	-
CS 703 B.3	3	2	-	-	3	-	-	-	1	-	-	-
CS 703 B.4	-	1	-	3	-	-	-	-	-	1	-	-
CS 703 B.5	3	1	2	2		1						

Course Name: Data Mining and Data Warehousing
Course Code: CS 703 C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence

Course Outcome(s):
After completion of the course students will be able to

CS 703 C.1:Understand and explain the fundamental concepts of the evolving technologies in Data Mining (such as Mining Frequent Patterns and Data Streams, Associations, Supervised and Unsupervised Learning, Graph Mining, Web Mining etc.) andData Warehousing (such as Data Cube and OLAP)recognizing their utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CS 703 C.2: Identify and formulate an engineering problem within the scope of Data Mining and Data Warehousing paradigm.

CS 703 C.3: Explore relevant literature and apply the concepts of Data Mining and Data Warehousing to solve problems of making automated decisions dealing with huge amount of data.

CS 703 C.4: Develop ideas for proposing solutions to the challenging problems of Data Mining and Data Warehousing.

CS 703 C.5: Implement ideas of Data Mining and Data Warehousing through developing feasible algorithms or frameworks and investigate their effectiveness by analyzing the performances in solving the relevant problems.

Course Content:

Module-1: Introduction to Data Mining[5L]
Basic Concepts 1L
Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data

Similarity Measure 2L
Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization 2L

Module-2:Introduction to Data Warehousing [6L]
Basic Concepts 1L
Data Warehouse Modeling: Data Cube and OLAP (Online Analytical Processing) 2L
Data Warehouse Design, Usage, Implementation 2L
Data Generalization by Attribute-Oriented Induction 1L

Module-3:Mining Frequent Patterns, Associations And Correlation Analysis [5L]
Basic Concepts, Frequent Item set Mining Methods: The Apriori Algorithm, Mining Frequent Item Sets without Candidate Generation, Mining Frequent Item Sets Using Vertical Data Format, Correlation Analysis 4L
Pattern Mining in Multilevel and Multidimensional Space 1L

Module-4:Classification and Regression [6L]
Basic Concepts, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier 3L
ANN-Backpropagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods 3L

Module-5: Clustering and Outlier Analysis [5L]
Basic Concepts, Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN: Density-Based Clustering Based on ConnectedRegions with High Density, Frequent Pattern–Based Clustering Method 4L
Outlier Analysis 1L

Module-6:Mining Data Stream, Time-Series, and Sequence Data [3L]
Basic Concepts of Data Stream Mining 1L
Mining Time Series Data 1L
Mining Sequence Patterns in Biological Data 1L

Module-7:Introduction to Graph Mining, Social Network Analysis,Multi-relational Data Mining, Text Mining and World Wide Web (WWW) Mining 6L
Graph Mining: Methods for Mining Frequent Subgraphs (Apriori-based Approach& Pattern Growth Approach)2L
Basic Concepts of Social Network Analysis and Multi-relational Data Mining2L
Basic Concepts of Text Mining 1L
Basic Concepts of World Wide Web (WWW) Mining 1L

Textbook:
1.Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.
2.Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press.

ReferenceBooks:
1.Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", PearsonEducation.
2.Robert Layton, "Learning Data Miningwith Python", Packt Publishing

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 703 C.1	3	2	-	-	-	-	-	-	-	-	-	3			

CS 703 C.2	2	3	-	-	-	-	-	-	-	-	-	-			
CS 703 C.3	2	2	3	2	-	-	-	-	-	-	-	-			
CS 703 C.4	2	2	2	3	-	-	-	-	-	-	-	2			
CS 703 C.5	2	2	3	3	2	2	2	-	-	-	-	2			

Paper Name: Human Resource Development and Organizational Behaviour
Paper Code: HU(CSE)701
Credits: 3
No. of lectures: 36

Course Objective(s):

- To develop an understanding of the nature, functioning and design of organisation as social collectivises.
- The basic concepts and theories underlying individual behaviour besides developing better insights into one's own self.
- To gain insight into the organizational learning processes, how they can be fostered and enhanced.
- Individual behaviour in groups, dynamics of groups and team building besides developing a better awareness of how they can be better facilitators for building effective teams as leaders themselves.

Course Outcomes

At the end of the course students are able
HU(CSE)701.1:To understand key functions in management as applied in practice.
HU(CSE)701.2:To identify and analyse major practices associated with HRD in modern work and organisations;
HU(CSE)701.3:To evaluate the connections between the HRD process and the contemporary performance management concerns of organisations
HU(CSE)701.4:To analyse the behaviour of individuals and groups in organisations in terms of the key factors that influence organisational behaviour.
HU(CSE)701.5:To assess the potential effects of organisational-level factors (such as structure, culture and change) on organisational behaviour.
HU(CSE)701.6:To evaluate the potential effects of important developments in the external environment (such as globalisation and advances in technology) on organisational behaviour

Course Contents

Module – 1 HRD-Macro Perspective: HRD Concept, Origin and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate. **3L**

Module -2 HRD–Micro Perspective: Areas of HRD; HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD; HR Accounting; HRD Audit, Strategic HRD **6L**

Module – 3 Instructional Technology for HRD: Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behaviour Modeling and Self Directed Learning; Evaluating the HRD.**5L**

Module – 4 Human Resource Training and Development: Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programmes; Role, Responsibilities and challenges to Training

Managers.**4L**

Module – 5 Organisational Effectiveness (OE): Concept; Approaches to O E; Adoptive Coping Cycle for Effectiveness; Achieving OE; Organisational Climate: Concept, Determinants of Organisational Climate.**3L**

Module-6 Organization Theory: Classical Theory; Neo-Classical Theory, Modern Behavioural Theories, contingency theory, system theory, modern structural models; Organizational Culture; Creating and Sustaining Culture; Work Culture.**6L**

Module –7 Motivation: Types of Motives; Theories of Maslow; Herzberg, McGregor, Alderfers, Porter and Lawler's Model; Job Enlargement, Job Enrichment, Behaviour Modification. **3L**

