INTEGRATED MASTER OF COMPUTER APPLICATIONS

CURRICULUM AND SYLLABUS
2021

SEMESTER I

Code	Title	L T P	Credit
21CUL101	**Cultural Education I**	**2 0 0**	**2**
21ENG101	**Communicative English**	**2 0 2**	**3**
	Language I	**2 0 0**	**2**
	Mathematics Core I	**3 1 0**	**4**
21ENV200	**Environmental Science and Sustainability**	**3 0 0**	**3**
21CSA103	**Computer Essentials**	**3 0 1**	**4**
21CSA106	**Problem Solving and Algorithmic Thinking**	**3 0 0**	**3**
21CSA182	**Problem Solving and Algorithmic Thinking Lab**	**0 0 1**	**1**
	TOTAL		**22**

SEMESTER II

Code	Title	L T P	Credit
21CUL111	**Cultural Education II**	**2 0 0**	**2**
21ENG111	**Professional Communication**	**1 0 2**	**2**
	Language II	**2 0 0**	**2**
	Mathematics Core II	**3 1 0**	**4**
21CSA112	**Database Management System**	**3 1 0**	**4**
21CSA113	**Programming in C**	**3 1 0**	**4**
21CSA114	**Computer Organization**	**3 1 0**	**4**
21CSA183	**Database Management System Lab***	**0 0 1**	**1**
21CSA186	**Programming in C Lab**	**0 0 1**	**1**
	TOTAL		**24**

SEMESTER III

Code	Title	L T P	Credit
21AVP201	**Amrita Values Programme I**	**1 0 0**	**1**
21SSK201	**Life Skills I**	**1 0 2**	**2**
	Mathematics Core III	**3 1 0**	**4**
21CSA201	**Data Structures and Algorithms**	**3 1 0**	**4**
21CSA202	**Object Oriented Programming using JAVA**	**3 1 0**	**4**
21CSA203	**Operating Systems**	**3 1 0**	**4**
21CSA204	**Principles of Management and Accounting**	**3 0 0**	**3**
21CSA282	**Data Structures and Algorithms Lab**	**0 0 1**	**1**
21CSA283	**Object Oriented Programming Lab using JAVA***	**0 0 1**	**1**
	TOTAL		**24**

SEMESTER IV

Code	Title	L T P	Credit
21AVP211	**Amrita Values Programme II**	**1 0 0**	**1**
21SSK211	**Life Skills II**	**1 0 2**	**2**
21CSA212	**Computer Networks**	**3 1 0**	**4**
21CSA213	**Advanced JAVA and J2EE**	**3 1 0**	**4**
21CSA214	**Web Technologies**	**3 1 0**	**4**
21CSA215	**Software Engineering**	**3 0 1**	**4**
	Open Elective	**3 0 0**	**3**
21CSA285	**Advanced JAVA and J2EE Lab**	**0 0 1**	**1**
21CSA286	**Web Technologies Lab***	**0 0 1**	**1**
	TOTAL		**24**

SEMESTER V

Code	Title	L T P	Credit
21SSK301	**Life Skills III**	**1 0 2**	**2**
21CSA301	**Data Warehousing and Data Mining**	**3 1 0**	**4**
21CSA302	**Python Programming**	**3 0 0**	**3**
21CSA390@	**Live-in-Labs@ / Elective I**	**3 0 0**	**3**
21CSA303	**Mobile Application Development***	**0 1 1**	**2**
21CSA381	**Python Programming Lab**	**0 0 1**	**1**
21CSA391	**Comprehensive Technical Viva Voce**		**2**
21CSA398	**Minor Project**		**4**
	TOTAL		**21**

SEMESTER VI

Code	Title	L T P	Credit
21CSA311	**C# and .NET Framework***	**0 1 1**	**2**
21CSA312	**Cryptography and Cyber Security**	**4 0 0**	**4**
	Elective II	**3 0 0**	**3**
	Professional Elective I	**3 0 1**	**4**
21CSA399	**Major Project**		**8**
	TOTAL		**21**
	TOTAL CREDITS		**136**

SEMESTER VII

Code	Title	L T P	Credit
21CSA501	**Design and Analysis of Algorithms**	**3 1 0**	**4**
	Elective III	**3 0 0**	**3**
	Elective IV	**3 0 0**	**3**
	Professional Elective II	**3 0 1**	**4**
21CSA585	**Research Learning and Problem Formulation**	**0 0 1**	**1**
	Mathematics Core IV	**3 1 0**	**4**
	Lab Elective I	**0 1 1**	**2**
	TOTAL		**21**

SEMESTER VIII

Code	Title	L T P	Credit
21MAT516	**Operations Research and Optimization Techniques**	**3 1 0**	**4**
21CSA511	**Machine Learning**	**3 1 0**	**4**
	Elective V	**3 0 0**	**3**
21CSA512	**Computer Language Engineering**	**3 0 0**	**3**
	Professional Elective III	**3 0 1**	**4**
21CSA591	**Research Seminar**	**0 0 1**	**1**
	Lab Elective II	**0 1 1**	**2**
	Lab Elective III	**0 1 1**	**2**
	TOTAL		**23**

SEMESTER IX

Code	Title	L T P	Credit
	Elective VI	**3 0 0**	**3**
	Elective VII	**3 0 0**	**3**
	Management Elective	**3 0 0**	**3**
	Lab Elective IV	**0 1 1**	**2**
21CSA698	**Dissertation Phase I**		**6**
	TOTAL		**17**

SEMESTER X

Code	Title	L T P	Credit
21CSA699	**Dissertation Phase II**		**12**
	TOTAL		**12**
	TOTAL CREDITS		**209**

* Project based course. Proper weightage may be given for the project in the continuous assessment.

LANGUAGES

Paper I			
Code	**Title**	**L T P**	**Credit**
21HIN101	**Hindi I**	**2 0 0**	**2**
21KAN101	**Kannada I**	**2 0 0**	**2**
21MAL101	**Malayalam I**	**2 0 0**	**2**
21SAN101	**Sanskrit I**	**2 0 0**	**2**
21TAM101	**Tamil I**	**2 0 0**	**2**
Paper II			
Code	**Title**	**L T P**	**Credit**
21HIN111	**Hindi II**	**2 0 0**	**2**
21KAN111	**Kannada II**	**2 0 0**	**2**
21MAL111	**Malayalam II**	**2 0 0**	**2**
21SAN111	**Sanskrit II**	**2 0 0**	**2**
21TAM111	**Tamil II**	**2 0 0**	**2**

MATHEMATICS CORES

Code	Title	L T P	Credit
21MAT231	**Mathematical Foundation for Computer Science**	**3 1 0**	**4**
21MAT232	**Discrete Mathematics**	**3 1 0**	**4**
21MAT233	**Statistical and Numerical Methods**	**3 1 0**	**4**
21MAT234	**Algebra and Number Theory**	**3 1 0**	**4**
21MAT235	**Foundations of Applied Mathematics - Part I**	**3 1 0**	**4**
21MAT236	**Foundations of Applied Mathematics - Part II**	**3 1 0**	**4**

PROFESSIONAL ELECTIVES

Code	Title	L T P	Credit
21CSA342	**IoT Architectures and Programming**	**3 0 1**	**4**
21CSA343	**Advanced Software Engineering and Design Patterns**	**3 0 1**	**4**
21CSA344	**Advanced Data Mining and Applications**	**3 0 1**	**4**
21CSA345	**Cloud Computing**	**3 0 1**	**4**
21CSA346	**System Security**	**3 0 1**	**4**
21CSA347	**Architecture and Deployment of Secure and Scalable WAN**	**3 0 1**	**4**
21CSA348	**Introduction to Business Analytics and Visualization**	**3 0 1**	**4**

LAB ELECTIVES I, II, III, IV

Code	Title	L T P	Credit
21CSA681	**MEAN Stack Lab**	**0 1 1**	**2**
21CSA682	**R Programming Lab**	**0 1 1**	**2**
21CSA683	**MATLAB Programming Lab**	**0 1 1**	**2**
21CSA684	**High Performance Computing Lab**	**0 1 1**	**2**
21CSA685	**Natural Language Processing Lab**	**0 1 1**	**2**
21CSA686	**Cyber Security Lab**	**0 1 1**	**2**
21CSA687	**Deep Learning Lab**	**0 1 1**	**2**
21CSA688	**System Administration Lab**	**0 1 1**	**2**
21CSA689	**Network Administration Lab**	**0 1 1**	**2**
21CSA781	**Competitive Programming Lab**	**0 1 1**	**2**
21CSA782	**Network and Grid Simulation Lab**	**0 1 1**	**2**
21CSA783	**Bioinformatics Lab**	**0 1 1**	**2**
21CSA784	**Big Data Analytics Lab**	**0 1 1**	**2**
21CSA785	**Computer Graphics and Visualization Lab**	**0 1 1**	**2**

ELECTIVE I, II

Code	Title	L T P	Credit
21CSA331	**Artificial Intelligence**	**3 0 0**	**3**
21CSA332	**Client Server Computing**	**3 0 0**	**3**
21CSA333	**Embedded Systems**	**3 0 0**	**3**
21CSA334	**Enterprise Resource Planning Management**	**3 0 0**	**3**
21CSA335	**Knowledge Management**	**3 0 0**	**3**
21CSA336	**Microprocessor Systems**	**3 0 0**	**3**
21CSA337	**Multimedia and Graphics**	**3 0 0**	**3**
21CSA338	**Social and Professional Issues in Computing**	**3 0 0**	**3**
21CSA339	**Soft Computing**	**3 0 0**	**3**
21CSA340	**Systems and Network Administration**	**3 0 0**	**3**
21CSA341	**Computer Graphics**	**3 0 0**	**3**

ELECTIVE III, IV, V, VI, VII (PG Level)

Code	Title	L T P	Credit
21CSA631	**Big Data Analytics and Visualization**	**3 0 0**	**3**
21CSA632	**Bioinformatics**	**3 0 0**	**3**
21CSA635	**Digital Image Processing**	**3 0 0**	**3**
21CSA636	**Computational Intelligence**	**3 0 0**	**3**
21CSA637	**Computer Graphics and Visualization**	**3 0 0**	**3**
21CSA638	**Database Administration**	**3 0 0**	**3**
21CSA639	**Malware Analysis**	**3 0 0**	**3**
21CSA640	**Deep Learning**	**3 0 0**	**3**
21CSA641	**Advanced Operating Systems and Distributed Computing**	**3 0 0**	**3**
21CSA642	**Information Retrieval**	**3 0 0**	**3**
21CSA643	**Connected Internet of Things Devices**	**3 0 0**	**3**
21CSA644	**Cloud Security**	**3 0 0**	**3**
21CSA645	**LAN Switching and Advanced Routing**	**3 0 0**	**3**
21CSA646	**Network Security**	**3 0 0**	**3**
21CSA647	**Open-Source Systems**	**3 0 0**	**3**
21CSA648	**Semantic Web Technologies**	**3 0 0**	**3**
21CSA649	**Software Quality Assurance**	**3 0 0**	**3**
21CSA650	**Structure and Interpretation of Computer Programs**	**3 0 0**	**3**
21CSA651	**Complex Networks**	**3 0 0**	**3**
21CSA652	**AI/ML Applications for Cyber Security**	**3 0 0**	**3**
21CSA653	**Wireless Communication and Networks**	**3 0 0**	**3**
21CSA654	**AI for Drug Discovery and Target Validation**	**3 0 0**	**3**
21CSA655	**Social Media Analytics**	**3 0 0**	**3**
21CSA656	**Natural Language Processing**	**3 0 0**	**3**
21CSA657	**Software Testing**	**3 0 0**	**3**
21CSA658	**Software Defined Networks**	**3 0 0**	**3**
21CSA659	**Pattern Recognition**	**3 0 0**	**3**
21CSA660	**Blockchain Technologies**	**3 0 0**	**3**
21CSA661	**Cyber Forensics**	**3 0 0**	**3**
21CSA662	**Parallel Computing**	**3 0 0**	**3**

MANAGEMENT ELECTIVES

Code	Title	L T P	Credit
21HU631	**Software Project Management**	**3 0 0**	**3**
21HU632	**Principles of Economics and Management**	**3 0 0**	**3**
21HU633	**Management and Organizational Behaviour**	**3 0 0**	**3**
21HU634	**Business Intelligence**	**3 0 0**	**3**

SYLLABUS

SEMESTER I

21CUL101	CULTURAL EDUCATION I	L-T-P-C:2-0-0-2

Course Objectives

- To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields.
- To equip students with a knowledge of their country and its eternal values.

Course Outcomes

COs	Description
CO1	Be introduced to the foundational concepts of Indian culture and heritage, the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education.
CO2	Understand the foundational concepts of Indian civilization like purusharthas, karma-siddhanta, Indian Society and Varna-ashrama-dharma which contributes towards personality growth.
CO3	Gain a positive appreciation of symbols of Indian culture, itihasas, festivals, traditions and the spirit of living in harmony with nature.
CO4	Imbibe the principles and practices of Yoga.
CO5	Get guidelines for healthy and happy living from the great spiritual masters.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	-	-	-	2	1	1	-	-	-
CO2	-	-	-	3	-	1	-	-	-
CO3	-	-	-	1	1	2	-	-	-
CO4	-	-	-	1	2	2	-	-	-
CO5	-	-	-	2	2	2	-	-	-
CAM	-	-	-	2	1	2	-	-	-

Syllabus

Unit-1

Introduction to Indian culture; Understanding the cultural ethos of Amrita Vishwa Vidyapeetham; Amma's life and vision of holistic education.

Unit-2

Goals of Life – Purusharthas; Introduction to Varnasrama Dharma; Law of Karma; Practices for Happiness.

Unit-3

Symbols of Indian Culture; Festivals of India; Living in Harmony with Nature; Relevance of Epics in Modern Era; Lessons from Ramayana; Life and Work of Great Seers of India.

Text Books / References:

1. Cultural Education Resource Material Semester-1
2. The Eternal Truth (A compilation of Amma's teachings on Indian Culture)
3. Eternal Values for a Changing Society. Swami Ranganathananda. Bharatiya Vidya Bhavan.
4. Awaken Children (Dialogues with Mata Amritanandamayi) Volumes 1 to 9
5. My India, India Eternal. Swami Vivekananda. Ramakrishna Mission.

21ENG101	COMMUNICATIVE ENGLISH	L-T-P-C: 2-0-2-3

Course Objectives

Course Outcomes

COs	Description
CO1	
CO2	
CO3	
CO4	
CO5	

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1									
CO2									
CO3									
CO4									
CO5									
CAM									

Syllabus

Textbooks / References:

21ENV200	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	L-T-P-C:3-0-0-3

Course Objectives

- To study the nature and facts about environment.
- To appreciate the importance of environment by assessing its impact on the human world

Course Outcomes

COs	Description
CO1	Recognize the physical, chemical & biological components of the Earth's systems and how they function
CO2	Develop an attitude of preserving and conserving bio-diversity.
CO3	Understand how local, regional, state, national and international laws and regulations influence environmental decisions
CO4	Realize the benefits of eco-friendly products and green initiatives

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	-	2	-	1	1	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-
CO3	-	2	2	1	1	1	-	-	-
CO4	-	3	-	3	-	-	-	-	-
CAM	-	2	2	1	1	1	-	-	-

Syllabus

Unit 1

State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.
Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.
Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action. Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/ pollution

Unit 2

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.
Discuss the interrelation of environmental issues with social issues such as: Population, Illiteracy,

Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3

Common goods and public goods, natural capital/ tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco- homes/ Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

Textbooks / References:

1. R. Rajagopalan, Environmental Studies: From Crisis to Cure. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.
2. Daniel D. Chiras, Environmental Science. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.
3. Andy Jones, Michel Pimbert and Janice Jiggins, 2011. Virtuous Circles: Values, Systems, Sustainability. IIED and IUCN CEESP, London. URL:http://pubs.iied.org/pdfs/G03177.pdf
4. Annenberg Learner, The Habitable Planet, Annenberg Foundation 2015. URL: http:// www.learner.org/courses/envsci/unit/pdfs/textbook.pdf.

21CSA103	COMPUTER ESSENTIALS	L-T-P-C:3-0-1-4

Course Objectives

- To provide understanding of the various components and functional units of computers, their design and working.
- To provide insight into digital systems and logic circuit design.

Course Outcomes

COs	Description
CO1	Understand the basic components of computer systems and its functionality.
CO2	Understanding of number systems and representations.
CO3	Understanding of boolean algebra, design and implementation of various logic circuits.
CO4	Understanding of various types of combinational and sequential circuits and their functions.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	1	-
CO2	3	-	-	-	-	-	1	-	-
CO3	2	2	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-
CAM	3	2	1	-	-	-	1	1	-

Syllabus

Computer Fundamentals: Brief history of Computer, Classification of Computers, Functions & Components of a Computer, Central Processing Unit, Storage units, Bus, Input and output Devices. Types of memory, RAM, ROM, Variants of ROM, Secondary storage devices- hard disk-disk components and geometry. Other Secondary Storage devices: CD/DVD Family, Blue ray Disc, Flash Drive, Memory stick, smart cards. Computer Languages-Machine, Assembly Language and Higher Level languages. Operating systems, Bootstrapping. Program execution with illustrative examples.

Number Systems: Decimal, Binary, Octal, Hexadecimal conversion from one to another- Binary arithmetic, representation of signed numbers, 1's and 2's Complement Arithmetic.

Logic Gates and Boolean Algebra. Logic Gate: Basic logic gates- AND, OR, NOT, NAND, NOR, Exclusive OR, Exclusive NOR gates- Logic symbols, truth table and timing diagrams. Boolean algebra - Basic laws and theorems, Boolean functions, truth table, minimization of boolean function using K map method, Realization using logic gates and universal gates.

Logic Circuits: Combinational logic circuits: Half adder, Full adder, Parallel binary adder, Subtracter, Decoders, Encoders, Multiplexers, De-multiplexers. Sequential logic circuits- Flip Flops – RS, JK, T and D Flip Flops, Edge triggered Flip Flops, Master slave Flip Flops.

Registers and Counters: Serial in serial out, Serial in Parallel out, Parallel in serial out, Parallel in Parallel out registers, Bidirectional shift registers. Introduction to counters and applications.

Lab: PC assembling, identification of components, bus subsystems, main chipsets on the motherboard (northbridge, southbridge), Disk formatting, Understanding disk partitions and obtaining partition information

using system tools. Operating system installation, Using package manager or system tools to install/update software. Obtaining essentialsystem resource utilization and information using system tools, Troubleshooting.

Basic Linux commands, Searching the file system using find and grep with simple regular expressions. Basic process control using signals: pausing and resuming process from a Linux terminal, terminating a process. Adding/removing fromsearch path using PATH variable. Compressing/uncompressing using tar/gzip and zip tools. Using man pages to understand tool documentation

Textbooks / References:

1. Floyd & Jain, “Digital Fundamentals”, Eighth Edition, Pearson Education, (2004).
2. Anand Kumar, “Fundamentals of Digital Circuits”, PHI Learning Pvt. Ltd., (2003).
3. Morris Mano, “Digital logic and Computer design”, First Edition, Prentice Hall of India, (2004).
4. Digital principles and Applications- Albert Paul Malvino, Donald P Leach, McGraw Hill
5. The Complete Reference PC Hardware – Craig Zacker, John Rourke, Tata McGraw-Hill, 2004.
6. All about Hard Disk- Manohar Lotia, BPB Publications.
7. P K Sinha & Priti Sinha, “Computer Fundamentals”, Fourth Edition, BPB Publications, (2004).
8. Halsey M. Windows 10 Troubleshooting. Apress; 2016.
9. Soyinka W. Linux Administration: A Beginner’s Guide. Fifth Edition, Mc Graw Hill Professional; 2008

21CSA106	PROBLEM SOLVING AND ALGORITHMIC THINKING	L-T-P-C: 3-0-0-3

Course Objectives

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides foundation for developing computational perspectives of one's own discipline.

Course Outcomes

COs	Description
CO1	Apply algorithmic thinking to understand, define and solve problems.
CO2	Design and implement algorithm(s) for a given problem.
CO3	Apply the basic programming constructs for problem-solving.
CO4	Understand an algorithm by tracing its computational states, identifying bugs and correcting them.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	3	2	-
CO2	2	3	1	-	-	-	3	3	-
CO3	3	2	2	-	-	-	-	-	-
CO4	1	-	2	-	-	-	-	1	-
CAM	3	2	2	-	-	-	3	2	-

Syllabus

Unit I

Problem-Solving - understand problem definition, constraints on input/output, sample input and expected output; Algorithmic thinking - reading input/writing output, data representation, choice of data types, formulating solutions to basic problems by applying sequence, selection, and repetition constructs; Modularity – decomposing into functions.

Unit II

Representing and manipulating composite data - lists and strings, problem-solving on lists- performing a search, aggregation, range and ordering operations on lists; Manipulating string data - concatenation, splitting, reversal, comparison, pattern matching on strings, problem-solving on strings.

Unit III

Using recursion for problem-solving, practical examples of recursion, iteration vs. recursion, simple and binary recursion; sorting and searching; Data structures - tuples, sets, dictionaries; Evaluating algorithms, error handling, writing test cases, the importance of documentation/ comments.

Unit IV

Libraries - Create, export and import packages, commonly used packages - math, random numbers, regular expressions, file handling; Programming semantics - Overflow, underflow, mutability, scope, visibility, exception handling, bitwise operators; Basics of algorithms - time and space complexity, asymptotic notations

Textbooks / References:

1. Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC press; 2014 Mar 27.
2. Charles Dierbach, Introduction to Computer Science using Python: A computational Problem-Solving Focus, 2012. www.it-ebooks.info
3. Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.
4. Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.
5. Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you become a computational thinker. World Scientific Publishing Company; 2017

21CSA182	PROBLEM SOLVING AND ALGORITHMIC THINKINGLAB	L-T-P-C: 0-0-1-1

Course Objectives

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides foundation for developing computational perspectives of one's own discipline.

Course Outcomes

COs	Description
CO1	Apply algorithmic thinking to understand, define and solve problems.
CO2	Design and implement algorithm(s) for a given problem.
CO3	Apply the basic programming constructs for problem-solving.
CO4	Understand an algorithm by tracing its computational states, identifying bugs and correcting them.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	3	2	-
CO2	2	3	1	-	-	-	3	3	-
CO3	3	2	2	-	-	-	-	-	-
CO4	1	-	2	-	-	-	-	1	-
CAM	3	2	2	-	-	-	3	2	-

Syllabus

Reading input/writing output, data representation, choice of data types, formulating solutions to basic problems by applying sequence, selection, and repetition constructs; Modularity – decomposing into functions. lists and strings, problem-solving on lists- performing a search.
Manipulating string data - concatenation, splitting, reversal, comparison, pattern matching on strings, problem-solving on strings.
Using recursion for problem-solving, practical examples of recursion, iteration vs. recursion, simple and binary recursion; sorting and searching.
Data structures - tuples, sets, dictionaries.
Libraries - Create, export and import packages, commonly used packages - math, random numbers, regular expressions, file handling;

Textbooks / References:

1. Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC press; 2014 Mar 27.
2. Charles Dierbach, Introduction to Computer Science using Python: A computational Problem-Solving Focus, 2012. www.it-ebooks.info
3. Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.
4. Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.
5. Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you become a computational thinker. World Scientific Publishing Company; 2017

SEMESTER II

21CUL111	CULTURAL EDUCATIONII	L-T-P-C: 2-0-0-2

Course Objectives

- To deepen students' understanding and further their knowledge about the different aspects of Indian culture and heritage.
- To instill into students, a dynamic awareness and understanding of their country's achievements and civilizing influences in various fields and at various epochs.
- To bring a greater ability to deal with life's challenges by helping students towards a balanced and harmonized personality.

Course Outcomes

COs	Description
CO1	To get an overview of India's contribution to the world in the field of art, architecture, and science; to understand the foundational concepts of ancient Indian education system; to glean insights from Mahabharata.
CO2	Learn the important concepts of Vedas, Vedangas, and Yogasutras for the refinement of personality.
CO3	Familiarize themselves with the Bhagavad-Gita and its relevance to daily life; Understand the sagacity of Chanakya; Role of Women in ancient Indian society.
CO4	To understand the principles of Yoga and its applicability through practice.
CO5	Gain a deep understanding of the underlying principles of diverse traditions of worship.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	-	-	-	2	1	1	-	-	-
CO2	-	-	-	3	-	1	-	-	-
CO3	-	-	-	1	1	2	-	-	-
CO4	-	-	-	1	2	2	-	-	-
CO5	-	-	-	2	2	2	-	-	-
CAM	-	-	-	2	1	2	-	-	-

Syllabus

Unit 1

To the World from India; Education System in India; Insights from Mahabharata; Human Personality. India's Scientific System for Personality Refinement.

Unit 2

The Vedas: An Overview; One God, Many Forms; Bhagavad Gita – The Handbook for Human Life; Examples of Karma Yoga in Modern India.

Unit 3

Chanakya's Guidelines for Successful Life; Role of Women; Conservations with Amma.

Text Books / References

1. Cultural Education Resource Material Semester-2
2. Cultural Heritage of India. R.C.Majumdar. Ramakrishna Mission Institute of Culture.
3. The Vedas. Swami Chandrashekhara Bharati. Bharatiya Vidya Bhavan.
4. Indian Culture and India's Future. Michel Danino. DK Publications.
5. The Beautiful Tree. Dharmapal. DK Publications.
6. India's Rebirth. Sri Aurobindo. Auroville Publications.

21ENG111	PROFESSIONAL COMMUNICATION	L-T-P-C: 1-0-2-2

Course Objectives

Course Outcomes

COs	Description
CO1	
CO2	
CO3	
CO4	

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1									
CO2									
CO3									
CO4									
CAM									

Syllabus

Textbooks / References:

21CSA112	DATABASE MANAGEMENT SYSTEM	L-T-P-C: 3-1-0-4

Course Objectives

- The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

Course Outcomes

COs	Description
CO1	Have a broad understanding of database concepts and database management system software including a high-level understanding of major DBMS components and their functions.
CO2	Able to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model so as to successfully design a complete application.
CO3	Understand Data Normalization and its usage in database design so as to successfully design a complete application
CO4	Learn transaction properties and types in a DBMS including concurrency control and recovery.
CO5	Able to write SQL statements to create tables and indexes, set constraints, insert/update/delete data, and query data in a relational DBMS thereby building a successful application.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	1	1
CO2	2	3	2	1	1	-	2	2	-
CO3	2	3	2	1	1	-	2	2	-
CO4	3	-	1	-	-	-	-	1	1
CO5	3	2	2	1	1	-	2	2	-
CAM	3	3	2	1	1	-	2	2	1

Syllabus

Unit 1

Introduction - Data Independence - The Three Levels of Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure, Instance and schema, Data Models, Types of DBMS

Unit 2

Keys - CODD's Rules, Design Issues -ER – Model –Attribute types- Weak Entity Sets - Extended ER Features –ER to Relational Mapping, Structure Of Relational Databases

Unit 3

Normalization –Anomalies- Functional Dependency: Armstrong's axioms- closure of a relation and closure of attribute– Lossless decomposition-1NF, 2NF, 3NF, Boyce - Codd Normal Form

Unit 4

The Relational Algebra -- Query Processing and Optimization: Evaluation of Relational algebra expressions-Query Equivalence-Transaction Processing: ACID properties, states of a transaction-Introduction to

concurrency control-Deadlock-Recovery.

Unit 5

Built in SQL functions- Set operations, Sub Queries-Joins-DCL – TCL- Views – Sequences – Index – Locks PL/SQL Basics – Exceptions – Cursors - Stored Functions – Triggers

Textbooks / References:

1. Silberschatz. Korth. Sudarshan: Database System Concepts - 6th Edition Mcgraw-Hill International Edition.
2. Ivan Bayross: Sql- PL/SQL The Programming Language of Oracle – 4th Edition - Bpb Publications.
3. C.J. Date: An Introduction To Database Systems - Eighth Edition – Pearson Education Asia
4. Kevin Loney - George Koch: Oracle 9i The Complete Reference Mcgraw-Hill International Edition.
5. Fundamentals of Database Systems" by Elmasri and Navathe.

21CSA113	PROGRAMMING IN C	L-T-P-C: 3-1-0-4

Course Objectives

- This course is designed to provide basic concepts of the C-programming and use of language constructs for problem solving using C language.
- This course also covers the usage of pointers, structures & functions for developing applications in C.

Course Outcomes

COs	Description
CO1	Learn fundamental programming concepts needed to develop computer programs.
CO2	Code, debug and execute a well-structured basic computer program using the C language.
CO3	Given a programming problem, design a solution and identify the C programming constructs needed for the solution and implement it in C language.
CO4	Understand and explain different constructs like arrays, pointers and structures and apply it for solving computational problems.
CO5	Develop reusable modules using functions and write programs for file handling.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	1	1	-
CO2	2	3	2	-	-	-	3	3	-
CO3	2	3	2	-	-	-	3	3	2
CO4	3	3	1	-	-	-	3	3	1
CO5	3	3	1	-	-	-	3	3	1
CAM	3	3	2	-	-	-	3	3	1

Syllabus

Unit 1

Introduction to C language - structure of 'C' program, Programming elements(tokens) –Classes of data types – Declaration of variables, assigning values to variables, Input and Output operations – printf, scanf, escape sequences (backslash character constants), Specifying Comments, Operators–operator precedence and associativity, Expressions – Evaluation of expressions, type conversions(type casting).

Unit 2

Control Flow - Decision Control and Loop Control, Decision Control Instructions – if-else , nested if-else, Use of logical operators in decision making, Switch control structure, Loop Control Instructions -While, for, do-while, nested loops.

Unit 3

Arrays – single dimensional arrays - declaration –memory representation– initialization and access.
2D arrays and multidimensional arrays.

Strings – defining strings, reading strings from standard input, initializing, accessing, character handling functions, arithmetic operations on characters, character by character input and output, string handling functions,

array of strings and its features.

Pointers –Introduction, declaring and initializing pointer variables, pointer expressions, pointers and arrays, pointers and strings, array of pointers.

Unit 4

Functions – definition-declaration-prototypes and function call- actual and formal arguments-types of functions-call by value-call by reference-nesting of functions-recursive functions-pointers to functions-storage class specifiers.

Enumerated data types, Preprocessor directives – Macros - Defining symbolic constants, File inclusion, Command line arguments.

Unit 5

Structures – definition-declaration-initialization-accessing structures- array of structures, array within structures, structures within structures, self-referential structures, pointers to structures, uses of structures.
Union- definition- union of structures.
Files – Reading and writing files - file handling functions – file opening modes – file operations

Textbooks / References:

1. "Let us C", Yashavant Kanetkar, 13th Edition, BPB Publications.
2. "Programming in ANSI C", E. Balagurusamy, 6th Edition, Tata McGraw-Hill Publishing Company Limited.
3. "C Programming Language" Brian W Kernighan, Dennis M Ritchie Second Edition, Prentice Hall.
4. "Test your C Skills", Yashavant Kanetkar.
5. "Exploring C", Yashavant Kanetkar,

21CSA114	COMPUTER ORGANIZATION	L-T-P-C: 3-1-0-4

Course Objectives

- To understand the basic structure and organization of computer system, basic functions and the operations of functional units.

Course Outcomes

Cos	Description
CO1	To understand the basic functional units of computer system, data representation and arithmetic operations.
CO2	To understand the concept of fetch and execution of machine instructions, addressing modes and different instruction types.
CO3	To familiarize the memory organization, types of memory and memory mapping.
CO4	To learn IO Organization and peripheral interfacing.
CO5	To understand parallel processing concepts and embedded systems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	2	-	-
CO2	3	-	-	-	-	-	2	-	-
CO3	3	2	1	-	-	-	2	-	-
CO4	3	1	-	-	-	-	1	-	-
CO5	3	3	-	-	-	-	1	-	-
CAM	3	2	1	-	-	-	2	-	-

Syllabus

Unit 1:BASIC STRUCTURE OF COMPUTERS:

Basic structure of a Computer System: - Functional Units, Multiprocessors and Multicomputers concepts, Basic Arithmetic Operations: Data Representation, Fixed Point Representation. Floating – Point Representation. Integer Addition and Subtraction, Fixed and Floating-point numbers, Floating point representation, Signed numbers, Binary Arithmetic, 1's and 2's Complements Arithmetic, Multiplication of positive numbers , signed operand multiplication - Booth multiplication.

Unit 2: BASIC PROCESSING UNIT AND MACHINE INSTRUCTIONS

Fundamental concepts, Register transfers, Fetching a word from memory, Storing a word in memory, Execution of a complete instruction, Branch instructions, A Complete processor,

Assembly language - Assembly language notation, Basic instruction types, Register Transfer Languages, Addressing modes, subroutines.

Unit 3: MEMORY ORGANIZATION AND ARCHITECTURE

Memory Organization: Basic Concepts, Semiconductor RAM memories, Read-only memories, Performance Analysis of memory, Cache memory: - Types of cache memory, Mapping functions, Replacement algorithms, Virtual memory: - Address Translation, Secondary storage.

Unit 4: INPUT OUTPUT ORGANIZATION

Introduction to I/O Operations, Peripheral devices , Input/Output interfaces, Modes of transfer:- Programmed I/O, Interrupt initiated I/O, Direct Memory access.

Unit 5:PARALLEL PROCESSING AND EMBEDDED SYSTEMS

Parallel Processing – Introduction to pipelining: - Instruction pipelining and Arithmetic pipelining, Hazards: - Data hazards, Instruction hazards, Handling data hazards and instruction hazards.
Embedded Systems: - Examples of embedded systems.

Integer Addition and Subtraction , Fixed and Floating point numbers, Floating point representation., Signed numbers, Binary Arithmetic, 1's and 2's Complements Arithmetic, 2's Complement method for multiplication, Booths Algorithm, Hardware Implementation, Floating Point Arithmetic , The accumulator, Shifts, Carry and Overflow.

Textbooks / References:

1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2. M Morris Mano, Computer System Architecture (3rd Edition).
3. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
4. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc.
5. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGrawHill.

21CSA183	DATABASE MANAGEMENT SYSTEM LAB	L-T-P-C: 0-0-1-1

Course Objectives

- The objective of this lab course is to understand the practical applicability of database management system concepts.
- Working on existing database systems, designing of database, creating relational database, analysis of table design.

Course Outcomes

COs	Description
CO1	Get practical knowledge on designing and creating relational database systems.
CO2	Write queries in SQL to retrieve any type of information from a database.
CO3	Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate function etc.
CO4	Use PL/SQL objects (functions, cursors, triggers etc.) for solving real life database problems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	1	2	2	3	3	3	2
CO2	3	1	2	-	-	-	2	1	-
CO3	3	1	2	-	-	-	2	1	-
CO4	3	1	1	-	-	-	2	1	-
CAM	3	1	2	2	2	3	2	1	2

Syllabus

Built in SQL functions- Set operations, Sub Queries-Joins-DCL – TCL- Views – Sequences – Index – Locks

PL/SQL – Exceptions – Cursors - Stored Functions – Triggers

21CSA186	PROGRAMMING IN C LAB	L-T-P-C: 0-0-1-1

Course Objectives

- This course aims to give hands-on experience on developing applications using different constructs in C language.

Course Outcomes

COs	Description
CO1	Enhance problem solving skills and use it for solving computational problems.
CO2	Design, implement, test, debug, and document moderately complex programs in C.
CO3	Implement C programs using functions, pointers and structures.
CO4	Use files and file operations to build data handling applications in C.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	3	3	-
CO2	3	3	2	-	-	-	3	3	2
CO3	3	3	2	-	-	-	3	3	2
CO4	3	3	1	-	-	-	3	3	1
CAM	3	3	2	-	-	-	3	3	2

Syllabus

Basic C program and its execution- Installation of a C compiler and familiarisation of its usage, C program to print message on the console, variable declaration and initialisation, reading values from standard input. Usage of format specifiers for printing values.
Operators- Arithmetic, Relational, Ternary, Logical, Bitwise
Control Statements-if, if-else, nested if, if-else if, switch, goto
Looping Control-while, for, do-while
Arrays-one-dimensional- creating, displaying merging, searching, sorting, reversing
Arrays-Two-dimensional- creating, displaying, Operations on 2D arrays
Strings-String functions, manipulation of strings, multi strings
Pointers – Pointer arithmetic, Array of pointers, pointer to array
Functions – passing arguments, returning values, recursive functions, pointers as arguments
Structures-Initializing, members as array, variables as array, passing structures to functions, pointers to structures
Union-Enum types, preprocessors-macros, macro with arguments, nested macro, file inclusion, command line arguments
File Handling

SEMESTER III

21AVP201	AMRITA VALUES PROGRAMME I	L-T-P-C: 1-0-0-1

Course Objectives

Course Outcomes

COs	Description
CO1	
CO2	
CO3	
CO4	
CO5	

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1									
CO2									
CO3									
CO4									
CO5									
CAM									

Syllabus

Textbooks / References:

21SSK201	LIFE SKILLS I	L-T-P-C: 1-0-2-2

Course Objectives

Course Outcomes

COs	Description
CO1	
CO2	
CO3	
CO4	
CO5	

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1									
CO2									
CO3									
CO4									
CO5									
CAM									

Syllabus

Textbooks / References:

21CSA201	DATA STRUCTURES AND ALGORITHMS	L-T-P-C: 3-1-0-4

Course Objectives

- This course aims to provide the basic knowledge of different data structures and its usage. It also covers techniques used for analysing algorithms and notations for expressing time complexity.

Course Outcomes

Cos	Description
CO1	Implement basic data structures such as Linked lists, Stack and Queue.
CO2	Analyse an algorithm, determine its time complexity and express it in asymptotic notation.
CO3	Implement different searching and sorting algorithms.
CO4	Use different data structures including tree and graph and solve computational problems using it.
CO5	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	1	-	-	-	2	3	1
CO2	3	1	1	-	-	-	3	2	-
CO3	3	3	1	-	-	-	1	3	-
CO4	3	3	1	-	-	-	3	3	1
CO5	2	3	2	-	-	-	3	3	1
CAM	3	3	1	-	-	-	3	3	1

Syllabus

Unit 1: Algorithm Analysis

Mathematical preliminaries; Efficiency of algorithms - notion of time and space complexity, Basic Complexity Analysis - Worst case, Average case and Best cases, Asymptotic Analysis- notations, analysing iterative programs – Simple examples; Recurrences, Analysis of Divide and conquer algorithms - Merge sort, Substitution Method, Master method.