Module– 8(a) Group & Group Dynamics - concept, importance, classification of groups, reason for group, formation, group cohesiveness. (b) Team work: meaning, concept, types, creating, and an effective team. (c) Leadership: Concept, Leader vs. Manager; Classical Studies on Leadership; Trait Theories; Behavioral Theories; Group and Exchange Theories; Contingency Theory of Leadership; Leadership Styles.**6L**

References:

1) Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi , 2005
2) Viramani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi.
3) Rao, T.V: Human Resource Development, Sage Publications, New Delhi.
4) Luthans, Fred: OrganisationalBehaviour, Tata McGraw-Hill Co. New Delhi, 2004.
5) Stephen, P. Robins: OrganisationalBehaviour, Prentice-Hall of India Pvt., Ltd., 2004.
6) John, W. Mewstrom& Davis, Keith : Organisational Behavior (Human Behavior at Work), Tata McGraw-Hill, New Delhi , 2002

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU(CSE)701.1	2	-	-	-	2	3	3	3	2	3	2	2	-	-	-
HU(CSE)701.2	2	-	-	2	-	-	2	-	3	-	3	-	-	-	-
HU(CSE)701.3	2	-	3	2	-	3	-	-	2	-	-	-	-	-	-
HU(CSE)701.4	-	2	-	3	2	3	-	2	-	-	-	-	-	-	-
HU(CSE)701.5	2	-	-	-	3	2	-	-	2	-	3	-	-	-	-

Course Name: Neural Networks and Deep Learning Lab
Paper Code: CS 791
Contact (Periods/Week): 0:0:3
Credit Point: 1.5

Prerequisite:

1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Good Exposure of Python packages like, Numpy, Pandas, Matplotlib, Scikit-learn

Course Objective(s):

- To introduce the Keras/Tensorflow API for Neural Networks and Deep Learning.

- To build Convolutional Neural Network modelsusingKeras/Tensorflow API
- To buildRecurrent Neural Network modelsusingKeras/Tensorflow API

Course Outcome(s):
On completion of the course students will be able to
CS 791.1: Understand the Keras/Tensorflow API in details using Python.
CS 791.2: Implement the Convolutional Neural Network models using Keras/Tensorflow API
CS 791.3: Implement the Recurrent Neural Network models using Keras/Tensorflow API

List of Experiment:

The following list of Experiments
1. Getting Started with DL in Keras
2. Deep Neural Networks for Supervised Learning: Regression
3. Deep Neural Networks for Supervised Learning: Classification
4. Tuning and Deploying Deep Neural Networks
5. Deep learning for computer vision
6. Deep learning for text and sequences
7. Going beyond the Sequential model: The Keras functional API
8. Inspecting and monitoring deep-learning models using Keras callbacks and TensorBoard
9. Text generation with LSTM
10. Generating images with variational autoencoders and Generative adversarial networks
11. Introduction to TensorFlow 2.0
12. Images and Tests with TensorFlow 2.0

Text Books:
1. JojoMoolayil, "Learn Keras for Deep Neural Networks",Apress,ISBN-13 (pbk): 978-1-4842-4239-1
2. Francois Chollet,"Deep Learning with Python",Manning Publications; 1st edition

CO-PO Mapping

CO	PO 1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 791.1	3	2	3	3	3	-	-	-	-	-	1	2
CS 791.2	3	2	2	2	1	-	-	-	-	-	-	1
CS 791.3	3	2	3	3	3	3	-	-	-	-	2	-

Course Name: Advanced Algorithms Lab
Course Code: CS 792 A
Contact: 0:0:3
Credits: 1.5

Prerequisites:
1. Programming knowledge
2. Knowledge of Design and Analysis of Algorithm

Course Objective(s):
- **Design and implement efficient algorithms for a specified application.**
- **Strengthen the ability to identify and apply the suitable algorithm for the given real world problem.**

Course Outcome(s):

After completion of the course students will be able to
CS 792 A.1:Introduce students to the advanced strategies of designing and analyzing algorithms.
CS 792 A.2: The student should be able to prefer suitable algorithms and use it for a precise problem.
CS 792 A.3: To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
CS 792 A.4: The student should be able to prefer suitable algorithms and use it for a precise problem.
CS 792 A.5: To introduce the students to recent developments in the area of algorithmic design.

Course Content:

1. Write the following problems in any programming language. Programming Language used: C
2. **Divide and Conquer:** Implementation of finding Maximum and Minimum element from an array of integer, Quick Sort, Check the running time for different positions of pivot elements. Randomized version of quick sort using Divide and Conquer Method.
3. **Dynamic Programming:** Calculation of the minimum number of scalar multiplications needed for chain of Matrices Multiplication Technique, Implementation of Single Source shortest Path for a graph (Dijkstra and Bellman Ford Algorithm), Implement all pair Shortest path for a graph (FloydWarshall Algorithm)
4. **Greedy method:** Implementation of fractional Knapsack Problem, MST by Prim's algorithm, Implement MST by Kruskal's algorithm
5. **Graph Traversal Algorithm:** Implement Depth First Search (DFS), application of DFS (do topological sorting, identify strongly connected components)
6. **String Matching:** Implement KMP algorithm
7. **Network Flow:** Implement Ford-Fulkerson algorithm to get maximum flow of a given flow network.
8. **Modulo Representation of integers/ polynomials:** Chinese Remainder Theorem
9. **Linear Programming:** Simplex Algorithm

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS-T-591.1	3	3	3	3	-	-	-	-	-	-	3	3	2	2	3
CS-T-591.2	3	3	3	3	-	-	-	-	-	-	3	3	2	3	3
CS-T-591.3	3	3	3	3	-	-	-	-	-	-	3	3	3	3	3
CS-T-591.4	3	3	3	3	-	-	-	-	-	-	3	3	3	2	3
CS-T-591.5	3	3	3	3	-	-	-	-	-	-	3	3	3	3	3

Course Name: Advanced Computer Architecture Lab
CourseCode: CS 792 B
Contact:0:0:3
Credits:1.5
Prerequisites: Knowledge of designing different circuits in Computer Organization and Architecture Lab

CourseOutcome(s):

CS 792 B.1: Ability to design the basic gates
CS 792 B.2: Ability to verify the truth table.

CS 792 B.3: Implement basic knowledge of Hardware description Language.
CS 792 B.4: Design circuit using Xilinx tools.