Unit 2: Searching and Sorting

Linear Search, Binary Search – Analysis
Bubble Sort, Insertion Sort, Merge sort, Quick Sort - Analysis

Unit 3: Linear Data Structures

Abstract Data Type, List ADT: Singly linked lists, Doubly linked lists, Circular Linked Lists, Stack ADT implementation and applications, Queue ADT: Implementation and Application. Circular Queue, Priority Queue

Unit 4: Non-Linear Data Structures

Properties of a binary tree, Representation of a binary tree, Operations on a Binary Tree, Binary tree – Insertion, Deletion, Traversal, Types of Binary Trees - Expression tree, Binary search tree, AVL tree, Heap

Unit 5: Graphs

Adjacency matrix, Adjacency list, Breadth First Search, Depth First Search, Minimum Spanning Tree- Prim's and Kruskal's Algorithm, Dijkstra's algorithm

Textbooks / References:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education
2. Samanta, Debasis. Classic Data Structures. PHI Learning Pvt. Ltd., 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms, 3rd edition, MIT Press, 2009.

21CSA202	OBJECT ORIENTED PROGRAMMING USING JAVA	L-T-P-C: 3-1-0-4

Course Objectives

- The main objective of this course is to understand the basic concepts and techniques which form the object-oriented programming paradigm using Java Language.

Course Outcomes

COs	Description
CO1	Identify classes, objects, members of a class and relationships among them needed for a specific problem.
CO2	Implement Java application programs using OOP principles and proper program structuring.
CO3	Demonstrate the concepts of polymorphism, inheritance and thread and document a Java Program using Javadoc.
CO4	Use Java AWT and Swing classes to build GUIs and understand how collection interface is implemented.
CO5	Demonstrate the Conceptual model of UML, activity diagram and their modelling techniques.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	1	-
CO2	3	3	3	-	-	-	2	3	-
CO3	3	2	2	-	-	-	2	2	-
CO4	3	3	1	-	-	-	1	2	1
CO5	3	3	3	1	1	1	1	2	1
CAM	3	3	3	1	1	1	2	2	1

Syllabus

Unit 1

Introduction to object oriented software design, Comparison of programming methodologies, Object Basics, Java Environment, Classes and Object, Data Members, Access Specifiers, Arrays within a Class, Array of Objects, Constructors, Default Constructors, Destructors, Static Members, Constant Members.

Unit 2

Overview of Streams, Bytes vs. Characters, File Object, Binary Input and Output, Reading and Writing Objects, Method Overriding, Polymorphism, Super, Interfaces and Abstract Classes, Packages, Exception

Unit 3

Introduction to Threads, Creating Threads, Thread States, Runnable Threads, Coordinating Threads, Interrupting Threads, Runnable Interface, Synchronization.

Unit 4

Collection framework, Collection interfaces and classes, AWT, Swing, Event Handling, Javadoc

Unit 5

Object Oriented Design with UML, Class, object diagrams and sequence diagrams. Use case diagrams and activity diagrams

Textbooks / References:

1. Herbert Scheldt, “Java: The Complete Reference, Eleventh Edition”, Oracle 2018
2. Deitel PJ. Java how to program. Eleventh Edition, Pearson; 2018.
3. Nino J, Hosch FA. Introduction to Programming and Object-oriented Design using Java. Wiley India Private Limited; 2010.
4. Naughton P. and Schildt H. Java 2: The Complete Reference. Eighth Edition, Tata McGraw- Hill; 2011.
5. Bahrami A. Object Oriented Systems Development. Second Edition, McGraw-Hill; 2008.
6. Booch G, Maksimchuk RA. Object-oriented Analysis and Design with Applications. Third Edition, Pearson Education; 2009.

21CSA203	OPERATING SYSTEMS	L-T-P-C: 3-1-0-4

Course Objectives

- A successful student will be able to understand the basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Outcome

COs	Description
CO1	Analyze the structure of OS and basic architectural components involved in OS design.
CO2	Understand the process concepts and different operations on processes along with mechanisms for Inter Process Communication.
CO3	To appreciate the role of Process synchronization towards increasing throughput of a system and understand the different mechanisms used for process synchronization and applying these mechanisms for solving some classical synchronization problems.
CO4	Apply various concepts related with deadlock to solve problems related with resources allocation.
CO5	Master concepts of memory management including virtual memory.
CO6	Understand the different I/O management techniques used in Operating Systems. Also familiar with the disk structure and different disk scheduling algorithms.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2
CO2	2	2	-	-	-	-	2	-	-
CO3	2	3	-	-	-	-	2	1	-
CO4	3	2	-	-	-	-	2	1	-
CO5	3	1	-	-	-	-	-	-	1
CO6	3	-	-	-	-	-	-	-	1
CAM	3	2	-	-	-	-	2	1	1

Syllabus

Unit 1

Introduction to Operating Systems: Mainframe systems-Desktop systems-Multiprocessor systems-Distributed systems-Clustered systems-Real-time systems-Handheld systems.
Operating System Structures: System components-Operating System services-System calls-System Programs-System Structures-System Design and Implementation-System Generation.

Unit 2

Process Management: Process Concept-Process Scheduling-Operations on processes-Cooperating processes-Inter Process Communication.
CPU Scheduling: Basic concepts-Scheduling criteria-Scheduling Algorithms-First Come First served Scheduling, Shortest job First Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling.
Process synchronisation: Background, critical section problem, semaphores, monitors, producer consumer

problem, dining philosophers problem, readers and writers problem.

Unit 3

Deadlocks: System Model-Deadlock Characterization-Methods for handling Deadlocks-Deadlock Prevention-Deadlock Avoidance-Deadlock detection-Recovery from deadlock.

Unit 4

Memory Management: Background-Swapping-Contiguous Memory allocation-Paging-Segmentation-Segmentation with Paging. Virtual Memory: Background-Demand paging-Process creation-Page replacement-Allocation of Frames-Thrashing.

Unit 5

I/O Systems: Overview, I/O Hardware, Mass storage structure- Disk structure, disk scheduling, disk management.

Textbooks / References:

1. Abraham SilberSchartz- peter B Galvin-Greg Gagne, Operating system Concepts. Eighth Edition, Addison-Wesley(2003).
2. S.Godbole - Operating Systems - Tata McGraw Hill Publications.
3. H.M Deitel - Operating Systems - Second Edition - Pearson Edition Asia.

21CSA204	PRINCIPLES OF MANAGEMENT AND ACCOUNTING	L-T-P-C: 3-0-0-3

Course Objectives

- The objective of this course to enable the students to have a basic knowledge of principles of management and to provide theoretical and practical aspects of various systems of accounting.

Course Outcomes

COs	Description
CO1	Observe and evaluate the influence of historical forces on the current practice of management.
CO2	Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment.
CO3	Practice the process of management's four functions: planning, organizing, leading, and controlling.
CO4	Identify and properly use vocabularies within the field of management to articulate one's own position on a specific management issue and communicate effectively with varied audiences.
CO5	Evaluate leadership styles to anticipate the consequences of each

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	-	-	-	2	2	2	-	-	-
CO2	-	-	-	2	2	2	-	-	-
CO3	-	-	-	2	2	2	-	-	-
CO4	-	-	-	2	2	2	-	-	-
CO5	-	-	-	2	3	3	-	-	-
CAM	-	-	-	2	2	2	-	-	-

Syllabus

Unit 1
Management: meaning and definition, importance of management, administration and management, functional management, functions of management, levels of management

Unit 2
Financial Accounting: Meaning and important terms, accounting concepts, double entry book keeping, types of accounts, journal, ledger, trial balance.

Unit 3
Final Accounts: Preparation of Trading and Profit and Loss Accounts and Balance Sheet, adjustments relating to outstanding expenses, prepaid expenses, accrued income unearned income, depreciation and bad and doubtful debts.

Unit 4
Financial Statement Analysis, Trend Analysis

Unit 5
Cost Accounting: Meaning and Definition, difference between cost accounting and financial accounting, Elements of cost, Cost sheet, Expenses excluded from cost.

Textbooks / References:

1. DinkarPagare – Principles of Management, Sultan Chand and Sons.
2. Vineeth, Shabu – Principles of Management and Accounting, Kalyani Publishers.
3. S.P. Jain, K.L. Narang – Financial Accounting, Kalyani Publishers.
4. S.P. Jain, K.L. Narang – Cost Accounting, Kalyani Publishers.

21CSA282	DATA STRUCTURES AND ALGORITHMS LAB	L-T-P-C: 0-0-1-1

Course Objectives

- This course aims to teach implementation of different linear and non-linear data structures and its usage in development of applications.

Course Outcomes

COs	Description
CO1	Implement different data structures like Stack, Queue, Linked List and their applications.
CO2	Implement different searching and sorting algorithms and select an efficient one for a particular scenario.
CO3	Implement various non-linear data structures.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	3	3	1
CO2	3	3	2	1	-	-	3	3	1
CO3	3	3	2	1	-	-	3	3	1
CAM	3	3	2	1	-	-	3	3	1

Syllabus

Unit 1

Searching – Linear, Binary Search searches
Sorting – Bubble, Insertion, Quick, Merge sort

Unit 2

Stack – Implementation, Applications – Infix to postfix, Evaluation of postfix expression, Check Balance of parenthesised expression etc.
Queues, Linked-Lists – Implementation and applications

Unit 3

Binary Trees - Implementation, Operations.

Unit 4

Graphs – Implementation of graph, BFS, DFS searches

21CSA283	OBJECT ORIENTED PROGRAMMING LAB USING JAVA	L-T-P-C: 0-0-1-1

Course Objectives

- The main objective of this course is to understand the basic concepts and techniques which form the object-oriented programming paradigm using Java Language.

Course Outcomes

COs	Description
CO1	Identify classes, objects, members of a class and relationships among them needed for a specific problem.
CO2	Write Java application programs using OOP principles and proper program structuring.
CO3	Demonstrate the concepts of polymorphism, inheritance and thread and document a Java Program using Javadoc.
CO4	Use Java AWT and Swing classes to build GUIs and understand how collection interface is implemented.
CO5	Demonstrate the Conceptual model of UML, activity diagram and their modelling techniques.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	1	-
CO2	3	3	3	-	-	-	2	3	-
CO3	3	2	2	-	-	-	2	2	-
CO4	3	3	1	-	-	-	1	2	1
CO5	3	3	3	1	1	1	1	2	1
CAM	3	3	3	1	1	1	2	2	1

Syllabus

UML

a. Class Diagram
b. Object Diagram
c. Sequence Diagram

Java

a. Designing classes and demonstrating object oriented concepts
b. Method Overloading and Method Overriding
c. Inheritance
d. Package
e. Multithreading
f. File handling with Java
g. Iterators and Collections- - Case study mode
h. UI Integration of Java concepts with Swing- Case study mode

List of Online tools

1. UML Concepts - ArgoUML
2. Object Oriented Concepts - HPoJ Tool

a. Designing classes and demonstrating object oriented concepts --> Supported by HPOJ
b. Method Overloading and Method Overriding --> Supported by HPOJ
c. Inheritance --> Supported by HPOJ
d. Multithreading --> Supported by HPOJ
e. Iterators and Collections --> Supported by HPOJ

Using Eclipse IDE.

a. Package
b. File Handling with java
c. UI Integration of Java concepts with Swing.

SEMESTER IV

21AVP211	AMRITA VALUES PROGRAMME II	L-T-P-C: 1-0-0-1

Course Objectives

Course Outcomes

COs	Description
CO1	
CO2	
CO3	
CO4	
CO5	

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1									
CO2									
CO3									
CO4									
CO5									
CAM									

Syllabus

Textbooks / References:

21SSK211	LIFE SKILLS II	L-T-P-C: 1-0-2-2

Course Objectives

Course Outcomes

COs	Description
CO1	
CO2	
CO3	
CO4	
CO5	

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1									
CO2									
CO3									
CO4									
CO5									
CAM									

Syllabus

Textbooks / References:

21CSA212	COMPUTER NETWORKS	L-T-P-C: 3-1-0-4

Course Objectives

- This course presents an in-depth discussion of the most important networking protocols comprising the TCP/IP protocol suite.
- Students will be able to understand state of the art in network protocols, architectures, and applications.

Course Outcome

COs	Description
CO1	Understand the concepts of Data Communication.
CO2	Learn the functions of OSI Layers.
CO3	Familiarise with the Transmission Media, Flow Control and Error Detection & Correction.
CO4	Understand fundamental concepts in Routing, Addressing & working of Transport Protocols.
CO5	Gain familiarity with common networking & Application Protocols.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	2	-	1	-	-	-	-	-	-
CO4	2	-	2	-	-	-	1	1	-
CO5	2	1	1	-	-	-	1	1	-
CAM	2	1	1	-	-	-	1	1	-

Syllabus

Unit 1

Evolution of Computer Networking - Types of Network - networks topologies - Protocols standards-Network Devices-The OSI reference model- TCP/IP Reference Model.
Physical Layer: transmission media- Analog Transmission- Digital transmission

Unit 2

Data Link Layer Design Issues-Services provided to the Network Layer-Framing-Error Control-Flow Control- Error Detection and Correction- Elementary Data Link Protocols- Sliding Window Protocols- Multiple Access Protocols-An overview of IEEE Standard for LANs, MAC Address.

Unit 3

Introduction to Network Layer – Services - Circuit Switching Vs Packet Switching-Packet Switched Networks-Types of Routing-routing algorithms- congestion control algorithms- Network Protocols-IP- IPV4, IPV6, Subnets, Gateways- Congestion Avoidance in Network Layer.

Unit 4

The Transport Services – Services provided to the upper layers –Elements of transport Protocols –Internet Transport Protocols- Congestion Controls in Transport Layer

Unit 5

Principles of Network Applications-Web and HTTP-Electronic mail-DNS

Textbooks / References:

1. Computer Networks (Fifth Edition) – Andrew S. Tanenbaum (Prentice Hall of India)
2. Computer Networking a Top-Down Approach (Fifth Edition)-James F. Kurose-Keith W. Ross (Pearson)
3. Computer Networks - Protocols, Standards and Interfaces (Second Edition) – Uyless Black (Prentice Hall of India Pvt. Ltd.)
4. Data communication and Networking (Fourth Edition)- Behrouz A Forouzan(Tata Mcgraw Hill)

21CSA213	ADVANCED JAVA AND J2EE	L-T-P-C: 3-1-0-4

Course Objectives

- The main Objective of the course is to enable students to understand the concepts underlying technologies in JAVA Enterprise edition with Swings and multithreading, configuring Apache tomcat server, Java beans and Enterprise Java Beans.

Course Outcome

COs	Description
CO1	Design and develop client-server applications using sockets in Java.
CO2	Develop applications in Java using swings and JDBC.
CO3	Understand the usage of generic classes and collections and write application using the same in Java.
CO4	Understand server-side programming and configure a web server to deploy servlets and JSP programs.
CO5	Create a moderately complex application with MVC architecture.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	3	3	1
CO2	3	2	3	-	-	-	3	3	2
CO3	2	3	3	-	-	-	2	2	1
CO4	2	3	3	-	-	-	2	3	2
CO5	2	2	3	2	1	2	2	2	3
CAM	2	2	3	2	1	2	2	3	2

Syllabus

Unit 1

Networking: Classes to be covered Socket, ServerSocket, IPAddress, URL connections – Swing controls – JDBC - Writing JDBC applications using select, insert, delete, update.

Unit 2

SERVLETS: Introduction to Servlets (Life cycle of servlets, Java Servlets Development Kit, creating, Compiling and running servlet). The servlet API: javax. servlet package. Reading the servlet Parameters, Reading Initialization parameter. The javax.servlet.http.

Unit 3

JAVA SERVER PAGES: Configuring Tomcat JSP/Servlet server. Brief Introduction to J2EE Architecture. Advantage of JSP technology. JSP Architecture, JSP Access Model. JSP Syntax Basic (Directions, Declarations, Expression, Scriplets, Comments) JSP Implicit Object (Out, HttpServlet Request, Http Servlet Respose, Exception Handling, Session Management.

Unit 4

Package Handling HTTP Request and Response (GET/ POST Request), Using Cookies, Session Tracking. Exception Handling.

Unit 5

Introduction to EJB – Understanding MVC – Building Controllers, models and views – Integrating hibernate with spring.

Textbooks / References:

1. Deitel&Deitel, "Java How to program", Prentice Hall, 2017.
2. Gary Cornell and Cay S. Horstmann, "Core Java Vol 1 and Vol 2", Sun Microsystems Press, Eleventh Edition, 2018.
3. Java EE 8 Development with Eclipse: Develop, Test, and Troubleshoot Java Enterprise Applications Rapidly with Eclipse, 3rd Edition

21CSA214	WEB TECHNOLOGIES	L-T-P-C: 3-1-0-4

Course Objectives

- This course will enable students to understand the concepts and techniques underlying website creation with HTML, CSS and client scripting with JavaScript. It will also equip students with latest web development applications Angular JS, Server scripting with PHP and XML.

Course Outcomes

COs	Description
CO1	Understand basics of web technologies.
CO2	Create interactive web applications using latest web technologies.
CO3	Publish and maintain interactive web applications.
CO4	Use XML standards and tools towards smart web applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	2	3	2
CO2	3	3	3	-	-	-	3	3	3
CO3	2	3	3	1	1	2	3	3	3
CO4	3	2	3	-	-	-	2	2	2
CAM	3	3	3	1	1	3	3	3	3

Syllabus

Unit 1

HTML5 and CSS3
HTML5- Basic Tags, Tables,Forms.HTML5 Tags,HTML Graphics, HTML media, HTML Graphics,HTML APIs.
CSS - Background, Borders,margin, Box model. Styling text, fonts, list, links, tables. CSS overflow, float, inline blocks, pseudoclasses, pseudoelements. CSS border images, rounded corners.

Unit 2

Java Script
Client side scripting using java script, Introduction to java script, internal and external Java script files, variables, control statements, loops, Arrays , string handling , How to write functions in JavaScript, inputting and outputting from form elements to JavaScript. DOM concept, creating html elements using java script. Drawing 2D shapes, handling events. Introduction to AJAX

Unit 3

Building Single page applications with Angular JS
Single page application – introduction , two way data binding, MVC in angular JS, controllers, getting user inputs , loops , Client side routing – accessing URL data , various ways to provide data in angular JS.

Unit 4

Server Side Programming

Server side scripting, Difference between client side and server side scripting languages. Introduction to PHP, variables, control statements, loops, Arrays, string handling, PHP forms, Global variables in PHP, Regular expression and pattern matching, Database programming: inputting and outputting data from MySQL using PHP, insertion , deletion and updating data.
State management in web applications, cookies, Application and session state.

Unit 5

Introduction to Xml, usage of XML, XML tags, elements and attributes, attribute type, XML validation: DTD and XSD, XML DOM

Case Study: Web Application Framework- Flask- Flask and SQLite- Bootstrap

Textbooks / References:

1. The Complete Reference, HTML and CSS by Thomas A Powell latest edition
2. XML: The Complete Reference Heather Williamson latest edition
3. Web Reference:- w3schools.com

21CSA215	SOFTWARE ENGINEERING	L-T-P-C: 3-0-1-4

Course Objectives

- The course provides a professionally guided education in software engineering that helps students to transition into an amateur software engineer by exposing themselves to a broad perspective on software systems engineering, concentrating on widely used techniques for developing large-scale software systems.
- This course covers a wide spectrum of software processes from initial requirements elicitation through design and development to system evolution.

Course Outcomes

COs	Description
CO1	Recognize and apply the principles of software engineering techniques.
CO2	Understand various software process models.
CO3	Apply the right software design methodology for a given scenario.
CO4	Evaluate a system developed for real-world applications.
CO5	Identify and implement various industry standards in software development and maintenance.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	2
CO3	2	3	3	2	1	2	2	-	2
CO4	2	2	1	1	1	2	3	3	3
CO5	1	3	3	2	3	3	-	-	3
CAM	2	3	3	2	1	2	3	3	2

Syllabus

Unit 1

Introduction to Software Engineering: Software Crisis-Changing Nature of Software- Software Myths -Process and Product - A Generic View of Process - Software engineering-A layered technology, a Process framework - Software characteristics- SDLC Introduction – Quality Attributes

Unit 2

Introduction to Software Paradigms - Approaches – Process Models – The Waterfall model, Incremental Process models, Evolutionary Process Models, Specialized Process Models, The Unified Process. – Agile Introduction - - Feasibility Studies - Software Requirements: Functional and non-Functional Requirements, User Requirements, System Requirements, Interface Specification, the Software Requirement Document.

Unit 3

Analysis Modeling - Elements of Analysis Model - System Models: Context Models, Behavioural Models, Data models, Object Models, Structured Method -. Design Engineering: Introduction to Design concepts - Design characteristics - Design Process and Design Quality-Creating an Architectural Design: Software architecture, Data Design - Architectural Styles and Patterns,

Unit 4

Test Engineering - Testing Fundamentals - Objectives - Principles – Testing Strategies: A strategic approach to software testing, Test Strategies for Conventional Software, Black-Box and White-Box testing, Validation testing, System testing, the Art of Debugging - ITG - Software Quality Metrics

Unit 5

Maintenance Engineering – Change Management – Maintenance Side effects - Reverse Engineering and Reengineering

Textbooks / References:

1. Roger S. Pressman, “Software Engineering”, Tata McGraw-Hill Publishing Company Pvt. Ltd, Sixth Edition.
2. Rajib Mall, Fundamentals of Software Engineering, Prentice Hall India.
3. Shooman, “Software Engineering”, Tata McGraw-Hill Publishing Company, Pvt. Ltd, 1987
4. Pankaj Jalote,, An integrated approach to Software Engineering, Springer/Narosa.
5. Ian Sommerville, Software Engineering, Seventh edition, Pearson education.
6. Waman S Jawadekar, Software Engineering: A primer, Tata McGraw-Hill, 2008. 5. Stephan Schach, Software Engineering, Tata McGraw Hill

21CSA285	ADVANCED JAVA AND J2EE LAB	L-T-P-C: 0-0-1-1

Course Objectives

- The main objective of the course is to enable students to implement the concepts underlying technologies in JAVA Enterprise edition with Swings and multithreading, configuring Apache Tomcat server, Java beans and Enterprise Java Beans.

Course Outcomes

COs	Description
CO1	Design and develop client-server applications using sockets in Java.
CO2	Develop applications in Java using swings and JDBC.
CO3	Implement the usage of generic classes and collections and write application using the same in Java.
CO4	Create server-side programming and configure a web server to deploy servlets and JSP programs.
CO5	Develop enterprise applications using Java EE.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	3	3	1
CO2	3	2	3	1	-	-	3	3	2
CO3	2	3	3	1	-	-	2	2	1
CO4	2	3	3	1	-	2	2	3	2
CO5	2	2	3	2	1	3	2	2	2
CAM	2	2	3	1	1	3	2	3	2

Syllabus

1. Program to demonstrate Swing components.
2. Program to implement Address Book using Swing components.
3. Program to demonstrate loading of file in an Swing Component.
4. Multithreading program, one of the threads print a….z and other thread print 1…26.Example: 1a2b3c…. 26z.
5. Multithreading program to schedule two jobs.
6. Client Server Socket Programming.
7. Server Socket which receives data from a java client program using JSON
8. Program to fetch a particular Website tags when an URL is specified.
9. Implement stack, queue, hashmap, hashtable, enumeration, ArrayList.
10. Create a table from a java program.
11. Update a table from a java program.
12. Load a table data in Swing components.
13. Delete a record from a table, drop table from a java file.
14. Program which shows use of Statement, Prepared Statement and Callable Statement.
15. Configure Apache Tomcat and write a hello world jsp page.
16. Configure Apache Tomcat server to deploy Servlets.
17. Exceptional handling in a JSP page.
18. Create a login page and authenticate a user in a JSP page using database.
19. Write a program to implement a simple servlet which writes a Welcome HTML page in the web browser.
20. A servlet should receive a parameter from JSP page and process it.

21. Servlet program to implement parameter handling.
22. Servlet program to handle GET and POST request.
23. A website hit counter data which has to be saved in a cookie.
24. Implement a Java Beans to set and get values.
25. Program to illustrate the procedure of handling session and print a Hello world using Java Bean.
26. Enterprise Session Beans, deploy, and run a simple Java EE application which does add, subtract, multiply and division using stateless session bean.
27. An application named account using stateful session bean. The purpose of account is to perform transaction operations (deposit and withdraw) for the customer.
28. The account application consists of an enterprise bean, which performs the transactions, and two types of clients: an application client and a web client.

21CSA286	WEB TECHNOLOGIES LAB	L-T-P-C: 0-0-1-1

Course Objectives

- This course will enable students to implement the concepts and techniques underlying website creation with HTML, CSS and client scripting with JavaScript. It will also equip students with latest web development applications Angular JS, Server scripting with PHP and XML.

Course Outcomes

COs	Description
CO1	Develop basics of web technologies using HTML and CSS.
CO2	Create interactive web applications using latest web technologies.
CO3	Develop and maintain interactive web applications.
CO4	Use XML standards and tools towards smart web applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	2	3	2
CO2	3	3	3	-	-	-	3	3	3
CO3	2	3	3	1	1	3	3	3	3
CO4	3	2	3	-	-	-	2	2	2
CAM	3	3	3	1	1	3	3	3	3

Syllabus

1. Create a web page with advanced layouts and positioning with CSS and HTML.
2. Design a website with different methods of embedding CSS in a web page.
3. Create a static web page which displays your personal details. (Hint: CSS3 and HTML5)
4. Create a web page through which the user can enter his / her details to become an authenticated user of that page.
5. Create a web site for a Computer Hardware shop. (Hint: CSS3 and HTML5).
6. Create a web site for Amrita School of Arts and Sciences. (Hint: CSS3 and HTML5).
7. Create a web page that shows different methods of embedding JavaScript.
8. Create a web page with rollover menus. Rollover menus should be created using JavaScript.
9. Create a simple calculator, which can perform the basic arithmetic operations.
10. Validate the registration for with the following criteria:
    a. Name and Age should be Mandatory Fields.
    b. Password and Re-enter Password fields should contain same value.
    c. Name field should accept only character values.
11. Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page.
12. Write a PHP program to store page views count in SESSION, to increment the count on each refresh, and to show the count on web page.
13. Using PHP and MySQL, develop a program to accept book information viz. Accession number, title, authors, edition and publisher from a web page and store the information in a database and to search for a book with the title specified by the user and to display the search results with proper headings.
14. Create a registration form using Angular JS.
15. Create a simple AngularJS calculator application using Angular Services.
16. Create an application Searching for a character and displaying its position using AngularJS.
17. Create an application using angular JS filters.

18. Create single page web applications using the MVC pattern of AngularJS.
19. Design an XML document to store information about a student in an engineering college affiliated to Amrita. The information must include USN, Name, Name of the College, Branch, Year of Joining, and e-mail id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.
20. Create an XML document with the following sample real estate data
    a. Ensure its validity
    b. Then try to break it
21. Create an internal DTD for the previous XML document.
22. Move the previous DTD to an external file and validate the XML document again.
23. Create an application that loads a text string into an XML DOM object, and extracts the info from it with JavaScript.
24. Create an application which reads data from an XML file into XMLDOM object and retrieves the text value of the first element in the xml file.

SEMESTER V

21SSK301	LIFE SKILLS III	L-T-P-C: 1-0-2-2

Course Objectives

Course Outcomes

COs	Description
CO1	
CO2	
CO3	
CO4	

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1									
CO2									
CO3									
CO4									
CAM									

Syllabus

Textbooks / References:

21CSA301	DATA WAREHOUSING AND DATA MINING	L-T-P-C: 3-1-0-4

Course Objectives

- This course will introduce the concepts of data warehouse and data mining, which gives a complete description about the principles, usage, architectures, applications, design and implementation of data mining and data warehousing concepts.

Course Outcomes

Cos	Description
CO1	Understand, describe and visualize the different types of data so as to apply data mining techniques.
CO2	Understand the concepts of a data warehouse and its operations.
CO3	Apply the frequent pattern mining algorithms for extracting associations from transaction data.
CO4	Develop skill in selecting the appropriate classification algorithm for solving practical problems.
CO5	Understand the concepts, methods and applications of cluster analysis.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	2
CO2	3	-	2	-	-	-	1	-	-
CO3	3	2	2	-	-	-	1	1	1
CO4	3	2	2	-	-	-	1	1	1
CO5	3	2	2	-	-	-	1	1	1
CAM	3	2	2	-	-	-	1	1	1

Syllabus

Unit 1

Introduction to Data Mining concepts – Different types of data for mining: database data, transaction data and other kinds of data- Different types of Patterns for mining techniques- Major issues in Data mining- Data objects and attributes types- Statistical description of data- Data visualization technique.

Unit 2

Introduction to Data warehousing concepts- Data warehouse basic concepts- Data warehouse Modeling- Data warehouse design and usage - Data warehouse implementation. Data generalization by attribute-oriented induction.

Unit 3

Frequent Patterns mining basic concepts- Apriori algorithm- Generating Association Rules from Frequent Itemsets - Improving the Efficiency of Apriori.

Unit 4

Classification basic concepts and general approaches- Decision tree induction – Bayes classification methods – Rule Based classification.

Unit 5

Clustering analysis basic concepts- Overview of clustering – major clustering method - partitioning methods: K-means & k-medoids.

Textbooks / References:

1. Jaiwei Han, Micheline Kamber and Jian Pei, ”Data mining concepts and techniques “, Third edition, Elsevier publisher , 2006
2. K P Soman, Shyam Diwakar and V. Ajay.” Insight into data mining theory and practice”, Prentice hall of India , 2006.
3. Yanchang Zhao, “R and Data Mining”, Elsevier, 2013

21CSA302	PYTHON PROGRAMMING	L-T-P-C: 3-0-0-3

Course Objectives

- The main objective of this course is to familiarize the student with Python programming concepts, syntax, semantics, and the runtime environment, as well as with general coding techniques and object oriented programming.

Course Outcomes

COs	Description
CO1	Understand the structure, syntax, and semantics of the Python language.
CO2	Solve realworld problems by applying the Python Data Structures, Objects, Functions and Modules.
CO3	Apply the fundamental principles of ObjectOriented Programming.
CO4	Apply the basics of data science using advanced Python libraries.
CO5	Build practical applications in Python.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	1	2	-
CO2	2	3	3	-	-	-	3	3	1
CO3	3	1	-	-	-	-	-	2	-
CO4	3	2	3	-	-	-	3	3	1
CO5	2	3	3	-	-	-	3	3	1
CAM	3	2	3	-	-	-	3	3	1

Syllabus

Unit 1

Basic concepts in Python: Python runtime environment, Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types and functions. Conditional statements and loop statements in Python.

Unit 2

Python Complex data types: Strings and string functions, List and Tuple manipulation, Dictionary and Set operations.

Unit 3

Functions and modules in Python: defining functions, scope, types of arguments, the anonymous function(lambda), map, filter, reduce and zip functions. Introduction to Python modules and creating own modules.

Unit 4

Exception handling in Python. Python File Operations: Reading files, Writing files in python. Python directories.

Object oriented programming in Python: Defining classes and instantiating objects. Python Constructors and

destructors. Inheritance and polymorphism in Python.

Unit 5

Fundamentals for data science: Introduction to Jupyter notebook, Programming using Numpy, Pandas and matplotlib libraries.

Textbooks / References:

1. Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016
2. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley, 2015
3. Jeeva Jose & P. Sojan Lal, “Introduction to Computing and Problem Solving with PYTHON”, Khanna Publishers, New Delhi, 2016.
4. Downey, A. et al., "How to think like a Computer Scientist: Learning with Python", John Wiley, 2015.
5. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, 2nd edition, O’Reilly Publication, ISBN-13: 978-1491957660, ISBN-10: 1491957662
6. Mark Lutz, “Learning Python”, 5th edition, O’Reilly Publication, 2013, ISBN 978- 1449355739
7. John Zelle, “Python Programming: An Introduction to Computer Science”, Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 1590282410
8. Michel Dawson, “Python Programming for Absolute Beginners”, Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009
9. David Beazley, Brian Jones., “Python Cookbook”, Third Edition, O’Reilly Publication, 2013, ISBN 978-1449340377

21CSA303	MOBILE APPLICATION DEVELOPMENT	L-T-P-C: 0-1-1-2

Course Objectives

- This course is designed to quickly get a student up to speed with writing apps for Android devices. The student will learn the basics of Android platform and get to understand the application lifecycle.

Course Outcomes

COs	Description
CO1	Understand the different API levels and working of Dalvik Virtual Machine.
CO2	Understand the different views, layouts and resource files.
CO3	Understand different UI components.
CO4	Understand Android Notifications and Services.
CO5	Develop SQLite applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	1	1	-
CO2	2	2	2	-	1	1	1	2	-
CO3	2	3	2	-	1	1	2	3	1
CO4	2	3	2	1	1	1	2	3	1
CO5	2	2	3	1	1	1	2	2	2
CAM	2	3	2	1	1	1	2	2	1

Syllabus

Introduction: About Android, Pre-requisites to learn Android, Dalvik Virtual Machine & .apk file extension, Android API levels (versions & version names)
Android Java Basics: Getting started with Android development, project folder structure, simple programming, running project, generating build/APK of the app from Android Studio
First application: Creating Android Project, Android Virtual Device Creation, Set up debugging environment, Workspace set up for development, Launching emulator, debugging on mobile devices.
Basic UI design: Basics about Views, Layouts, Drawable Resources, Input controls, Input Events, Toasts.
More UI Components: Layouts - GridView and ListView, Action bar, Adapters, Menus: Option menu, context menu, sub menu, Pickers - Date and Time, Spinners.
Activity and Fragment: Activity, Fragment, Activity Lifecycle and Fragment Lifecycle.
Intents: Implicit Intents, Explicit intents, communicating data among Activities.
Navigation Drawer: Panel that displays the app's main navigation screens on the left edge of the screen
Android Notifications – Toast, Dialogs (TimePicker, DatePicker, Progress, Alert), Notification Manager and Push Notification
Introducing SQLite - SQLiteOpenHelper and creating a database - Opening and closing a database, Working with cursors Inserts, updates, and deletes
As a term project students should implement a mobile app with the following: Understand the app idea and design user interface/wireframes of mobile app. Set up the mobile app development environment

Textbooks / References:

1. Head first Android Development.
2. Android Programming: Pushing the Limits, Wiley By Erik Hellman

3. Android Application Development Black Book, Dreamtech Press, Pradeep Kothari, KLSI

Course Objectives

- This course provides the basics of programming using Python programming language.

Course Outcomes

COs	Description
CO1	Design programs to solve problems using the Python language constructs.
CO2	Develop real-time applications using advanced Python libraries.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	3	3	-
CO2	2	3	3	-	-	-	3	3	1
CAM	2	3	3	-	-	-	3	3	1

Syllabus

Installing Python: basic syntax, interactive shell, editing, saving, and running a script.

Python variables, assignments, expressions, numerical data types and operators, writing comments in the program. Exercise on Control structures and loops in Python: if-else, for, while.

Lists, tuples, set and dictionaries: basic list operators, replacing, inserting, removing an element; searching and sorting lists; tuple creation and manipulation, creating sets and set operations, dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

Designing functions with various types of arguments. Exercise on the usage of lambda, map, filter, zip.
Working with text files: Programs for manipulating files and directories, os and sys modules; Reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

Developing Python programs to implement inheritance and overloading and overriding.

Introduction to Jupyter notebook and IPython. Developing programs using Numpy, Panda and Matplotlib libraries in Jupyter notebook.

21CSA391	COMPREHENSIVE TECHNICAL VIVA VOCE	L-T-P-C: 0-2-0-2

Course Objectives

- The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of computer science acquired over 3 years of study in the undergraduate program.
- To assess the student's technical and analytical skills in the domain of computer science and also communication skills.

Course Outcomes

Cos	Description
CO1	Prepare comprehensively to answer questions from all the courses of five semesters.
CO2	Attain Oral Presentation skills by answering questions in precise and concise manner.
CO3	Gain confidence and interpersonal skills.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	-	-	-	-
CO2	2	1	-	-	2	-	-	-	-
CO3	2	-	-	-	2	1	-	-	-
CAM	2	1	-	-	2	1	-	-	-

Syllabus

The viva may be done based on every course covered till the fifth semester. The objective of this is to enable the students to attend placements and be better performers in their future.

Semester 1: Programming concepts, Syntax, IDE, Logic and programming constructs, Compiler and interpreter problem solving- Logic and algorithms and other topics, C language, COA- Arrays, structure, enum and functions, pointers and other topics

Semester 2: Oops and C++, Object, class, inheritance, polymorphism and abstraction and message passing and other topics, Data structures - Sorting and searching, Tree, list, graph and other topics, OS- Types, Kernel, shell, features. OS core. Linux vs windows, DBMS-DDL, DML and DCL, Normalization, Relationships, Dependancy.

Semester 3: Java, OOPS concepts in java. JDK, JVM, JRE, wrapper classes and other topics, Networking: protocols, layers-model, Devices, Web technologies: HTML, XML, Javascript and other topics

Semester 4: Advanced Java and J2ee- Collections framework, JDBC, Servelets API,JSP and other topics, Software engineering- Software Process, project management, SDLC phases and other topics

Semester 5: C# and .Net- C# fundamentals and core and other topics. Network security/cryptography and cyber security

21CSA398	MINOR PROJECT	4 Credits

Course Objectives

- The main objective of the Project is for the students to learn and experience all the major phases and processes involved in solving real life problems.

Course Outcomes

The major outcome of the minor project must be well-trained students. More specifically students must have acquired the following skills:

COs	Description
CO1	Able to practice acquired knowledge within the chosen area of technology for project development.
CO2	Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO3	Reproduce, improve, and refine technical aspects for the projects.
CO4	Work as an individual or in a team in development of technical projects.
CO5	Communicate and report effectively project related activities and findings.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	1	3	3	3
CO2	1	2	2	-	3	3	2	1	-
CO3	2	2	3	-	-	1	3	3	1
CO4	1	2	2	2	3	3	2	1	1
CO5	-	-	-	3	3	3	-	1	-
CAM	2	2	2	3	3	3	3	1	1

21CSA311	C# AND .NET FRAMEWORK	SEMESTER V	L-T-P-C: 0-1-1-2

Course Objectives

- To gain a thorough understanding of the philosophy and architecture of .NET and acquire a working knowledge about the .NET programming model along with database connectivity to develop application programs.