List of Experiment:

1. HDL introduction
2. Basic digital logic base programming with HDL
3. 8-bit Addition, Multiplication, Division
4. 8-bit Register design
5. Memory unit design and perform memory operators..
6. Implement Encoder, Decodercircuitandsimulatefortruthtableverification.
7. Implementdifferenttypesofflipflopandsimulatefortruthtableverification.
8. Implementdifferenttypesofparallelcircuits (SISO, SIPO, PISO, PIPO)andsimulatetheresult.
9. Implement ALU and simulate the result.
10. Implement RAM chip and simulate the result.
11. 8-bit simple CPU design
12. 8. Interfacing of CPU and Memory
13. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 792 B.1	**3**	3	2	**3**	2	3	-	2	3	-	-	-
CS 792 B.2	**3**	3	3	**2**	3	3	-	-	-	-	-	-
CS 792 B.3	**3**	2	**2**	3	2	-	-	2	-	-	-	-
CS 792 B.4	**3**	3	2	**2**	2	3	-	-	-	-	-	-

Course Name: Advanced Operating Systems Lab
Course Code: CS 792 C
Contact:0:0:3
Total Contact Hours: 36
Credits: 1.5

Prerequisites: Operating Systems
Course Objective(s):
The objective of the course is to make the students able to -

- Understand and execute basic commands of shell script
- Apply basic operations in shell scripts which are required for different applications.
- Identify and understand concept of file systems in shell script
- able to understand the concept of creating new process from parent process.
- Able to understand concept of virtual file and execute basic commands on it

Course Outcome(s):
After completion of the course students will be able to
CS 792 C.1: Understand and implement basic services and functionalities of the operating system using system calls and able to Understand the benefits of thread over process and implement synchronized programs using multithreading concepts.
CS 792 C.2: Analyze the design aspects and issues of distributed operating systems.
CS 792 C.3: Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
CS 792 C.4: Implement memory management schemes and page replacement schemes

CS 792C.5: Understand the concepts of deadlock in operating systems and implement them in Multiprogramming system.

Course Content:

Preliminaries of Operating System: 6P
managing users, managing systems, file managements, useful commands, Shell scripting : shell syntax, executing shell scripts.
Process : 12P
creating new process, counting maximum number of processes a system can handle at a time, handling system calls; inter process communication through pipes and message passing, zombie process, orphan process.

Process Synchronization: 6P
handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.

Signal : 6P
study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).

Text book:
1. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.

Reference Books:
1.Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.

CO – PO Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 792 C.1	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CS 792 C.2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CS 792 C.3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CS 792 C.4	3	3	3	3	-	--	-	-	-	-	-	-	-	-	-
CS 792 C.5	3	3	3	3	-	-	-	-	3	3	-	-	-	-	-

4thYear8thSemester									
Sl.No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CS 801 A CS 801 B CS 801 C	Real Time Systems Data Analytics Soft Computing	3	1	0	4	4
2	ENGG	Major	CS 802 A CS 802 B CS 802 C	VLSI Design & Application Bio-informatics Robotics	3	1	0	4	4
3	ENGG	Minor	CS 803 A CS 803 B CS 803 C	Introduction to IoT Image Processing Optimization Techniques	3	0	0	3	3
B.PRACTICAL									
4	ENGG	Minor	CS 893 A CS 893 B CS 893 C	Internet of Things Lab Image Processing Lab Optimization Techniques Lab	0	0	3	3	1.5
5	PRJ	Project	CS 881	Major Project-II	0	0	12	12	6
6	PRJ	Internship	CS882	Grand Viva	0	0	0	0	1.5
Total of Theory, Practical and Mandatory Activities/Courses								26	20

Course Name: Real Time Systems
Course Code: CS 801 A
Total Contact Hours:36
Credit:3

Prerequisites:
1. Concepts of Operating systems and Algorithm.
2. Knowledge of Distributed System basics.

Course Objective(s):

- To understand the real-time systems
- Obtain a broad understanding of the technologies and applications for emerging and exciting domain of real-time systems.
- Get in-depth hands-on experience in designing and developing a real time systems.

Course Outcome(s):

CS 801 A.1: Understand the concepts of Real-Time systems
CS 801 A.2: Recognize the characteristics of a real-time system
CS 801 A.3: Understand and develop document on an architectural design of a real-time system.
CS 801 A.4: Develop and document Task scheduling, resource management, real-time operating systems and fault tolerance applications of real-time systems.

Course Contents:

Module-1: Introduction [8L] Definition, Typical Real Time Applications: Digital control, High Level Controls, Signal processing etc. , Release Times, Deadline period and time constraints, Hard and soft real time systems, Reference models for RTOS: Processors and Resources, Temporal parameters of Real-time workload, Periodic Task Model, Precedence Constraints and Data Dependency.

Module-2: Real Time Scheduling. [8L] Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Stack-Time-First (LST) algorithms, Rate Monotonic algorithm, Offline versus Online Scheduling.

Module-3: Resources Sharing. [8L] Effect of Resource Contention and Resource Access Control (RAC), Non-pre-emptive Critical Sections, Basic Priority- Inheritance and Priority-Ceiling Protocols, Stack based Priority Ceiling Protocol, Use of Priority Ceiling Protocol in Dynamic priority systems, Pre-emption Ceiling Protocol, Access control in Multiple **Module** Resources, Controlling Concurrent Accesses to Data Objects.

Module-4: Real Time Communication. [6L] Basic Concepts of Real time Communication, Soft and Hard real-time Communication systems, Model of Real-time Communication, Priority based service and Weighted Round Robin Service disciplines for switched Networks, Medium Access control protocols for broadcast networks, Internet and resource reservation protocols

Module-5: Real Time Operating Systems and Databases. [6L] Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of temporal data, temporal consistency, on-currency Control, and Overview of Commercial Real Time databases.

Text Books

1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication

Reference Books

1. Real Time Systems – Mall Rajiv, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 801 A.1	3	2	3	1	2	-	-	-	-	-	-	-
CS 801 A.2	3	2	3	3	-	-	-	-	-	-	-	-
CS 801 A.3	3	3	3	3	2	-	-	-	-	-	-	-
CS 801 A.4	3	2	3	3	2	-	-	-	-	-	-	-

Course Name: Data Analytics
Course Code: CS 801B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Programming skills of Python.