Course Outcomes

COs	Description
CO1	Learn to use .NET frame work and basic programming concepts in C#
CO2	Students will be able to develop programs to solve real world problems using OOPS concepts in C#
CO3	Understand the Window Programming and event driven programming
CO4	Learn to use ADO.net to store and retrieve data from database

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	3	2	2
CO2	3	3	3	-	-	-	3	3	2
CO3	3	3	3	-	-	1	3	3	2
CO4	3	3	3	-	-	1	3	3	2
CAM	3	3	3	-	-	1	3	3	2

Syllabus

Unit 1

.Net Framework Overview- Architecture-.Net Framework class Libraries-CLR-Metadata-Interoperability-Assemblies-the .net Packaging system-CLR-MSIL , Introduction to Visual Studio.Net-C# Programming Concepts-Predefined Types- Value types and reference type, Classes and Objects, Constructors and methods , Conditional statements, loops, arrays , indexers and properties.

Unit 2

String class: methods and properties of string class, enumerations, boxing and unboxing, OOPS concepts: Encapsulation, data hiding, inheritance, interfaces, polymorphism, operator overloading, overriding Methods, Static Class members, Delegates and events. Exception Handling.

Unit 3

Basics of Windows Programming- Event Driven Programming, Windows Forms, Using common controls-Labels, textboxes, buttons, check boxes, radio button, progress bar, combo box, list box. Components-timer, imagelist, Menus, MDI, Mouse and keyboard event handling.

Unit 4

Introduction to ADO.Net-Object Model- System. Data Namespace- Data Bound controls- Connected Mechanism-Disconnected mechanism-.Net Data Providers.

Textbooks / References:

1. C# 4.0 the Complete Reference by Herbert Schildt
2. C# by Balaguruswamy
3. Latest version of Andrew Trolsens C# text from Apress (Pro C# 5.0 and the .NET Framework 4.5)
4. Robert Powel, Richard Weeks, C# and the .NET Framework, Techmedia

21CSA312	CRYPTOGRAPHY AND CYBER SECURITY	L-T-P-C: 4-0-0-4

Course Objectives

- The objective of this course is to teach the concepts of securing computer network protocols, based on the application of cryptography techniques.

Course Outcomes

COs	Description
CO1	Provide security of the data over the network.
CO2	Do research in the emerging areas of cryptography and network security.
CO3	Implement various networking protocols.
CO4	Protect any network from the threats in the world.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	1	1	-
CO2	1	2	3	-	-	2	2	3	3
CO3	-	-	3	-	3	2	1	2	-
CO4	-	-	3	2	3	3	2	2	1
CAM	2	2	3	2	3	2	2	2	2

Syllabus

Unit 1

Introduction to Cyber Security - Types of Attacks(Active/passive), Goals for Security, Security threat and vulnerability, Cyber security models (the CIA triad, the star model). Malicious Software: Viruses, Worms, Information Theft, Key loggers, Phishing, Spyware Payload Stealthing, Backdoors, Rootkits, Distributed Denial of Service Attacks.

Unit 2

Classical encryption techniques substitution ciphers and transposition ciphers, cryptanalysis, steganography, Stream and block ciphers - Modern Block Ciphers: Block ciphers principles, Shannon's theory of confusion and diffusion. Data encryption standard (DES), Strength of DES, Differential and Linear cryptanalysis, Block cipher modes of operations.

Unit 3

Public key concepts, Principles of public key crypto systems, RSA algorithm, security of RSA. Key Management and distribution. Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution.

Unit 4

Message Authentication Codes: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions, Case study on attacks. Digital Signatures. Elgamal Digital Signature Techniques, Digital signature standards (DSS).

Unit 5

Introduction to SSL. Introduction to SSL and TLS.Introduction to Cyber Crime and security: Cyber Crimes, types of Cyber Crime, hacking, attack vectors, Cross Site Scripting (XSS), XSS Consequences. Cyber Space and criminal behavior, traditional problems associated with Cyber Crime, Introduction to Incident Response, Digital Forensics.

Textbooks / References:

1. William Stallings-Cryptography and Network security PHI 3rd edition 2003.
2. Dr.T.RPadmanabhan N Harini “Cryptography and Security paper back”, Wiley India.
3. Behrouz A. Forouzan, “Cryptography and Network Security”, Tata McGraw-Hill Publishing.
4. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education.
5. Manuel Mogollon, “Cryptography and Security Services – Mechanisms and Applications”, Cybertech Publishing.
6. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.

21CSA399	MAJOR PROJECT	8 Credits

Course Objectives

- To allow students to develop their own ideas and get experienced in industrial and research projects.
- It provides an opportunity in solving a real life problem by applying the knowledge gained through various courses of study and an exposure on different phases of software /system development life cycle**.**

Course Outcomes

The major outcome of the major project must be well-trained students. More specifically students must have acquired the following skills:

COs	Description
CO1	Able to practice acquired knowledge within the chosen area of technology for project development.
CO2	Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO3	Reproduce, improve, and refine technical aspects for the projects.
CO4	Work as an individual or in a team in development of technical projects.
CO5	Communicate and report effectively project related activities and findings.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	1	3	3	3
CO2	1	2	2	-	3	3	2	1	-
CO3	2	2	3	-	-	1	3	3	1
CO4	1	2	2	2	3	3	2	1	1
CO5	-	-	-	3	3	3	-	1	-
CAM	2	2	2	3	3	3	3	1	1

SEMESTER VII

21CSA501	DESIGN AND ANALYSIS OF ALGORITHMS	L-T-P-C: 3-1-0-4

Course Objectives

- The objective of the course is to analyse the asymptotic performance of algorithms with the use of different paradigms of problem-solving techniques and to illustrate clever and efficient ways of solving a given problem. In each case emphasis will be placed on rigorously proving correctness of the algorithm. In addition, the analysis of the algorithm will be used to show the efficiency of the algorithm over the naive techniques.

Course Outcomes

COs	Description
CO1	Analyze the asymptotic performance of algorithms.
CO2	Demonstrate major algorithms and data structures.
CO3	Apply important algorithmic design paradigms and methods of analysis.
CO4	Synthesize efficient algorithms in common engineering design situations.
CO5	Understand famous NP-complete problems

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	2	3	-	-
CO2	2	3	-	-	-	-	1	3	3	-
CO3	2	3	-	-	-	-	1	3	3	-
CO4	2	3	2	-	-	-	1	3	2	-
CO5	3	1	-	-	-	-	2	1	1	-
CAM	2	3	2	-	-	-	1	3	3	-

Syllabus

Introduction–Asymptotic Notations -Monotonicity vs. Nonmonotonicity – Example – Function Comparisons-Analysis of iterative programs, Analysis of recursive programs Recurrence Relation: Back Substitution Method - Recursion Tree Methods, Master Method.

Sorting: Bubble –Insertion Sort-Selection Sort. Divide and Conquer: Quick Sort- Merge Sort - Bucket Sort - Lower Bounds-Heap Sort – Comparisons of Sorting.

Introduction to KMP, BMP Searching, Greedy Algorithm: Fractional Knap-sack Problem-Task Scheduling Problem.

Dynamic Programming: Matrix Multiplication Problem-0/1 Knap-sack Problem.

Graph Algorithms: Graph Traversals (DFS, BFS with Analysis) -Shortest Path Algorithms (with Analysis) – Dijkstra -Bellman Ford-Floyd Warshall's all Pair shortest path Algorithm-Minimum spanning Tree (with Analysis) –Kruskal–Prims.

String Matching: Boyer Moore algorithm.

NP Problems: Definition: P-NP-NP Complete-NP Hard. Examples : P-NP.

Textbooks / References:

1. CormenT.H ,Leiserson C.E, Rivest R.L and Stein C, “Introduction to Algorithms”, Third Edition, Prentice Hall of India, 2009.
2. Baase.S and Gelder A.V., “Computer Algorithms-Introduction to Design andAnalysis”, Third edition, Pearson Education Asia, 2003.
3. Ellis Horowitz ,SartajSahni.S and Rajasekaran.S, “Fundamentals of ComputerAlgorithms”, Silicon Press, 2008.
4. Goodrich M.T and Tamassia.R, “Algorithm Design Foundations, Analysis, andInternet Examples”, Fourth Edition, John Wiley and Sons, 2002.
5. Dasgupta.S, Papadimitriou.C. andVazirani.U, “Algorithms”, Eighth edition, TataMcGraw-Hill, 2009.

21CSA585	RESEARCH LEARNING AND PROBLEM FORMULATION	L-T-P-C: 0-0-1-1

Course Objectives

- To inculcate research interest in students, help them to identify a research area and conduct literature review.

Course Outcomes

COs	Description
CO1	To develop the understanding of the basic framework of research process.
CO2	Identify various sources of information for literature review and data collection.
CO3	Gain a practical understanding of the various methodological tools used for conducting research.
CO4	Able to conduct a research study from its inception to its report and study on Ethical issues in research.
CO5	To formulate a problem based on a case study and design a proper research design with supporting literature survey.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	1	-	-	2
CO2	2	2	-	-	-	1	1	-	-	-
CO3	2	1	3	-	-	-	2	-	2	1
CO4	2	2	-	-	-	-	1	1	1	1
CO5	2	3	-	-	-	-	1	1	-	1
CAM	2	2	3	-	-	1	1	1	2	1

Syllabus

Research: Meaning, Purpose, Types of Research, Steps in Research, Identification, Selection and Formulation of Research Problem, Research Questions, Research Design, Review of Literature. Internet as a source in identifying gap areas from literature reviews and emerging trends. Research Report writing.

Ethical Issues, Copyright, Royalty, Intellectual Property Rights and Patent Law, Reproduction of Published Material, Citation and Acknowledgement.

Case study: conduct literature review on a chosen research topic, prepare a review report and present a seminar.

Textbooks / References:

1. CR Kothari: “Research Methodology-Methods and Techniques”, New Age International Publishers, 2004.
2. Jacques Barzun, Henry F. Graff: “The Modern Researcher” Edition 6, Wadsworth Inc Fulfillment, 2003.
3. Carlo Lastrucci, The Scientific Approach: Basic Principles of the Scientific Method (Cambridge, Mass.: Schenkman, 1967).
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age, 2016.

SEMESTER VIII

21MAT516 OPERATIONS RESEARCH AND OPTIMIZATION TECHNIQUES L-T-P-C: 3-1-0-4

Course Objectives

- This course aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

Course Outcomes

COs	Description
CO1	Understand the basic concepts of linear programming, duality and methods for solving linear programming problem.
CO2	Understand the mathematical formulation of transportation and assignment problems and solution methods.
CO3	Solve simple games using various techniques.
CO4	Solve nonlinear unconstrained optimization problems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	2
CO2	3	2	1	-	-	-	-	1	-	-
CO3	3	2	-	1	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	1	1	1
CAM	3	2	1	1	-	-	-	1	1	1

Syllabus

Unit 1

Linear Programming: Introduction - Mathematical Formulations - Solutions – GraphicalMethod - Simplex Method - Artificial Variables- Big M - Two Phase Methods - Variants in Simplex Method - Duality Theory and Problems.(T-1)

Unit 2

Transportation and its Variants: Definition - Transportation Algorithms and Solutions -Assignment Model - Hungarian Method, Simulation -Types of Simulations - Monte Carlo Simulation(T-1)

Unit 3

Game Theory: Competitive Games - Rectangular Game - Saddle point - Minmax (Maxmin)Method of Optimal Strategies - Value of the Game. Solution of Games with Saddle Points -Dominance Principle. Rectangular Games without Saddle Point – Mixed Strategy for 2 X 2Games.(T-1)

Unit 4

Single Variable Non-Linear Unconstrained Optimization
One dimensional Optimization methods, Uni-modal function, Region elimination methods - interval halving, Fibonacci search, Golden section search, Point estimation method - successive quadratic search, Gradient based

methods – Newton's method, secant method(T-2).

Unit 5

Multi Variable Non-Linear Unconstrained Optimization
Direct search method – Univariant Method, Pattern search methods – Powell's, Hook-Jeeves search methods, Gradient methods – Steepest decent method, Fletcher reeve's method. (T-2)

Textbooks / References:

1. Kantiswarup, P. K. Gupta and Manmohan, "Operations Research", Seventh Edition, Sultan Chand, 1991.
2. S.S. Rao, "Optimization Theory and Applications", Second Edition, New Age International (P) Limited Publishers, 1995.
3. Hamdy A. Taha(1987): Operations Research– An Introduction, 4/e, Prentice Hall of India, Private Ltd, New Delhi.
4. Kapoor V.K.(2008):Operations Research, 8/e, Sultan Chand & Sons.
5. Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", Prentice Hall of India, New Delhi, 2004.

21CSA511	MACHINE LEARNING	L-T-P-C: 3-1-0-4

Course Objectives

- The primary objective of this course is to introduce the basic concepts of Machine Learning – the supervised and unsupervised machine learning paradigms; to build a thorough understanding of basic machine learning algorithms – their design, implementation and comparative analysis – and to apply them to Classification, Clustering and Regression problems.

Course Outcomes

COs	Description
CO1	Select and implement machine learning techniques and computing environments that are suitable for the applications under consideration.
CO2	Recognize and implement various ways of selecting suitable hypothesis and model parameters for different machine learning techniques.
CO3	Understand the significance of cost function and regularization for different machine learning algorithms to generalize well to new examples.
CO4	Understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
CO5	Develop skills using recent machine learning software for solving practical problems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	1	2	2	3	2
CO2	3	2	1	-	-	-	2	2	-	-
CO3	3	2	2	1	-	1	2	1	1	1
CO4	2	2	2	-	-	-	2	1	1	1
CO5	1	1	3	-	-	-	2	2	2	2
CAM	3	2	2	1	-	1	2	2	1	2

Syllabus

Introduction to ML; Problems, data and tools. Learning systems, goals, challenges and applications of machine learning systems. Aspects of developing systems, training data, testing data, concept representation, classification errors, validation. Linear regression, SSE, gradient descent, bias and variance estimation, overfitting and underfitting, regularization. Logistic regression, hypothesis representation, decision boundary, cost function, multi-class classification. Nearest neighbor methods. Decision Tree learning, representing concepts as decision trees, picking the best splitting attribute: entropy and information gain. Probability and classification, Naïve Bayes classification, Non-linear predictions, EM algorithm, kernels, Kernel regression, kernels, Support Vector Machine (SVM) and kernels, kernel optimization. Neural networks learning, non-linear hypothesis, model representation, perceptron, cost function, back propagation algorithm.Bayesian Networks. Unsupervised learning, clustering, different clustering methodologies - Spectral clustering, subspace clustering. Dimensionality Reduction, Data compression, PCA, LDA algorithm. Current problems on machine learning. Implementation of machine learning algorithms using recent machine learning software.

Textbooks / References:

1. Machine Learning, Tom Mitchell, McGraw Hill, 1997 .
2. Introduction to Machine Learning, Ethem Alpaydin, PHI Learning, 2nd Edition, 2012
3. Christopher, M. Bishop. Pattern Recognition and Machine Learning, Springer-Verlag NY, 2016.
4. Duda, Richard, Peter Hart, and David Stork, “Pattern Classification” Second Edition, New York, NY: Wiley-Interscience, 2000.
5. Hastie, T., R. Tibshirani, and J. H. Friedman, “The Elements of Statistical Learning: DataMining,

Inference and Prediction", New York, Springer, 2001.

Course Objectives

- The main objective of this course is to introduce the major concept areas of language translation and compiler design and to develop an awareness of the function and complexity of modern compilers. This course is a study of the theory and practice required for the design and implementation of interpreters and compilers for programming languages. Upon completion of this course, the student will be able to use automata theory and theory of computation. Familiarize with different optimization techniques.

Course Outcomes

COs	Description
CO1	Understand the concepts of Regular Languages and Context free grammar in the context of formal languages and automata.
CO2	Understand the structure of compilers and the corresponding steps in the compilation process and explain scanning and lexical analysis in the context of the compilation process.
CO3	Understand how syntax and semantic analysis are done in a compiler, and learn different approaches for Syntax analysis.
CO4	Get an idea of how Intermediate codes are useful in generating the target code and various optimization techniques.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	2	-	1
CO2	3	2	1	-	-	-	-	-	1	1
CO3	3	2	1	-	-	-	-	1	1	1
CO4	3	1	-	-	-	-	-	2	-	1
CAM	3	2	1	-	-	-	-	2	1	1

Syllabus

Theory of Automata and Formal Language: Alphabets, Strings and Language, Finite State Machine – Deterministic Finite Automata (DFA) – Definition, State Transition Graph, Transition Table, Language of DFA, Non-Deterministic Finite Automata (NFA)- equivalence of NFAs and DFAs- Conversion of NFA to DFA - minimization of Finite Automata.

Regular Expressions: Chomsky hierarchy of languages, Regular Expressions and regular language – Definition – Operators – Properties- Context-free Grammar - Context free languages

Introduction to Compilers: Compiler structure – Overview of Translation. Lexical Analysis: From regular expression to Scanner. Implementation of scanner: Lex
Parsers: Expressing syntax – Context free grammar, derivations, parse trees, ambiguity, Classes of parsing - Top-down parsing: Recursive descent parsing, Non-recursive predictive parsing. Bottom-up parsing: LR(0), LR(1) and LALR(1) – Implementation of Parser - YACC

Context-Sensitive Analysis: Type Systems – Attribute – Grammar – Syntax Directed Translation.
Intermediate Representations: Intermediate Languages - Graphical and Linear Intermediate Representations – Three address code, Quadruples, Triples, Assignment statements, Boolean expressions, Symbol tables. Procedure Abstraction: Procedure calls – Name Spaces – Communicating Values between Procedures.

Code Optimization: Organization of code optimizer, basic blocks and flow graphs, optimization of basic blocks,

the principal sources of optimization, the directed acyclic graph (DAG) representation of basic block, global data flow analysis.

Code Generation: Machine dependent code generation, object code forms, the target machine, a simple code generator, register allocation and assignment, peephole optimization.

Textbooks / References:

1. Peter Linz, "An Introduction to Formal Languages and Automata", Third Edition, 2002.
2. Keith Cooper and Linda Torczon, "Engineering a Compiler", 2nd Edition, Morgan Kauffmann, 2011.
3. Alfred V.Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Prentice Hall, Second Edition, 2006.
4. Andrew W. Appel and Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.

21CSA591	RESEARCH SEMINAR	L-T-P-C: 0-0-1-1

Course Objectives

- This course intended for the students to choose an area of research and its oral presentation.