Course Objective(s):

1. Comprehend the fundamental concepts of the Big Data Analytics exploring machine learning strategies such as Supervised and Unsupervised Learning etc. for analyzing various types of large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework).
2. Formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions
3. Apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data distributed across multiple locations.
4. Excogitate and Implement ideas to address the challenging issues of Big Data Analytics.
5. Analyze the effectiveness of various Big Data Analytics Frameworks.

Course Outcome(s):

CS 801B.1 :
Understand and explain the fundamental concepts of the Big Data Analytics which are primarily explored for making automated decisions using machine learning strategies on analyzing large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework) underscoring the utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CS 801B.2 :
Identify and formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions within the scope of Big Data Analytics Frameworks.

CS 801B.3 :
Explore relevant literature and apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data using Map Reduce,

Hadoop and advanced SQL Frameworks.

CS 801B.4 : Excogitate ideas for proposing solutions to the challenging problems of Big Data Analytics.

CS 801B.5 : Implement ideas of Big Data Analytics through developing feasible algorithms or frameworks and investigate their effectiveness in solving the relevant problems by analyzing the performances using proper techniques.

Course Content:

Module – 1: Introduction to Basic Analytics [10L] Introduction: Big data overview, Analyst's perspective on data repositories, Current analytical architecture, Drivers of big data, Examples of big data analytics. Life Cycle of Data Analytics:Phase 1: Discovery, Phase 2: Data preparation, Phase 3: Model planning, Phase 4: Model building, Phase 5: Communication of results, Phase 6: Making operational. Basic Analytic Methods: Visualization, Dirty data, Data exploration versus presentation, Statistical methods for evaluation – hypothesis testing, difference of means, rank sum test, type I and type II errors, ANOVA.

Module - 2: Advanced Analytic Methods I [8L] Clustering: Overview, K-means, Determining the number of clusters, Diagnostics. Association Rules: Overview, Apriori algorithm, Evaluation of candidate rules, Application of association rules, Validation and testing, Diagnostics. Regression: Linear regression - model description, Logistic regression – model description, Other regression models. Classification: Decision trees – overview, General algorithm, Decision tree algorithms, Evaluating a decision tree, Naïve Bayes – Bayes theorem, Naïve Bayes classifier, Diagnostics of classifiers.

Module – 3: Advanced Analytic Methods II [8L] Time Series Analysis: Overview, Box-Jenkins methodology, Autocorrelation function (ACF), Autoregressive model, Moving average model, ARMA and ARIMA model, Building and evaluating an ARIMA model. Text Analysis: Steps in text analysis, Collecting raw text, Representing text, Term Frequency Inverse Document Frequency (TFIDF), Categorizing documents by types, Determining sentiments. Map Reduce and Hadoop:Analytics for unstructured data – map reduce, Apache Hadoop, Hadoop Ecosystem – Pig, Hive, Hbase, Mahout.

Module – 4: Advanced Analytic Methods III [10L] Technology and Tools: SQL essentials - Join, Set, Grouping extensions, Advanced SQL – Window functions, User-defined functions, Ordered aggregates, MADlib, NoSQL. Integration of Techniques: Communicating and operationalizing an analytic project. Creating final deliverables – Developing core materials, project goals, Main findings, Approach, Model description and model details, Recommendations, Providing technical specifications and code. Data visualization basics - Key points, evolution of a graph, common representation methods, how to clean up a graphic.

Textbook:

1. EMC Education Services (Editor), Data Science and Big Data Analytics. John Wiley & Sons, 2015.
2. Mike Barlow, Real-Time Big Data Analytics: Emerging Architecture. O'Reilly, 2013.

ReferenceBooks:

1. Nathan Marz and James Warren, Big Data: Principles and Best Practices for Scalable Real time Data Systems. Manning Publications, 2015.
2. Venkat Ankam, Big Data Analytics. Packt Publishing Ltd., UK, 2016.

CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CS 801 B.1	3	2				-	-	-	-	-	-	3
CS 801 B.2	2	3			-	-	-	-	-	-	-	-
CS 801 B.3	2	2	3	2		-	-	-	-	-	-	-
CS 801 B.4	2	2	2	3		-	-	-	-	-	-	2
CS 801 B.5	2	2	3	3	2	2	2	-	-	-	-	2

Course Name: Soft computing
Course Code: CS801C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Discrete Mathematics, Probability and Statistics

Course Outcome(s):

After completion of the course students will be able to

CS801C.1: Understand the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.

CS801C.2: Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems.

CS801C.3: Apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems

CS801C.4: Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem. CS-D-602.5: To understand the concept and techniques of designing and implementing of soft computing methods in real world problem.

Course Content:

Module-1: Intr**oduction to Soft Computing:[8L]**

An Overview of Artificial Intelligence, Evolution of Computing - Soft Computing Constituents – From Conventional Artificial Intelligence to Computational Intelligence - Machine Learning Basics. Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing

Module-2: Fuzzy sets and Fuzzy logic [7L]:

Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation

equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.

Module -3: Artificial Neural Networks [9L]:

Introduction, basic models, Hebb's learning, Adeline, Perception, Multilayer feed forward network. Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Module -4: Genetic Algorithms [7L]:

Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of Genetic Algorithm, Analysis of selection operations, Hypothesis of building Blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications. Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.

Module -5: Hybrid Systems [5L]:

Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic controlled Genetic Algorithm. Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Text book:

1.“Neural Networks, Fuzzy logic, and Genetic Algorithms”, S. Rajasekaran & G. A. V. Pai , PHI.
2.“Principles of Soft Computing”, S.N.Sivanandam, S.N Deepa, wiley publications.
3.“Neural Networks”, S. Haykin, Pearson Education, 2ed, 2001.
4.“An Introduction to Genetic Algorithm”, Mitchell Melanie, Prentice Hall, 1998.

Reference Books:

1. “Genetic Algorithms in Search, Optimization and Machine Learning”, David E. Goldberg, Addison Wesley, 1997. 2.“Intelligent Hybrid Systems”, D. Ruan, Kluwer Academic Publisher, 1997.

CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS 801 C.1	3	3	3	3	-	-	-	-	-	-	-	2
CS 801 C.2	3	3	3	3	2	2	-	-	-	-	-	2
CS 801 C.3	3	3	3	3	2	2	-	-	-	-	-	2
CS 801 C.4	3	3	3	3	2	-	-	-	-	-	-	2
CS 801 C.5	3	3	3	3	-	2	-	-	2	2	-	2

Course Name: VLSI Design & Application
Course Code: CS802A
Contacts: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite:
Concept of courses Solid State Devices; Analog Electronic Circuit; Digital Electronic and Circuit

Course Objective(s):

Objective of the course is:

To understand the basic concepts of designing combinational and sequential circuits and the design of VLSI ICs

To motivate students to design VLSI circuits in the area of digital, analog

To encourage for the design of IC with low power and high speed.

To study various programmable logic devices like PLDs and FPGA.

Course Outcome(e):

The students will be able to

CS802A.1: Understand scale of integration and VLSI design flow and VLSI Design steps.

CS802A.2: Calculate and analyze the different parameters related to the different MOS devices and to design the combinational and sequential logic circuits.

CS802A.3: Describe fabrication steps of IC and construct stick diagram & layout of CMOS inverter and basic gates based on Layout design rules.

CS802A.4: Understand the VHDL basics and to construct the combinational and sequential logic circuits.

Course Content

Module –1: Introduction to VLSI Design: [9L]

Historical perspective development of VLSI from discrete electronic circuit to VLSI.IC, MSI, LSI, Microelectronics & VLSI. Types of VLSI Chips (General purpose, ASIC, PLA, FPGA),photo-resist Basic CMOS Technology – (Steps in fabricating CMOS), Basic n-well CMOS procVLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioural, Structural, Physical), Y-Chart, Digital VLSI Design Steps.

Module-2: MOS structure: [2L]

E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flat band voltage, Potential balance & Charge balance, Inversion, MOS capacitances. Three Terminal MOS Structure: Body effect. Four Terminal MOS Transistor: Drain current, I-V characteristics. Current-voltage equations (simple derivation).Scaling in MOSFET, General scaling, Constant Voltage & Field scaling.] CMOS: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.

Module-3: Micro-electronic Processes for VLSI Fabrication: [10L]

Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition,

Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative ess, p-well CMOS process, Twin tub process, Silicon on insulator Layout Design Rule: Stick diagram with examples, Layout rules.

Module –4: Hardware Description Language:[6L]:
VHDL or Verilog Combinational & Sequential Logic circuit Design.

Text Books:
1. Digital Integrated Circuit , J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education
2. CMOS Digital Integrated Circuits Analysis and Design , S.M.Kang&Y.Leblebici,TMH.

Reference Books:
1. Microelectronic Circuits , Sedra & Smith , Oxford
2. Introduction to VLSI Circuits and System , Uyemura , Wiley

CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CS802A.1	2	2	3	1	1	-	-	1	2	1	1	1
CS802A.2	3	2	1	2	1	-	-	1	2	1	1	2
CS802A.3	3	3	3	2	1	-	-	1	2	1	1	2
CS802A.4	2	2	1	1	1	-	-	1	2	1	1	2

Course Name: Bio-informatics
Course Code: CS802B
Contact (Periods/Week): L-T-P=3-0-0
Credit Point: 3
No. of Lectures: 35

Course Objective(s):
The student should made to: Be familiar with the modeling techniques. Learn microarray analysis. Exposed to Pattern Matching and Visualization.

Outcomes:
The students will be able to upon completion of the course, The students will be able to Develop models for biological data Apply pattern matching techniques to bioinformatics data – protein data genomic data. Apply micro array technology for genomic expression study

Course Outcome(s):

CS802B.1 To acquire the knowledge of Bioinformatics technologies with the related concept of DNA, RNA and their implications
CS802B.2 To develop idea in MOLECULAR BIOLOGY
CS802B.3 To understand the concept and techniques of different types of Data Organization and Sequence Databases with different types of Analysis Tools for Sequence Data Banks
CS802B.4 To acquire the knowledge of the DNA SEQUENCE ANALYSIS
CS802B.5 To analyse the performance of different types of Probabilistic models used in Computational Biology.

Couse Content:

Module -1: [7L] INTRODUCTION TO MOLECULAR BIOLOGY:

Concepts of Cell, tissue, types of cell, components of cell, organelle. Functions of different organelles. Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and crick model. Exons and Introns and Gene Concept. Concepts of RNA : Basic structure, Difference between RNA and DNA. Types of RNA. Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Translation, Introduction to Metabolic Pathways. Introduction to Bioinformatics. Recent challenges in Bioinformatics.

Module -2: [10L]

Introduction to Genomic data, Data Organization and Sequence Databases: Sequence Data Banks - Introduction to sequence data banks - protein sequence data bank. Signal peptide data bank, Nucleic acid sequence data bank - GenBank, AIDS virus sequence data bank. RRNA data bank, structural data banks - protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank - Metabolic pathway data : Microbial and Cellular Data Banks. Introduction to MSDN (Microbial Strain Data Network):Numerical Coding Systems of Microbes, Hibridoma Data Bank Structure, Virus Information System Cell line information system; Protein Sequence Databases, DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different **Module**s: GenBank; OMIM, Taxonomy browser, PubMed;

Module 3: [8L] DNA SEQUENCE ANALYSIS DNA Mapping and Assembly :

Size of Human DNA ,Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing Secondary Structure predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking. Tertiary Structure

predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

Module -4: [10L] Introduction Probabilistic models used in Computational Biology:

Probabilistic Models; Gene Regulatory Method Application of HMM in Bio informatics : Genefinding, profile searches, multiple sequence alignment and regulatory site identification. Applications in Biotechnology : Protein classifications, Fold libraries, Protein structure prediction: Fold recognition (threading), Protein structure predictions : Comparative modeling (Homology), Advanced topics: Protein folding, Protein-ligand interactions, Molecular Modeling& Dynamics, Drug Designing.