Course Outcomes

COs	Description
CO1	Understand a topic of relevance, drawing on different theories, perspectives and past research studies and methods.
CO2	Review and critically evaluate published research in Computer Science and related disciplines.
CO3	Write a comprehensive review of literature on the selected topic and related disciplines.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	2	3	3	3
CO2	3	2	2	2	3	3	2	2	1	2
CO3	3	2	3	2	2	1	2	3	3	1
CAM	3	2	2	2	2	1	2	3	3	2

Syllabus

Each student can select an area for research in consultation with the faculty. Students need to do a comprehensive literature review on the selected research topic and related disciplines. Then students will be required to make an in-class presentation. Feedback on the student presentation skills and ability to explain their research to others is another important component of the course.

Textbooks / References:

1. Relevant literature for the research problem.

SEMESTER IX

21CSA698	DISSERTATION PHASE I	6 Credits

Course Objectives

- Students will be required to identify relevant information on a topic and critically review the research of others. A range of approaches should be used to assess the impact this information will have on either the planning of services or improving health.
- The dissertation should demonstrate competence in the following areas, as applicable to their chosen dissertation topic:
    a. Critically appraising and interpreting published literature.
    b. Using epidemiological approaches to describe health status.
    c. Collecting and using data and information to answer a clinical research question.
    d. Assessing the effectiveness and efficiency of health services.

Course Outcomes

COs	Description
CO1	Provide opportunities to identify real world problems.
CO2	Conduct thorough literature review on the problem domain.
CO3	Specialize in problem specific methods, applications, and tools.
CO4	Demonstrate independence and originality in thought and application.
CO5	Provide opportunity to work as a team and evaluate the develop product/algorithm both from individuals' and teams' perspective.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	1	-	-	2
CO2	2	2	-	-	-	1	1	-	-	-
CO3	2	1	3	-	-	-	2	-	2	1
CO4	2	2	-	-	-	-	1	1	1	1
CO5	2	3	-	-	-	-	1	1	-	1
CAM	2	2	3	-	-	1	1	1	2	1

SEMESTER X

21CSA699	DISSERTATION PHASE II	12 Credits

Course Objectives

- The aim of this course is to enable students to develop an understanding and obtain practical experience of the research process and research skills required to undertake a supervised research project.

Course Outcomes

COs	Description
CO1	Apply the skills a student acquired through the different courses in this program to design software solutions for real world problems.
CO2	Understand the industry-standard project practices, under time and deliverable constraints.
CO3	Get opportunity to work as a team and evaluate the developed product/algorithm both from individual's and team's perspective.
CO4	Write and publish research papers.
CO5	Demonstrate independence and originality in thought and application and communicate among software professionals to demonstrate the knowledge and principles.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	1	-	-	2
CO2	-	-	-	3	-	-	1	-	3	-
CO3	-	-	-	1	3	3	-	-	-	-
CO4	1	3	-	-	-	-	1	1	-	-
CO5	2	2	2	1	2	2	1	3	2	2
CAM	2	2	2	1	3	3	1	2	3	2

LAB ELECTIVES

21CSA681	MEAN STACK LAB	L-T-P-C: 0-1-1-2

Course Objectives

- MEAN Stack lab is a lab elective course which focuses on the modern web Technology for creating and managing websites. MEAN Stack is a complete software stack for building a complete maintainable web application quickly and easily. The stack is comprised of Mongo DB, Express, Angular, and Node.js.
- To learn this, the student needs a good understanding of java script along with Html and CSS. This course provides exposure to the following topics: Basics of HTML, CSS and JavaScript, JSON (data transfer format), Node JS & Express (Server side), Mongo DB (Data base), AngularJS (Front End).

Course Outcomes

COs	Description
CO1	Understanding the basics of client-side web development with html, CSS, JavaScript
CO2	To work with the Node JS and Express to handle server-side communication in web application
CO3	Design and implement the client side with Angular and communicate with Node.
CO4	To implement a NoSQL database with MongoDB and mongoose.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	1	3	-
CO2	2	2	3	-	-	-	-	1	3	1
CO3	2	3	3	-	-	-	-	1	3	1
CO4	1	2	3	-	-	-	-	1	3	1
CAM	2	2	3	-	-	-	-	1	3	1

Syllabus

Unit 1

Basics of HTML, CSS, and JavaScript -Variables, objects, functions, and scopes, Logic flow and loops, Event handling and Document object model, Handling JSON data, Understanding Json callbacks.

Unit 2

Introduction to Node JS Installation, Callbacks, installing dependencies with npm, Concurrency and event loop fundamentals, Node JS callbacks, Building HTTP server, Importing and exporting modules. Building REST services using Node JS REST services, Installing Express JS, Express Node project structure, Building REST services with Express framework, Routes, filters.

Unit 3

Building Single Page Applications with AngularJS Single Page Application – Introduction, Two-way data binding(Dependency Injection), MVC in Angular JS, Controllers, getting user input, Loops, Client-side routing – Accessing URL data, Various ways to provide data in Angular JS – Services and Factories, Working with filters, Directives and Cookies.

Unit 4

MongoDB Basics and Communication with Node JS Installation, CRUD operations, Sorting, Projection, Aggregation framework, MongoDB indexes, connecting to MongoDB with Node JS, Introduction to Mongoose, connecting to MongoDB using mongoose, defining mongoose schemas, CRUD operations using mongoose.

Textbooks/References:

1. Simon Holmes, Clive Herber "Getting MEAN with Mongo, Express, Angular, and Node, Second Edition.
2. Jeff Dickey, "Write Modern Web Apps with Mean Stack , Peachpit press, 2015
3. Ken Williamson, "Learning Angular JS", O′Reilly; 1 edition (24 March 2015)
4. Mithun Satheesh, "Web development with MongoDB and Node JS", Packt Publishing Limited; 2nd Revised edition (30 October 2015).
5. Amos Q. Haviv, MEAN Web Development.2014

21CSA682	R PROGRAMMING LAB	L-T-P-C: 0-1-1-2

Course Objectives

- The goal of this course is to help students learn the most important tools in R programming language that will allow the student to practice data science.

Course Outcomes

COs	Description
CO1	Learn the basic syntax of R programming language in RStudio environment.
CO2	Pre-process raw data in R for further analysis.
CO3	Conduct exploratory data analysis and create insightful visualizations to identify patterns.
CO4	Understand supervised and unsupervised machine learning algorithms.
CO5	Evaluate the performance of models and degree of certainty of predictions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	1	3	-	-
CO2	3	2		-	-	-	1	1	-	-
CO3	3	3	-	-	-	-	1	2	2	-
CO4	3	3	-	-	-	-	1	2	2	1
CO5	3	2	-	-	-	-	1	1	2	1
CAM	3	3	-	-	-	-	1	2	2	1

Syllabus

Unit 1
Introduction to Data Science Process – Loading Data in R – Exploring Data – Managing Data

Unit 2
Modeling Methods – Choosing and evaluating models – Data Driven Models – Supervised Learning techniques – Unsupervised Learning – Ensemble Models

Unit 3
Delivering Results – Documentation and Deployment – Producing Effective Reports and Visualizations

Textbooks/References:

1. "R for Data Science", Hadley Wickham and Garett Grolemund, O'Reilly, 2017.
2. "Data Mining for Business Analytics: Concepts, Techniques and Applications in R", Galit Shmueli, et al, Wiley India, 2018.
3. "Practical Data Science with R", Nina Zumel and John Mount, Dreamtech/Manning, 2014.

21CSA683	MATLAB PROGRAMMING LAB	L-T-P-C:0-1-1-2

Course Objectives

- To impart the knowledge to the students with MATLAB software.
- To introduce students the use of a high-level programming language, Matlab. [scientific problem solving with applications and examples from Engineering].

Course Outcomes

COs	Description
CO1	To impart the knowledge to the students with MATLAB software.
CO2	To provide a working introduction to the MATLAB technical computing environment.
CO3	To introduce students the use of a high-level programming language, MATLAB.
CO4	To introduce different types of toolboxes in MATLAB

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	2	2	1
CO2	2	2	3	-	-	-	-	1	2	1
CO3	2	3	3	-	-	-	-	1	2	1
CO4	2	2	3	-	-	-	-	1	3	1
CAM	2	2	3	-	-	-	-	1	2	1

Syllabus

Unit 1: Introduction to MATLAB, Installation, basic features, MATLAB Desktop, command window, workspace, current directory, data types

Unit 2: Matrices, control flow and operators, strings, graphics, basic plotting, mathematical functions, programmers toolbox, array operations and linear equations

Unit 3: M-file scripts, debugging, solving linear systems, polynomials, Eigen values, Eigen vector, interpolation, least square regression, root finding methods.

Unit 4: Statistics and Machine Learning Toolbox-Image Processing Toolbox-Text Analytics Toolbox-Deep Learning Toolbox

Unit 5: GUI Design, Introduction Of Graphical User Interface, GUI Function Property GUI Component Design, GUI Container Writing the code of GUI Callback ,Dialog Box Menu, Designing Applications

Textbooks/References:

1. http://www.eng-tips.com/threadminder.cfm?pid=575
2. http://www.matlabtutorials.com/mathforum/
3. http://www.mathworks.in/matlabcentral/
4. http://www.cfd-online.com/Forums/tags/matlab.html
5. http://diydrones.com/forum/topic/listForTag?tag=Matlab
6. MATLAB Manuals and Handbooks
7. Duane Hanselman, Bruce Little Field “Mastering MATLAB 7” , Pearson Education India

21CSA684	HIGH PERFORMANCE COMPUTING LAB	L-T-P-C:0-1-1-2

Course Objectives

- The course helps to understand methods to improvise the programming aspects for execution on high performance computer systems. It also introduces the fundamentals of graphics processing units and many integrated cores, using their architectures and corresponding programming environments to develop fundamental and advanced parallel algorithms through the GPU. Shared Memory parallel programming and Message Passing Interfaces are also learnt to appreciate the aspects and its purpose.

Course Outcomes

COs	Description
CO1	Ability to design, formulate, solve, and implement high performance versions of standard single threaded algorithms.
CO2	Ability to demonstrate the architectural features in the GPU
CO3	Design programs to extract maximum performance in a multicore, shared memory execution environment processor
CO4	Design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm
CO5	Understand the basics of programming languages like Julia or Scala using platforms like Apache Spark that support high performance algorithm development

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	1	1	2	-
CO2	3	-	1	-	-	-	1	-	1	1
CO3	3	2	2	-	-	-	-	1	1	1
CO4	2	1	2	-	-	-	1	1	1	-
CO5	2	1	3	-	-	-	1	1	1	1
CAM	3	2	2	-	-	-	1	1	1	1

Syllabus

Introduction to parallel computing, introduction to OPENMP, OPENMP paradigms, parallel regions, multi-threading, data sharing attribute clauses, worksharing, OPENMP reduction, runtime functions, OPENMP exercises to illustrate for loop, sections, critical section, synchronization. Divide and conquer strategies using OPENMP. Introduction to MPI, basics of MPI, MPI function call, example programs on MPI and OPENMP+MPI. Collective communication. Data grouping for communication.
Introduction to Heterogeneous Parallel Computing, GPU architecture, Thread hierarchy,GPU Memory Hierarchy, Vector Addition, Matrix Multiplication algorithms.
Scala REPL, Classes, Immutable and Mutable Fields, Methods, Default and Named Arguments, Objects, Collections overview, Sequences and Sets, Tuples and Maps,Higher Order Functions

Textbooks/References:

1. Wen-Mei W Hwu, David B Kirk, Programming Massively Parallel Processors A Hands-on Approach, Morgann Kaufmann, 3e.
2. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP, MIT Press, 2008.
3. Gropp, Lusk, Skjellum, Using MPI, Using MPI, 2014.
4. https://developer.nvidia.com/udacity-cs344-intro-parallel-programming
5. Existing university courses list: https://developer.nvidia.com/educators/existing-courses

6. Tim Mattson. Introduction to OpenMP. SC11. (Available on Youtube).
7. MPI Video Tutorials by Open-MPI. https://www.open-mpi.org/video/

21CSA685	NATURAL LANGUAGE PROCESSING LAB	L-T-P-C:0-1-1-2

Course Objectives

- This course introduces the fundamental concepts and techniques of natural language processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches

Course Outcomes

COs	Description
CO1	Understand leading trends and systems in natural language processing.
CO2	Describe concepts of morphology, syntax, semantics, and pragmatics of the language
CO3	Implement programs in Python to carry out natural language processing.
CO4	Understand vectors for word/sentence representation

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-
CO2	2	-	3	-	-	-	1	-	2	-
CO3	1	3	3	-	-	-	1	-	2	-
CO4	1	3	3	-	-	-	1	-	2	-
CAM	2	3	3	-	-	-	1	-	2	-

Syllabus

Text Preprocessing - tokenization, part-of-speech tagging, chunking, syntax parsing and named entity recognition. Public NLP toolkits – NLTK, spacy
Words: Semantics (Basic ideas in Lexical Semantics, WordNet and WordNet based similarity measures)
Text representations and embeddings: One-hot encoding, Bag-of-Words (BoW) Dictionary: Term Frequency – Inverse Document Frequency (TF-IDF), N-gram. Word Embedding: Word2vec, Glove BERT and Fasttext
Introduction to Machine learning and deep learning for NLP, Sequence to sequence modelling (Encoder decoder).

Textbooks/References:

1. Daniel and James H Martin “Speech And Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Second Edition, Prentice Hall of India, 2008.
2. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
3. James Allen, “Natural Language Processing with Python”, O’Reilly Media, July 2009.

21CSA686	CYBER SECURITY LAB	L-T-P-C:0-1-1-2

Course Objectives

- The main aim of this course is to study various vulnerabilities, attacks and its defense mechanisms. Students are given training in secure coding.

Course Outcomes

COs	Description
CO1	Understand the causes of basic security vulnerabilities and how they are exploited
CO2	Understand the basic security issues in web and its countermeasures
CO3	Develop skills in using security-oriented development
CO4	Develop the skill to test the security vulnerabilities in a system

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	1	3	-	-
CO2	3	2		-	-	-	1	1	-	-
CO3	3	3	-	-	-	-	1	2	2	-
CO4	3	3	-	-	-	-	1	2	2	1
CAM	3	3	-	-	-	-	1	2	2	1

Syllabus

Security Issues in C Language: String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues, Code Injection Attacks, Canary based countermeasures using StackGuard and Propolice. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs. Socket Security, Avoiding Server Hijacking, Securing RPC, ActiveX and DCOM Database and Web-specific issues: SQL Injection Techniques and Remedies, Race conditions, Time of Check Versus Time of Use and its protection mechanisms. Validating Input and Inter-process Communication, Securing Signal Handlers and File Operations. XSS scripting attack and its types – Persistent and Non persistent attack XSS Countermeasures and Bypassing the XSS Filters. Defence in Depth and Principle of Least Privilege. Secure Coding Techniques: Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, ARP Spoofing and its countermeasures. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs

Textbooks/References:

1. Michael Howard , David LeBlanc, “Writing Secure Code”, Microsoft Press, 2nd Edition, 2003
2. Robert C.Seacord, “ Secure Coding in C and C++”, Pearson Education, 2nd edition, 2013
3. Julia H. Allen, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, “ Software Security Engineering : A guide for Project Managers”, Addison-Wesley Professional, 2008
4. Buffer Overflow Attacks: Detect, Exploit, Prevent by Jason Deckar,Syngress,1st Edition, 2005
5. Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1st Edition, 2004

21CSA687	DEEP LEARNING LAB	L-T-P-C:0-1-1-2

Course Objectives

- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

Course Outcomes

COs	Description
CO1	To know the main techniques in deep learning and the main research in this field.
CO2	Be able to design and implement deep neural network systems.
CO3	Able to train neural networks for various application domains.
CO4	Use deep Learning technologies throughout most of machine learning pipeline.
CO5	To understand how to develop algorithms for resolving real world problems**.**

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	1	-	1
CO2	3	2	2	-	-	-	1	1	1	-
CO3	3	1	1	-	-	-	1	1	1	1
CO4	2	1	1	-	-	-	1	1	1	1
CO5	1	3	-	-	-	-	1	1	1	1
CAM	3	1	1	-	-	-	1	1	1	1

Syllabus

1. CNNs for Hand-written digit recognition using Tensor flow.
2. CNNs for Hand-written digit recognition using Keras.
3. Simple image classification with Inception Model.
4. Demonstrate use of GoogleNet and Hyper-parameter Optimization.
5. Demonstrate use of AlexNet and Hyper-parameter Optimization.
6. Create CONV layer of a CNN.
7. Display details of CONV layer of a CNN.
8. Demonstrate use of Stride and Pad for CONV layers of a CNN.
9. Neuron view of the convolution layer.
10. RELU in CNNs.
11. Pooling and fully connected layers in CNNs
12. Classify movie reviews — binary classification using Keras.
13. Python Code: RNNs for Hand-written digit recognition using Tensorflow
14. Python Code: Bi-directional RNNs for Hand-written digit recognition using Tensorflow
15. Python Code: Next word prediction using RNNs

Textbooks/References:

1. Domingos, Pedro. "A few useful things to know about machine learning." Communications of the ACM 55.10 (2012): 78-87.
2. Li Fei-Fei (Stanford), Rob Fergus (NYU), Antonio Torralba (MIT), “Recognizing and Learning Object Categories” (Awarded the Best Short Course Prize at ICCV 2005).
3. Baydin, AtilimGunes, Barak A. Pearlmutter, and Alexey AndreyevichRadul. "Automatic differentiation in machine learning: a survey." arXiv preprint arXiv:1502.05767 (2015).
4. Bengio, Yoshua. "Practical recommendations for gradient-based training of deep architectures." Neural Networks: Tricks of the Trade. Springer Berlin Heidelberg, 2012. 437-478.
5. LeCun, Yann A., et al. "Efficient backprop." Neural networks: Tricks of the trade. Springer Berlin

Heidelberg, 2012. 9-48.

Course Objectives

- This course will help the students to install and configure different types of operating systems, applications, and services. It will also enable them to troubleshoot the errors from the software.

Course Outcomes

COs	Description
CO1	Able to identify and familiarizing with various types of software's and operating systems.
CO2	Understand the installation and management of virtual machines and various operating systems
CO3	Understand the installation and configurations of various devices and its drivers
CO4	Able to manage disks, users, files etc.
CO5	Able to handle various system and network services and its management.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	1	-
CO2	3	-	3	-	-	-	-	-	1	-
CO3	3	-	3	-	-	-	-	-	1	-
CO4	3	1	2	-	-	-	-	-	1	-
CO5	3	1	2	-	-	-	-	-	1	-
CAM	3	1	3	-	-	-	-	-	1	-

Syllabus

1. Type of Softwares
2. Installation and Management of Virtual Machine
3. Different types of Operating Systems and Installation
4. Managing Files and Directories
5. Managing Disks.
6. Loading and Configuring Device Drivers
7. Install & Implementing DNS
8. Installing Active Directory Domain Services
9. Implementing a Group Policy Infrastructure
10. Managing User Desktops with Group Policy
11. Configuring Quotas and File Screening Using File Server Resource Manager
12. User Management

Textbooks/References:

1. Todd Lammle, "CCNA Routing and Switching Review Guide", Wiley-Sybex, 2014
2. William Panek, "Mcsa - Windows Server 2012: Complete Study Guide", Wiley India Pvt. Ltd. – New Delhi.
3. Robert Butler, Mark Minasi, "Mastering Windows Server 2012" R2 (English) 1st Edition, - Wiley India Pvt. Ltd.
4. Rand Morimoto, Michael Noel," Windows Server 2012 Unleashed", Sams

21CSA689	NETWORK ADMINISTRATION LAB	L-T-P-C:0-1-1-2

Course Objectives

- The main objective of this course is to provide students with a basic understanding of computer network technologies and concepts. It gives an overview of different network types, topologies, identification of different network components of IP addressing, firewalls, routing protocols, etc.

Course Outcomes

COs	Description
CO1	Able to identify the various network components and network topologies.
CO2	Understand the concepts and assigning of various types of IP Addresses.
CO3	Understand the layers and protocols.
CO4	Able to do the installation and configurations under software and hardware firewalls
CO5	Able to work the packet transmission and routing protocols.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	1	-	-	-
CO3	3	1	2	-	-	-	-	-	-	-
CO4	3	1	3	-	-	-	1	-	1	-
CO5	3	1	3	-	-	-	1	-	1	-
CAM	3	1	3	-	-	-	1	-	1	-

Syllabus

1. Identifying Network Components
2. Familiarizing with various types of Network Topologies
3. Assigning IPv4 Addressing
4. IPv4 Subnetting
5. Assigning IPv4 Addresses - Static IP Addressing & Dynamic IP Addressing
6. Assigning IPv6 Addressing
7. Working with UDP and TCP protocols
8. Packet transmission through OSI Layer
9. Software and Hardware firewalls
10. Working with routing protocols

Textbooks/References:

1. Mark Dye, Rick McDonald, Antoon Rufi ”Network Fundamentals: CCNA Exploration Companion Guide”, Cisco Networking Academy, 2008
2. Kaveh Pahlavan, Prashant Krishnamurthy, ”Networking Fundamentals: Wide, Local and Personal Area Communications“, Paperback, 2014
3. Curt M. White, “Fundamentals of Networking and Data Communications” (English), 7th Edition Cengage Learning

21CSA781	COMPETITIVE PROGRAMMING LAB	L-T-P-C:0-1-1-2

Course Objectives

- In this course students will learn how to apply algorithms in order to solve complex problems. The goal of this course is to teach students how to apply familiar algorithms to non-intuitive problems. Along the way students will also gain useful skills for which competitive programmers are so highly valued by employers: ability to write efficient, reliable, and compact code, manage your time well when it's limited, apply basic algorithmic ideas to real problems, etc.

Course Outcomes

COs	Description
CO1	To improve knowledge of algorithms and programming languages
CO2	To provide a deep understanding of problem solving.
CO3	To introduce competitive programming.
CO4	To understand approaches applied at the world competitions
CO5	To analyze programming concepts with competitive up solving context
CO6	To think outside the box and meet tough deadlines.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	1	-	3	1	1
CO2	2	2	-	-	-	-	1	2	1	-
CO3	1	-	1	-	-	-	2	3	2	-
CO4	2	1	1	-	-	-	1	-	-	2
CO5	1	-	1	-	-	-	1	3	1	1
CO6	-	-	-	2	-	-	1	-	-	-
CAM	3	2	1	2	-	-	1	3	1	1

Syllabus

Data Structures and Libraries- Sorting, Dynamic arrays, Iterators
Problem Solving Paradigms-Divide and Conquer, Greedy, Dynamic Programming
Graphs: Depth First Search, Breadth First Search, Kruskal's, Dijkstra's, Bellman Ford's, Floyd Warshall's, Edmonds Karp's, Special Graphs
Mathematics: Number Theory, Prime numbers, factorial, Combinatorics, Probability Theory, Linear Algebra
String Processing
Computational Geometry- Graham's Scan, Intersection Problems

Textbooks/References:

1. Competitive Programming 3 by Felix Halim and Steven Halim
2. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests by Antti Laaksonen
3. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, and Clifford Stein
4. The Algorithm Design Manual by Steven Skiena
5. Concrete Mathematics by Donald Knuth, Oren Patashnik, and Ronald Graham, 648 pages.

6. Computational Geometry: Algorithms and Applications by Marc van Kreveld, Mark de Berg, and Otfried Cheong

21CSA782	NETWORK AND GRID SIMULATION LAB	L-T-P-C:0-1-1-2

Course Objectives

- To impart knowledge about network simulation tools to design and understand the working of different protocols and network models also introduce them to a distributed Cloud.

Course Outcomes

COs	Description
CO1	Simulate network concepts using NS3.
CO2	Work with TCP and UDP protocols and related applications.
CO3	Create a Local Area network and WLAN analyze the QoS Parameters.
CO4	Simulate the Cloud computing environment using SimGrid.
CO5	Create a cloud load balancer and analyze performance.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-
CO2	3	3	1	-	-	-	-	-	1	-
CO3	3	3	1	-	-	-	1	-	1	-
CO4	3	2	3	-	-	-	-	1	1	-
CO5	3	2	3	-	-	-	1	1	1	-
CAM	3	2	3	-	-	-	1	1	1	-

Syllabus

Introduction to NS3 -Simulation of a simple wired network topology and working with Netanim .Working with UDP and TCP Sockets based applications .Simulation of a wireless network topology, simulation of a heterogeneous topology .Working with routing protocols, debugging using gdb tool, analyzing various QoS parameters of the network using a case study scenario.
Introduction and installing SimGrid tool, Formation of cluster environment SimGrid as a Grid Simulator and analyse the features and working of Grid. SimGrid as a P2P Simulator demonstrate with example scenario. SimGrid as a Cloud Simulator setting up and running heterogeneous jobs over cloud, Case study application on scheduling and load balancing using SimGrid.

Textbooks/References:

1. NS3 Manual - https://www.nsnam.org/docs/release/3.13/manual/ns-3-manual.pdf
2. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet, First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.
3. Bart Jacob (Editor), ┼Introduction to Grid Computing, IBM Red Books, Vervante, 2005.
4. Daniel Minoli, A Networking Approach to Grid Computing, John Wiley Publication, 2005.
5. Barry Wilkinson, Grid Computing: Techniques and Applications, Chapman and Hall, CRC, Taylor and Francis Group, 2010.

21CSA783	BIOINFORMATICS LAB	L-T-P-C: 0-1-1-2

Course Objectives

- Objective of this course is to understand and use computational approaches in biological sequence data stored in the large warehouse of public repositories.

Course Outcomes

COs	Description
CO1	Understand biological sequencing and the sequence formats
CO2	Perform database search from public sequence data repositories
CO3	Perform pairwise and multiple sequence alignment

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	3	-	1
CO2	3	2	3	-	-	-	-	3	2	3
CO3	3	2	3	-	-	-	-	3	2	3
CAM	3	2	3	-	-	-	-	3	2	3

Syllabus

Genomic Sequencing, Sequence Formats, Sequence databases: nucleotides, proteins, structures, genes, expression, taxonomy; NCBI,GENBANK, Structure database -PDB, Marker databases – dbSNP, dbSTS, dbEST, Unigene; Literature Databases :PubMed, PubMedCentral, OMIM, Books, Citation Matcher
Accessing Public Databases,tools : Entrez, FASTA BLAST, Organism specific databases,Searching and retrieval of nucleotide sequences from GenBank database, Retrieval of protein sequences from "SWISS-PROT" database. Searching and retrieving the protein structure data using Entrez and protein viewing, Database homology search of a nucleotide sequence using Blast, nucleotide sequence analysis, protein sequence analysis, 3-D structure display and similarity searching, Submitting sequence to Databases
Global and Local alignment tools,genomes and maps

Textbooks/References:

1. Mount D.W. : Bioinformatics: Genome and Sequence Analysis: (2001), Cold Spring Harbor Laboratory Press, New York
2. Baxevanis AD &OuletteBFF : Bioinformatics – A practical guide to the Analysis of Genes and Proteins, Willey International publishers

21CSA784	BIG DATA ANALYTICS LAB	L-T-P-C:0-1-1-2

Course Objectives

- To optimize business decisions and create competitive advantage with big data analytics. Practice java concepts required for developing map reduce programs. Impart the architectural concepts of Hadoop and introducing map reduce paradigm. Practice programming tools PIG and HIVE in Hadoop eco system.

Course Outcomes

COs	Description
CO1	Gain the ability to choose the right solution for a commercial task involving big data, including databases, architectures, and cloud services.
CO2	Gain an understanding of the analysis of big data including methods to visualize and automatically learn from vast quantities of data.
CO3	Develop the programming skills to build solutions using big data technologies such as MapReduce, scripting for NoSQL,0020Apache Mahout, Hive and the ability to write parallel algorithms for multi-processor execution.
CO4	Understanding of the issues of scalability of databases, data analysis, search, and optimization.
CO5	Get insights into different data visualization techniques. Understanding of real-life issues faced by different organizations and its effective solutions

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	1	3	-	-
CO2	3	2		-	-	-	1	1	-	-
CO3	3	3	-	-	-	-	1	2	2	-
CO4	3	3	-	-	-	-	1	2	2	1
CO5	3	2	-	-	-	-	1	1	2	1
CAM	3	3	-	-	-	-	1	2	2	1

Syllabus

INSTALL VMWARE - Installation of VMWare to setup the Hadoop environment and its ecosystems.
HADOOP MODES – Perform setting up and Installing Hadoop in its three operating modes. Standalone, Pseudo distributed, fully distributed- Use web-based tools to monitor your Hadoop setup.
USING LINUX OPERATING SYSTEM - Implementing the basic commands of LINUX Operating System – File/Directory creation, deletion, update operations.
FILE MANAGEMENT IN HADOOP – Implement the following file management tasks in Hadoop: Adding files and directories, retrieving files and Deleting files
MAPREDUCE PROGRAM 1 - Run a basic word count Map Reduce program to understand Map Reduce Paradigm.
MAPREDUCE PROGRAM 2 - Write a Map Reduce program that mines weather data.Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented
MAPREDUCE PROGRAM 3- Implement matrix multiplication with Hadoop Map Reduce.
PIG LATIN LANGUAGE – PIG: Installation of PIG, Write Pig Latin scripts sort, group, join, project, and filter your data.
HIVE- Installation of HIVE, Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

Textbooks/References:

1. Jay Liebowitz, ―Big Data And Business Analytics Laboratory, CRC Press.
2. Data Analytics: Become A Master In Data Analytics, by Richard Dorsey, 2017
3. Data Analytics: The Ultimate Beginner's Guide to Data Analytics by Edward Mize, 2017

21CSA785	COMPUTER GRAPHICS AND VISUALIZATION LAB	L-T-P-C:0-1-1-2

Course Objectives

- To introduce the construction of a graphics geometric primitives and algorithms related with them. Also covers the basic transformation of 2D & 3D graphics. Understanding of how to clip the basic geometrical primitives, how to animate shapes to fit them as per the picture definition.

Course Outcomes

COs	Description
CO1	Understand the construction of basic geometric shapes
CO2	Apply basic scan conversion algorithm to construct various geometric shapes.
CO3	Understand the transformations as well as projection in 2D and 3D.
CO4	Understand the basic knowledge of window clipping.
CO5	Understand the basic idea of the animation to make the animation with geometric primitives.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	2	2	-
CO3	3	1	-	-	-	-	-	2	2	-
CO4	3	1	-	-	-	-	-	2	2	-
CO5	3	3	3	2	2	1	1	1	1	1
CAM	3	1	3	2	2	1	1	2	2	1

Syllabus

Basic geometric primitives design- line, circle ,concentric circle, rectangle, triangle ,pentagon, hexagon, octagon, Scan conversion-Bresenham's line drawing algorithm implementation, mid-point circle drawing algorithm implementation, midpoint ellipse algorithm implementation, boundary fill algorithm implementation, flood fill algorithm implementation, 2D-Transformation-translation,rotation,scaling,shearing,reflection,3D Transformation -rotation, translation, scaling, shearing, reflection, 3D-Projection: parallel-Obloque,orthographic,axonometric,perspective. Clipping- Cohen-Sutherland line and polygon clipping algorithm. Animation- using key frame animation animate a bouncing ball, using NURBS modelling create a human face using different NURBS primitives, Using animation create a ball revolving around a stationary ball along a given path,
Tools: OPEN GL, Code Block

Textbooks/References:

1. Donald Hearn and Pauline Baker, "Computer Graphics with OpenGL", Third Edition, Prentice Hall of India, 2009.
2. Rajiv Chopra , "Computer Graphics – A Practical Approach"

ELECTIVE I, II

21CSA331	ARTIFICIAL INTELLIGENCE	L-T-P-C:3-0-0-3

Course Objectives

- The main objective of this course is to familiarize the students with how to represent knowledge, including incomplete and uncertain knowledge of the real world; how to reason logically with that knowledge using probabilities; how to use these reasoning models and methods to decide what to do, particularly by constructing plans; and how to reason and make decisions in the presence of uncertainty about the world. It includes some state-of-the-art topics, such as the logical representation of different types of knowledge, reasoning under uncertainty

Course Outcomes

COs	Description
CO1	Define the basics of artificial intelligence and the deep challenges it presents to the researcher.
CO2	Explain various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms).
CO3	Define the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference mechanisms, game playing and expert systems
CO4	Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	2	1	-
CO3	2	3	-	-	-	-	2	1	-
CO4	2	2	-	-	-	-	1	1	-
CAM	2	3	-	-	-	-	2	1	-

Syllabus

Unit 1: What is Artificial Intelligence? – The AI Problems – The Underlying Assumption – What is an AI technique – Criteria for Success.Problems, Problem Spaces and Search – Defining Problem as a State Space Search – Production Systems – Problem Characteristics – Production System Characteristics – Issues in the design of Search Programs.

Unit 2: Heuristic Search Techniques - Generate – and – Test – Hill Climbing – Best-First Search – Problem Reduction – Constraint Satisfaction - Means - Ends Analysis. Knowledge Representation issues – Representations and Mapping - Approaches to knowledge Representation – Issues in knowledge Representation – The Frame Problem. Using Predicate Logic – Representing simple facts in Logic – Representing Instance and Isa Relationship – Computable Functions and Predicates – Resolution – Natural Deduction.

Unit 3: Representing Knowledge Using Rules – Procedural versus Declarative knowledge – Logic Programming – Forward versus Backward Reasoning – Matching – Control Knowledge. Symbolic Reasoning under Uncertainty – Introduction to Non-monotonic Reasoning – Augmenting a Problem Solver – Implementation: Depth - First Search.
Statistical Reasoning – Probability and Baye's Theorem – Bayesian Networks – Fuzzy Logic.

Unit 4: Game Playing - The Minimax Search Procedure – Adding Alpha-Beta Cutoffs. Understanding – What is Understanding? What makes Understanding hard?

Unit 5: Common Sense – Qualitative Physics – Common sense ontology – Memory Organization - Expert Systems – Representing and Using Domain knowledge – Expert System Shells – knowledge Acquisition - Components of an AI program.

Textbooks/References:

1. Artificial Intelligence (Second Edition) – Elaine Rich, Kevin knight (Tata McGraw-Hill)
2. A Guide to Expert Systems – Donald A. Waterman (Addison-Wesley)
3. Principles of Artificial Intelligence – Nils J. Nilsson (Narosa Publishing House)
4. Introduction to Artificial Intelligence – Eugene Charnaik, Drew McDermott (Pearson Education Asia)

21CSA332	CLIENT SERVER COMPUTING	L-T-P-C:3-0-0-3

Course Objectives

- The objective of this course is to familiarize with client server computing concepts, to understand the components of client server application, client server system development and the data storage concepts in client server computing.

Course Outcomes

Cos	Description
CO1	Understand the concept of client server computing
CO2	Understand the components of client server application.
CO3	Understand the concept of client server network.
CO4	Develop Client Server Systems
CO5	Understand the data Storage concepts in client server computing.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	1	2	-
CO3	2	2	1	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-
CO5	1	1	-	-	-	--	-	-	-
CAM	2	2	2	-	-	-	1	2	-

Syllabus

Unit 1: Client/Server Computing: DBMS concept and architecture, Single system image, Client Server architecture, mainframe-centric client server computing, downsizing and client server computing, preserving mainframe applications investment through porting, client server development tools, advantages of client server computing.

Unit-2: Components of Client/Server application: The client: services, request for services, RPC, windows services, fax, print services, remote boot services, other remote services, Utility Services & Other Services, Dynamic Data Exchange (DDE), Object Linking and Embedding (OLE), Common Object Request Broker Architecture (CORBA). The server: Detailed server functionality, the network operating system, available platforms, the network operating system, available platform, the server operating system.

Unit-3: Client/Server Network: connectivity, communication interface technology, Interposes communication, wide area network technologies, network topologies (Token Ring, Ethernet, FDDI, CDDI) network management, Client-server system development: Software, Client–Server System Hardware: Network Acquisition, PC-level processing unit, Macintosh, notebooks, pen, UNIX workstation, x-terminals, server hardware.

Unit-4: Client Server Systems Development: Services and Support, system administration, Availability, Reliability, Serviceability, Software Distribution, Performance, Network management, Help Disk, Remote Systems Management Security, LAN and Network Management issues. Training, Training advantages of GUI Application, System Administrator training, Database Administrator training, End-user training.

Unit-5: Data Storage: magnetic disk, magnetic tape, CD-ROM, WORM, Optical disk, mirrored disk, fault tolerance, RAID, RAID-Disk network interface cards. Network protection devices, Power Protection Devices, UPS, Surge protectors. The future of client server Computing Enabling Technologies, The transformational system.

Textbooks/References:

1. Patrick Smith & Steave Guengerich, “Client / Server Computing”, PHI

2. Dawna Travis Dewire, “Client/Server Computing”, TMH

Course Objectives

- To acquire knowledge on the basic working of a microcontroller system and its programming.
- To provide experience to integrate hardware and software for microcontroller applications systems.

Course Outcomes

Cos	Description
CO1	Understand the basic structure and design of Embedded systems.
CO2	Understand the fundamentals of Embedded processor, Bus Communication in processors, Input/output interfacing.
CO3	Develop programs for Embedded systems.
CO4	Understand different Phases & Modelling of Embedded system.
CO5	Understand the architecture of System-on-Chip and design examples.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	3	-	-
CO2	3	1	-	-	-	-	1	-	-
CO3	3	3	-	-	-	-	2	2	-
CO4	3	3	-	-	-	-	2	2	1
CO5	2	3	2	-	-	-	1	2	1
CAM	3	3	2	-	-	-	2	2	1

Syllabus

Unit 1: INTRODUCTION TO EMBEDDED SYSTEMS
Introduction to Embedded Systems, Components of Embedded Systems, Structural units in Embedded processor, DMA, Memory management methods- memory mapping, cache replacement concept, Timer and Counting devices, Real Time Clock- CPU architecture of ARM processor- CPU Bus organization

Unit 2: EMBEDDED NETWORKING AND ISR
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – Serial Communication Standards and Devices- ISR concept-– multiple interrupts – Serial Bus Protocols- RS232 standard – RS485 –USB – Inter Integrated Circuits (I2C)

Unit 3: RTOS BASED EMBEDDED SYSTEM DESIGN
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Inter-process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance

Unit 4: PROGRAMMING CONCEPTS OF EMBEDDED PROGRAMMING
Introduction to Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In Circuit emulator, Target Hardware Debugging, Features of Embedded C++ and Embedded Java(basic only), Software Implementation, Validation, Testing, system-on-chip

Unit 5: EMBEDDED SYSTEM APPLICATION DEVELOPMENT

Objectives, different Phases & Modeling of the Embedded product Development Life Cycle (EDLC), IPC, Message Queue, Sockets- RPCs.
Case study 1: Study on Smart card- Adaptive Cruise control in a Car -Mobile Phone software for key inputs.
Case study 2: Study of other popular RTOS

Textbooks/References:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011.
2. Peckol, "Embedded system Design",JohnWiley&Sons,2010
3. Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill,2009
4. Lyla B Das," Embedded Systems-An Integrated Approach",Pearson2013
5. Elicia White,"Making Embedded Systems",O'Reilly Series,SPD,2011
6. Bruce Powel Douglass,"Real-Time UML Workshop for Embedded Systems,Elsevier,2011.