Text Book:

Yi-Ping Phoebe Chen (Ed), "BioInformatics Technologies", First Indian Reprint, Springer Verlag, 2007.

References Book:

1. Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press, 2005

CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CS802B.1	3	-	-	-	-	1	1	-	-	-	-	-
CS802B.2	-	1	2	1	-	-	-	-	-	1	-	1
CS802B.3	1	2	-	2	2	-	-	-	1	-	-	-
CS802B.4	2	-	-		-	2	2	-	-	1	1	-
CS802B.5	-	3	-	1	-	3	-	1	-	-	2	-

Course Name: Robotics
Course Code: CS802C
Contacts: 3L
Credits: 3
Allotted hours: 35L

Prerequisite:
Microprocessor & Microcontroller
Computer Organization & Architecture

Course Objective(s):
To study microcontroller operations for robotics
To study how different interfaces are implemented in a microcontroller.
To learn how Microchip PIC micro PIC16F627 can be erased and reprogrammed
To learn how different sensors, outputs, and peripherals can be wired to a microcontroller to work cooperatively and create a high-level control program.
To design robots in a real time environment.

Course Outcome(s):
After the successful completion of this course, the student will be able to:
CS802C.1 To describe and explain the microcontrollers used the in robots.
CS802C.2. To design the software and build the prototype of robots.
CS802C.3. To apply localization and mapping aspects of mobile robotics.
CS802C.4. To demonstrate self-learning capability.

Course contents:

Module 1[5L]
Brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, commonsensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Module 2 [8L]
Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.

Module 3[8L]
Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators.

Module 4[9L]
Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.

Module 5[5L]
Introduction and some well-known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modelling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics, and static stability of a three-wheeled WMR ‘s on uneven terrain, Simulations using MATLAB and ADAMS.

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and

joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's).

Textbooks:
Myke Predko, ―Programming Robot Controllers‖ – McGrawHill, 1st edition, 2003.

Reference books:
Michael slater, ―Microprocessor – based design: A comprehensive Guide to Effective Hardware Design, Prentice Hall, 1989.
Myke Predko, ―Programming and customizing the 8051- micro-controller‖, Tata McGraw-Hill, New Delhi, 2000.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS802C.1	3	3	-	1	1	-	-	-	-	-	-	-
CS802C.2	2	3	-	1	-	-	-	-	-	-	-	-
CS802C.3	2	3	3	-	-	-	-	-	-	-	-	-
CS802C.4	2	2	-	-	-	-	-	-	-	-	-	3

Course Name: Introduction to IoT
Course Code: CS803A
Contact (Periods/Week):3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Objective(s):
Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcomes:
On completion of the course students will be able to

CS 803 A.1: Understand and differentiate the concepts of Internet of Things and Internet
CS 803 A.2: Identify appropriate MAC protocols and routing protocols while solving a problem
CS 803 A.3: Analyze and compare the basic protocols in wireless sensor network and IoT
CS 803 A.4: Solve different real life problems in different domains based upon the concept of IoT and sensor network
CS 803 A.5: Implement basic IoT applications on embedded platform.

Course Content:

Module 1: [7L]
Fundamental of IoT
The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.

Module 2: [6L]
Wireless Sensor Network
Network & Communication aspects, Wireless medium access issues, MAC protocol,routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Module 3: [7L]
IoT and M2M
A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 4: [7L]
IoT Architecture
Introduction, Architecture Reference Model- Introduction, Reference Model, and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 5: [5L]
IoT Applications for Value Creations
Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT in health care, Value for Industry, smart home Management.

Module 6: [4L]
Internet of Things Privacy, Security and Governance
Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

Text books:
1.Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2.Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Reference books:
1.Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2.Waltenegus Dargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS 803 A.1	3	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CS 803 A.2	3	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CS 803 A.3	3	3	3	2	2	-	1	-	-	-	-	-	1	2	-
CS 803 A.4	3	3	3	3	3	2	2	-	-	-	-	-	3	-	-
CS 803 A.5	3	3	3	3	3	2	2	-	2	2	1	1	3	-	-

Course Name: Image Processing
Course Code: CS803B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
1. Fourier analysis
2. Linear algebra
3. Probability

Course Objective(s):

- To learn discrete Fourier transform and its properties
- To study the monochrome and color image fundamentals
- To learn the analytical tools and methods which are currently used in digital image processing as applied to image information for human viewing.
- To learn image compression and segmentation techniques.

Course Outcomes:

After completion of course, students would be able

CS803B.1: To acquire the knowledge of basic pre-processing techniques in monochrome and color images.
CS803B.2: To develop skill in concepts of image enhancement like linear and non linear spatial filters using MATLAB.
CS803B.3: To understand the concept and techniques of simple image processing projects using different methods of restoration.
CS803B.4: To acquire the knowledge of the various segmentation algorithms for practical applications.
CS803B.5: To analyze the performance of Lossless and Lossy compression techniques in images.

Course Contents:

Module -1: Introduction:[5L]
Digital Image Fundamentals **:** Overview, Computer imaging systems , Digital Image Representation, Fundamental steps in Image Processing **[1L]**, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display **[1L]**. Digital Image Formation: A Simple Image Model, Use and Analysis of Color Models in Image Processing **[2L]**, Sampling & Quantization - Uniform & Non-uniform **[1L]**.

Module -2: Mathematical Preliminaries : [5L]
Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure **[1L]**; Distance Measures, Arithmetic/Logic Operations, Discrete Signals and Systems **[1L]-** A Review – Fourier Transformation, Properties of The Two Dimensional Fourier Transform **[2L]**, Discrete Fourier Transform, Discrete Cosine & Sine Transform **[1L]**.

Module 3: Image Enhancement : [6L]
Spatial Domain: Gray level transformations – Histogram processing **[2L]** Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain **[2L]**– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters **[2L]**.

Module -4: Image Restoration, Segmentation and Filtering :[14L]
Image Restoration and Segmentation:Image restoration: noise removal: mean & adaptive filters,

degradation model, inverse filter **[2L]**. Discrete Formulation, Algebraic Approach to RestorationUnconstrained& Constrained **[1L]**; Constrained Least Square Restoration, Restoration by Homomorphic Filtering **[1L]**, Geometric Transformation - Spatial Transformation, Gray Level Interpolation **[1L]**. Image Segmentation : Point Detection, Line Detection, Edge detection, Combined detection **[2L]**,

Module -5: Edge Linking, Boundary Detection and Image compression : [5L]

Edge Linking & Boundary Detection- Local Processing, Global Processing via The Hough Transform **[2L]**; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding**[2L]**; Region Oriented Segmentation - Basic Formulation, Region Growing by PixelAggregation, Region Splitting & Merging **[2L]**, Image compression: system model, lossless methods, lossy methods [2L]

Module -6: Image Representation and Recognition :[5L]

Image Representation and Recognition :Boundary representation – Chain Code – Polygonal approximation **[1L]**, signature, boundary segments – Boundary description **[1L]** – Shape number- Fourier Descriptor **[1L]**, moments- Regional Descriptors –Topological feature **[1L]**, Texture – Patterns and Pattern classes – Recognition based on matching **[1L]**.

Text Books:

1. Chanda&Majumder , Digital Image Processing & Analysis, PHI

Reference books:

1. Malay K. Pakhira, Digital Image Processing and Pattern Recognition, First Edition,PHI Learning Pvt. Ltd.,2011.
2. Rafael C. Gonzales and Richard E. Woods, Digital Image Processing, Third Edition,Pearson Education,2010.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS803B.1	3	-	-	2	-	1	1	-	-	-	-	-	**3**	**3**	**1**
CS803B.2	-	1	2	1	-	-	-	-	-	-	-	1	**3**	**3**	**1**
CS803B.3	1	2	-	3	2	-	-	-	1	-	-	-	**3**	**3**	**3**
CS803B.4	2	-	-	-	-	1	-	-	-	1	1	-	**3**	**3**	**3**
CS803B.5	-	3	-	2	-	1	-	1	-	-	-	-	**3**	**3**	**3**

Course Name: Optimization Techniques
Course Code: CS803C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
Basic Knowledge of Function, plotting of Equation and inequations, Formulation of Mathematical Problem. Finding maximum and minimum from row or column or from Matrix.

Course Objective:
Purpose of this course to develop models and then analyze the model using the techniques of Operations Research, Decision making under uncertainty and risk.

Course Outcomes(s):

On successful completion of the learning sessions of the course, the learner will be able to:

CS803C.1: Recall the distinctive characteristics of different types of decision-making problem to formulate and solve a real-world problem a prototype of mathematical problem.
CS803C.2: Understand the theoretical workings of appropriate decision making approaches and tools to identify the optimal strategy in competitive world.
CS803C.3: Apply the principles of different Methods/Model of Operations Research to solve practical problems.
CS803C.4: Analyze different engineering problems linked with Optimization Technique.

Course Content:

Module 1:
Linear Programming Problem(LPP): Basicsof Linear Programming Problem(LPP) and its Applications. General Mathematical Formulation of LPP; Definitions: Convex set, Solution, Feasible Solution, Basic and Non-Basic Variables, Basic Feasible Solution, Degenerate and Non-Degenerate solution, Optimum/Optimal Solution; Solution of LPP by Graphical Analysis/Method, Simplex Method, Charnes' Big M-Method; Duality Theory. **4L+3L+3L=10L**

Module 2:
Transportation Problem, Assignment Problem. **6L**

Module 3:
Game Theory: Introduction**;** Two person Zero Sum game, Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance.
5L

Module 4:
Network Optimisation Models: CPM PERT (Arrow network), Time estimates, earliest expected time, latest allowable occurrence time, latest allowable occurrence time and stack. Critical path, Probability of meeting scheduled date of completion of project. Calculation of CPM network.Various floats for activities.
5L

Module 5:
Sequencing: Johnson's Algorithm (1957) For **n** Jobs and **two** machines, **n** Jobs and **three** machines. **2L**

Module 6:
Queuing Theory: Introduction and Basic Structure of Queuing Theory; Basic Definations and Notations; Birth-and-Death Model (Poisson / Exponential distribution); Poisson Queue Models: (M/M/1):(∞/FIFO)and(M/M/1):(N/FIFO) and Problems. **5L**

Module 7:
Inventory Control: Determination of EOQ, Components, Deterministic Continuous & Deterministic Periodic Review Models, Stochastic Continuous & Stochastic Periodic Review Models. **3L**

Project Domain:
1. Study on Real life Problem Solve by Simplex Method.
2. Study on Real life Distribution Problem Solve by Transportation Problem.
3. Study on Real life Game / Marketing Problem Solve by Game Theory.
4. Study on Real life Network / Queueing Problem Solve by PERT/CPM and Queueing Theory.
5. Study on Real life Inventory Control Problem Solve by Inventory Control.

Text Books:
1. Operations Research by Kanti Swaroop and P.K. Man Mohan, Sultan Chand and Sons
2. Linear Programming and Theory of Games by Ghosh and Chakraborty, Central Book Agency
3. Linear Programming and Theory of Games by P.M.Karak, ABS Publishing House
4. Operations Research, D.K.Jana & T.K.Roy, Chhaya Prakashani Pvt. Ltd.
5. Operations Research, Kalavati,VIKAS
6. Operations Research,Humdy A Taha,PHI / Pearson

Reference Books:
1. Operations Research Theory and Applications by J.K.Sharma, Macmillan India Limited.
2. Operations Research, Vijayakumar, Scitech
3. Operations Research by S.D. Sharma, Kedar Nath Ram Nath Publishers.
4. Operations Research by A.P. Verma, S. K. Kataria & Sons.
5. Operations Research by P.K. Gupta & Hira, S.Chand
6. Operations Research by V.K. Kapoor

CO-PO Mapping:

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CS803C.1	3	2	-	-	-	-	-	-	-	-	-	1
CS803C.2	3	2	-	-	-	-	-	-	-	-	-	1
CS803C.3	3	2	2	-	-	-	-	-	-	-	-	1
CS803C.4	2	3	1	-	-	-	-	-	-	-	-	1

Course Name: Internet of Things Lab
CourseCode:CS803A
Contact:0:0:3
Credits:1.5

Prerequisite: Sensors,SystemIntegrationCloudandNetworkSecurity

Course Outcome:

Afterlearningthecourse,thestudentwillbeable:

CS803A .1: UnderstandinternetofThingsanditshardwareandsoftwarecomponents

CS803A .2: InterfaceI/Odevices,sensors&communicationmodules

CS803A .3: Remotelymonitordataandcontroldevices

CS803A .4: Develop reallifeIoTbasedprojects

List of Experiments:

1.Definition,Characteristics,andFeaturesofIoT.

2.Familiarizationwith ArduinoIDEandwritingaprogramusingArduinoIDEforLEDblinking.

3.Study of LM35temperature sensors and write programs to monitor them with Arduino with Thing Speak.

4.StudyofDHT-11sensorsandwrite programstomonitorthemwithArduinowithThingSpeak

5.Study of ultrasonic sensors and write programs to monitor them with Arduino with Thing Speak

6.FamiliarizationwithNodeMCUandwritingaprogramusingitforLEDblinking.

7.Study of LM35 temperature sensors and write programs to monitor them using Node MCU

8.StudyofDHT-11sensorsandwrite programstomonitorthemusingNode MCU

9.Studyofultrasonicsensorsandwriteprogramstomonitorthemusing NodeMCU

10.SetupRaspbianontheRaspberryPiandwriteaprogram toblinkanLEDusingPython.

11.InterfacingdigitalsensorsandrelayboardswithRaspberryPi&ESP8266

12.FamiliarizationwithPythonandwritingprogramsinPyCharm IDEusingAnaconda Framework.

13.DefineandExplain EclipseIoTProject.

14.IntroductiontoBlinkApplicationandimplementationofsmallprojects

15.IntroductiontoCiscoPacketTracer

16.Case Study: Intelligent Traffic systems (case study), Smart Parking (case study), Smart water management (case study), Anyotherinnovativeexperiment

List ofOpenSourceSoftware/learningwebsite:

- https://github.com/connectIOT/iottoolkit
- https://www.arduino.cc/

Mapping of COs with POs and PSOs:(Detailed:High:3;Medium:2;Low:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CS803A .1	2	2	2	2	3	2	1	1	2	2	3	3	3	2	2
CS803A .2	2	3	3	3	3	1	1	1	2	2	3	3	3	1	3
CS803A .3	3	3	2	3	3	2	2	2	3	3	3	3	2	1	3
CS803A .4	3	3	2	2	2	1	1	1	1	1	2	3	2	2	3

Course Name: Image Processing Lab
Course Code: CS893B
Contact: 0:0:3
Credits: 1.5

Prerequisite: Should have prior knowledge on syntaxes of programming like C++, JAVA.
Course Objective(s)

- To learn discrete Fourier transform and its properties
- To study the monochrome and color image fundamentals
- To learn the analytical tools and methods which are currently used in digital image processing as applied to image information for human viewing.
- To learn image compression and segmentation techniques.

Course Outcomes:

On completion of the course students will be able to

CS893B.1: Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description.
CS893B.2: Analyze images in the spatial domain.
CS893B.3: Analyze images in the frequency domain through the Fourier transform.
CS893B.4: Design and implement with MATLAB algorithms for digital image processing operations such as point processing, histogram processing,
CS893B.5: Spatial and frequency domain filtering, denoising, transforms, compression, and morphological processing.

Experiments:

1. W.A.P in MATLAB to extract different attributes of an Image.
2. W.A.P in MATLAB program for Image Negation.
3. W.A.P in MATLAB for Power Law Transformation.
4. W.A.P in MATLAB for Histogram Mapping and Equalization.
5. W.A.P in MATLAB for Image Smoothening and Sharpening.
6. W.A.P in MATLAB for Edge Detection using Sobel, Prewitt and Roberts Operators.
7. W.A.P in MATLAB for Morphological Operations on Binary Images.
8. W.A.P in MATLAB for Pseudo Colouring of images.
9. W.A.P in MATLAB for Chain Coding applied on images.
10. W.A.P in MATLAB for DCT/IDCT Computation.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS893B.1	2	-	-	2	-	1	3	-	-	-	-	-	3	3	3
CS893B.2	-	1	3	1	-	-	-	-	-	1	-	-	3	3	3
CS893B.3	1	2	-	-	-	3	-	-	1	-	2	-	3	3	3
CS893B.4	2	-	2	-	-	1	-	-	-	1	1	-	3	3	3
CS893B.5	-	2	-	3	-	1	-	1	-	1	-	-	3	3	3

Course Name: Optimization Techniques Lab
Course Code: CS893C
Contact: 0:0:3
Credits: 1.5

Course Objective(s):

- To introduce the optimization techniques using both linear and non-linear programming.
- To focus on the convex optimization though some techniques will be covered for non-convex function optimization.
- To frame engineering minima maxima problems in the framework of optimization problems.

Course Outcome(s):

After the completion of the course, the students will be able to
CS893C.1. Demonstrate the basic principles and concepts of Python
CS893C.2. Explore the applicability of programming skills in Python.
CS893C.3. Summarize various optimization techniques like LPP models.
CS893C.4. Analyse the transportation, inventory and assignment problems.
CS893C.5. Explain the concepts of sequencing, game theory and dynamic programming.

List Of Experiments (Includes but Not Limited to)

1. Matrix Operations
2. Minimum Cost Path
3. Finding Maximum Number in An Array
4. Array Sorting
5. Linear Programming Problem
6. Queuing Problem
7. Sequencing Problem
8. Game Theory
9. Assignment Problem
10. Dynamic Programming Problem
11. Inventory Problem

Recommended Books :

[1] Foulds, L. R. (2012). Optimization techniques: an introduction. Springer Science & Business Media.
[2] Onwubolu, G. C., & Babu, B. V. (2013). New optimization techniques in engineering (Vol. 141). Springer.
[3] Lopez, C. (2014). MATLAB optimization techniques. Apress.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS893C.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CS893C.2			-	2	3	-	-	-	-	-	-	-	-	-	-
CS893C.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CS893C.4	1	3	-	3	3	-	-	-	-	-	-	-	-	-	-
CS893C.5	1	3	-	2	2	-	-	-	-	-	-	-	-	-	-