21CSA334	ENTERPRISE RESOURCE PLANNING MANAGEMENT	L-T-P-C:3-0-0-3

Course Objectives

- The objective of this course is to describe the concept of ERP and the ERP model; define key terms; explain the transition from MRP to ERP; identify the levels of ERP maturity. Explain how ERP is used to integrate business processes; define and analyse a process; create a process map and improve and/or simplify the process; apply the result to an ERP implementation.

Course Outcomes

COs	Description
CO1	Understand the structure of ERP.
CO2	Understand ERP and related technologies.
CO3	Understand the different functional modules in ERP.
CO4	Understand ERP implementation life cycle.
CO5	Understand the importance of ERP and E commerce.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	1	-
CO3	1	2	-	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-
CO5	1	2	-	-	-	-	-	-	-
CAM	1	2	1	-	-	-	-	1	-

Syllabus

Unit 1: ERP Introduction, Benefits, Origin, Evolution and Structure: Conceptual Model of ERP, the Evolution of ERP, the Structure of ERP.

Unit 2: Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing (OLAP), Product Life Cycle Management (PLM), LAP, Supply chain Management.

Unit-3: ERP Marketplace and Marketplace Dynamics: Market Overview, Marketplace Dynamics, the Changing ERP Market. ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications.

Unit 4: ERP Implementation Basics, ERP Implementation Life Cycle, Role of SDLC/SSAD, Object Oriented Architecture, Consultants, Vendors and Employees.

Unit 5: ERP & E-Commerce, Future Directives- in ERP, ERP and Internet, Critical success and failure factors, Integrating ERP into organizational culture. Cloud computing in ERP.

Textbooks/References:

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill
2. Vinod Kumar Garg and Venkitakrishnan N K, “Enterprise Resource Planning Concepts and Practice”, PHI.

21CSA335	KNOWLEDGE MANAGEMENT	L-T-P-C:3-0-0-3

Course Objectives

- To understand knowledge management Systems and the intellectual methods for designing and deploying a Knowledge Management System. Study various tools used in Knowledge Management and its applications.

Course Outcomes

COs	Description
CO1	To get basic idea on knowledge management Systems
CO2	Be familiar with tools for Knowledge management.
CO3	Be exposed to knowledge management Applications.
CO4	Be familiar with some case studies

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	1
CO2	1	1	2	-	-	-	1	-	1
CO3	1	1	1	-	-	-	1	1	1
CO4	2	1	1	-	-	-	1	1	1
CAM	2	1	1	-	-	-	1	1	1

Syllabus

Introduction: An Introduction to Knowledge Management – The foundations of knowledge management-decision support systems. Business Intelligence, Attributes of Knowledge, Expression of Knowledge- Business benefits of knowledge-Evolution of Knowledge Management – Ethics for Knowledge Management.
Tools for knowledge management-Knowledge Initiatives, KM Process-Life cycle, Knowledge Networking, Principles behind KM success, Thematic Analysis - Knowledge Transformation and Dynamics.
Knowledge Management System and Development, Generic model - Life Cycle- Application Cycle- Challenges in Developing KMS- KM System Architecture, Knowledge Construction Architecture, Implementation of KMS, The learning concept and Knowledge Management System -Establish a knowledge strategy framework, Validation of Knowledge, Validation of knowledge - Knowledge Creation, Acquisition of Knowledge-Knowledge Acquisition Techniques.
Application phase and Organisation Learning, Knowledge Transfer, Knowledge sharing: Knowledge Transferring sharing and tools, Codification of Knowledge, build a knowledge Maps, Designing Knowledge Transfer and Sharing strategy, Network structures for Knowledge Transfer, Knowledge Asset, Organization and Knowledge Management – Building the Learning Organization. Knowledge Markets- Technology Foundations – The Internet and Internet Services – Web Components and Communications.

Textbooks/References:

1. Knowledge Management –Waman S Jawadekar,Tata McGraw Hill Education Private Limited-2011
2. Knowledge Management –E Sudhir Warier, Vikas Publishing House Pvt. Ltd. -2009
3. Measuring and Managing Knowledge: Tom Housel and Arthur Bell 2001, International Edition, Tata McGraw-Hill
4. Knowledge Management: Ganesh Natarajan, President & CEO Aptech

21CSA336	MICROPROCESSOR SYSTEMS	L-T-P-C:3-0-0-3

Course Objectives

- The objective of the course is to make students clear about the architecture and instruction set of typical 8-bit microprocessor. It also deals with Assembly Language Programming using a macro-assembler. Input-output techniques and important programmable support chips used in microprocessor-based systems are discussed in detail.

Course Outcomes

COs	Description
CO1	To understand the general architecture of microprocessor system.
CO2	To understand basic architecture of 8 bit microprocessor- Intel 8085, instruction fetching, decoding and execution.
CO3	To understand the basic programming instructions, addressing modes.
CO4	To understand the different interrupts and interrupts handling in 8085.
CO5	To understand the Programmable Peripheral Interface, ADC,DAC, Programmable interval timer.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-
CO3	3	1	2	-	-	-	-	1	-
CO4	3	1	1	-	-	-	-	1	-
CO5	3	1	1	-	-	-	-	1	-
CAM	3	1	1	-	-	-	-	1	-

Syllabus

Unit 1: Introduction of Microcomputer System: CPU, I/O devices, clock, memory, bussed architecture, Tristate logic, address bus, data bus and control bus. Semiconductor Memories: Development of semiconductor memory, internal structure and decoding, memory read and write timing diagrams, MROM, ROM, EPROM, EEPROM, DRAM

Unit 2: Architecture of 8-bit Microprocessor: Intel 8085A microprocessor,Pin description and internal architecture. Operation and Control of Microprocessor: Timing and control unit, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state transition diagram.

Unit 3: Instruction Set: Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, macro RTLand micro RTL flow chart of few typical instructions; Unspecified flags and instructions. Assembly Language Programming: Assembler directives, simple examples;Subroutines, parameter

Unit 4: Interrupts: Interrupt structure of 8085A microprocessor, processing of vectored and nonvectored interrupts, latency time and response time; Handling multiple interrupts

Unit 5: Programmable Peripheral Interface: Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, programming; ADC and DAC chips and their interfacing. Programmable Interval Timer: Intel 8253, pin configuration, internal block diagram of counter and modes of operation, counter

read methods, programming, READ-BACK command of Intel 8254.

Textbooks/References:

1. Hall D.V.,"Microprocessor and Interfacing-Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, 2008.
2. Gaonkar R.S.,"Microprocessor Architecture,Programming and Applications", 5th Ed., Penram International, 2007.
3. Stewart J,"Microprocessor Systems- Hardware,Software and Programming", Prentice Hall International Edition,1990
4. Short K. L.,"Microprocessors and Programmed Logic", 2nd Ed.,Pearson Education, 2008.

21CSA337	MULTIMEDIA AND GRAPHICS	L-T-P-C:3-0-0-3

Course Objectives

- The course enables the student to learn the concepts of multimedia like text, speech, image and video processing in today's international standards. Further, it also adds an essence of multimedia systems design, multimedia networks, multimedia search engines and emerging multimedia value-added services.

Course Outcomes

COs	Description
CO1	Describe the types of media and define multimedia system
CO2	Describe the process of digitizing (quantization) of different analog signals
CO3	Use and apply tools for image processing, video, sound and animation.
CO4	Apply methodology to develop a multimedia system.
CO5	Apply acquired knowledge in the field of multimedia in practice and independently continue to expand knowledge in this field.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	1	3	1	-	-	-	2	-
CO2	2	-	-	1	-	-	1	1	2
CO3	2	1	3	2	-	-	1	2	-
CO4	2	2	3	1	-	-	3	3	1
CO5	3	3	3	3	-	1	2	2	2
CAM	2	2	3	1		1	1	2	2

Syllabus

Unit 1: Introduction: Graphics Systems – Raster Scan & Random Scan systems. Output Primitives,What is Multimedia? – Introduction to making Multimedia - Media Skills – Macintosh and Windows Platforms – Basic software tools.
Unit 2: Making instant Multimedia – Multimedia Authoring tools.
Unit 3: Multimedia Building Blocks: Text – Sound – Images.
Unit 4: Multimedia Building Blocks: Animation: types, techniques, key frame animation, utility, morphing. Virtual Reality concepts.– Video.
Unit 5: Multimedia and the Internet: The Internet and how it works – Tools for World Wide Web – Designing for the World Wide Web.

Textbooks/References:

1. Nigel Chapman – Digital Multimedia – Wiley – ISBN – 81-265-0489-7
2. John F. Koegel Buford – Multimedia Systems – PEARSON – ISBN – 81-78-08-162-8
3. Donald Hearn, Pauline Baker, " Computer Graphics – C Version", Pearson Education.
4. Steinmetz R. & Nahrstedt K., "Multimedia: Computing, Communications and Applications", Pearson Education.
5. David F. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill
6. Foley, van Dam, Feiner & Hughes, "Computer Graphics Principles & Practice", Pearson Education.
7. William M. Newman, Robert F. Sproull, "Principles of Interactive Computer Graphics" , Tata McGraw-Hill.
8. David F. Rogers, J. Alan Adams, "Mathematical Elements for Computer Graphics", Tata McGraw-Hill.
9. Tay Vaughan, "Multimedia: Making it Work", Tata McGraw-Hill.

21CSA338	SOCIAL AND PROFESSIONAL ISSUES IN COMPUTING	L-T-P-C:3-0-0-3

Course Objectives

- This course is designed to explore the nature and principles of ethics—including personal, professional, and corporate ethics - in a computing context. Address the interplay between ethics on the one hand; and law, society, politics, economy, justice, responsibility, honesty on the other. Explore specific ethical issues raised by the ubiquity of computer and information technology in today's society.

Course Outcomes

COs	Description
CO1	Able to identify social and ethical issues that arise in the development and application of computing technology in modern society
CO2	Understand the responsibilities of computer professionals as defined by the Software Engineering Code of Ethics and Professional Practice
CO3	Understand risks and security operations in an organization.
CO4	Able to formulate viewpoints concerning the current legal and ethical status of intellectual property rights – specifically trade secrets, trademarks, copyrights, patents, and licensing – as they relate to computer software
CO5	Able to handle some legal issues related to computer crime and hacking

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	-	2	-	-	-	-	1
CO2	3	-	-	2	-	-	-	-	1
CO3	3	1	1	-	-	-	1	-	1
CO4	2	1	-	2	-	-	1	-	1
CO5	2	2	2	-	-	-	1	2	-
CAM	3	1	2	2	-	-	1	2	1

Syllabus

Unit 1: Social Context: Introduction to the social implications of computing, Social implications of networked communication, Growth of, Control of, and access to the Internet, Gender – Related issues, Cultural issues, International Issues, Accessibility Issues (e.g. underrepresentation of minorities, Women and disabled in the computing profession), Public policy issues (e.g. electronic voting).

Unit 2: Analytical Tools: Making and evaluating ethical arguments, Identifying and evaluating ethical choices, Understanding the social context of design, Identifying assumptions and values. Professional Ethics: Community values and the laws by which we live, The nature of professionalism (Including care, attention and discipline, fiduciary responsibility, and mentoring).Keeping up-to-date as a professional (in terms of knowledge, tools, skills, legal and professional framework as well as the ability to self-assess and computer fluency), Various forms of professional credentialing and the advantages and disadvantages, The role of the professional in public policy, Maintaining awareness of consequences, Ethical dissent and whistle-blowing. Codes of ethics, conduct, and practice(IEEE, ACM, SE, AITP, and so forth), Dealing with harassment and discrimination, “Acceptable use” policies for computing in the work place. Healthy Computing environment (ergonomics)

Unit 3: Risks: Historical examples of software risks (such as the Therac-25 case), Implications of software complexity, Risk assessment and Risk Management; Risk removal, risk reduction and risk control.
Security Operations: Physical security, Physical access controls, Personnel access controls, Operational security,

Security polices for systems/networks, Recovery and Response, Dealing with problems (both technical and human)

Unit 4: Intellectual Property: Foundations of Intellectual Property, Copyrights, patents, and trade secrets, Software Piracy, Software Patents, Transactional issues concerning Intellectual Property. Privacy and Civil Liberties: Ethical and legal basis for privacy protection, Ethical and legal framework for freedom of information, Privacy implications of database systems (e.g. Data gathering, storage and sharing, massive data collecting, computer surveillance systems) Technological strategies for privacy protection, Freedom of expression in cyberspace, International and intercultural implications.

Unit 5: Computer Crime: History and examples of computer crime, "Cracking" ("Hacking") and its effects, Viruses, Worms, and Trojan Horses, Identity Theft, Crime Prevention strategies.

Textbooks/References:

1. Ethics for Information Age, 3rd Edition, Michael J. Quinn, Pearson/Addison Wesley, 2009

21CSA339	SOFT COMPUTING	L-T-P-C:3-0-0-3

Course Objectives

- The objective of this course is to familiarize with soft computing concepts, introduce and use the idea of Neural networks, fuzzy logic and use of heuristics based on human experience, introduce and use the concepts of Genetic algorithm and its applications to soft computing using some applications.

Course Outcomes

COs	Description
CO1	Understand the concept of soft computing and its applications
CO2	Understand the design of neural network architectures
CO3	Understand the concept of fuzzy systems.
CO4	Understand neuro-fuzzy hybrid systems and its applications
CO5	Understand the genetic algorithm concepts.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	2	3
CO2	3	3	2	-	-	-	1	2	2
CO3	3	3	2	-	-	-	1	2	2
CO4	2	3	2	-	-	-	1	3	1
CO5	3	1	-	-	-	-	3	1	1
CAM	3	3	2	-	-	-	1	2	2

Syllabus

Unit 1: Introduction to Soft Computing-Concept of computing systems-"Soft" computing versus "Hard" computing-Characteristics of Soft computing-Some applications of soft computing techniques.

Unit 2: What is Neural Network, Learning rules and various activation functions, Single layer Perceptron, Back Propagation networks, Architecture of Back propagation (BP)Networks, Backpropagation Learning, to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

Unit 3: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

Unit 4: Hybrid Soft Computing Techniques and Applications-Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing-based hybrid fuzzy controllers.

Unit 5: Genetic Algorithm: -History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization

Textbooks/References:

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI

2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

Course Objectives

- The main aim of this course is to provide basic ideas to manage and administer computer systems as well as networks. Students are trained with practical sessions

Course Outcomes

COs	Description
CO1	Understand the role of a System/Network administrator
CO2	Understand the basic software commands for managing and administering the systems/networks.
CO3	Develop skills in doing subnetting, routing, and VPN installation.
CO4	Develop the skill to test the security vulnerabilities and their countermeasures.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	1	2	2	2	-	-	-
CO2	2	1	1	1	1	-	-	-	-
CO3	2	1	2	-	-	-	-	2	-
CO4	2	1	2	-	-	-	-	1	-
CAM	2	1	2	2	2	2	-	2	-

Syllabus

Unit 1: Understanding System Administration – Network Operating System - Network File System – Admin User - Administration Tools – Commands - Configuration Files – Log Files - Backup and Restore Files.
Unit 2: User Management - Issues - Registration – Account Policy – Login environment – Setting up and Supporting Users – Disk Quotas.
Unit 3: Network Administration – Topologies – Network Devices - Understanding TCP/IP – Administering TCP/IP - Network Configuration – Static and Dynamic -Routing, Switching, VPN and other security protocols- Firewall administration
Unit 4: Introduction to File Server – Setting Up a File Server – Network File Systems - SAMBA – Web Server.
Unit 5: Understanding Directory Services – Active Directory/LDAP – Network Security – Importance of Port Number – Tracking Services – Monitoring your System – Network Security Tools Implement and monitor security measures for the protection of computer systems, networks, and information.

Textbooks/References:

1. Red Hat Linux - System Administration
2. Windows Server 2016 Administration Fundamentals by Bekim Dauti
3. UNIX and Linux System Administration Handbook, 4thEd., by Nemeth, Snyder, Hein and Whaley (Prentice Hall, 2010)
4. The Practice of System and Network Administration, 2nd Ed., by Limoncelli, Hogan and Chalup (Addison Wesley, 2007)
5. Mark Burgess – Principles of Network and System Administration –2ndEdition - John Wiley & Sons
6. Essential System Administration: Tools and Techniques for Linux and Unix Administration, 3rd Edition 3rd Edition by Æleen Frisch
7. LDAP System Administration: Putting Directories to Work 1st Edition by Gerald Carter
8. TCP/IP Network Administration (3rd Edition; O'Reilly Networking) Third Edition by Craig Hunt
9. Network Troubleshooting Tools (O'Reilly System Administration) 1st Edition by Joseph D Sloan
10. Linux Cookbook: Essential Skills for Linux Users and System & Network Administrators 2nd Edition by Carla Schroder

21CSA341	COMPUTER GRAPHICS	L-T-P-C:3-0-0-3

Course Objectives

- The primary objective of this course is to give the basic principles of 2D and 3D computer graphics, to study the elementary mathematical techniques that allow us to position objects in three dimensional spaces and techniques necessary to produce basic 2D/3D dimensional illustrations.

Course Outcomes

COs	Description
CO1	Understand various Graphics applications, different video display devices, and describe Raster-Scan Systems and Random-Scan Systems.
CO2	Construct lines and circles by applying Bresenham's Line Algorithm and Midpoint Circle Algorithm and apply appropriate filling algorithms to fill objects.
CO3	Describe two-dimensional and three-dimensional transformations.
CO4	Describe line clipping and projections.
CO5	Implement basic graphics programming using OpenGL.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	2	-
CO3	3	2	1	-	-	-	-	2	-
CO4	3	2	1	-	-	-	-	2	-
CO5	3	3	3	2	2	1	1	1	1
CAM	3	2	1	2	2	1	1	2	1

Syllabus

Unit 1: Applications of Graphics, Display devices, Random and Raster Graphics systems, Output Primitives: Bresenham's Line Algorithm, Midpoint Circle Algorithm; Filled Area Primitives: Boundary-Fill Algorithm, Flood-Fill Algorithm; Bitmap Character Generation.

Unit 2: Two-Dimensional Geometric Transformations: Translation, Rotation, Scaling, Homogeneous coordinates. Reflection, Shear. Three-Dimensional Geometric Transformations: Translation, Rotation, Scaling, Reflection, Shear.

Unit 3: Two-Dimensional Viewing: Window-to-viewport transformation, Clipping - Cohen Sutherland Line Clipping algorithm.

Unit 4: Three-Dimensional Viewing: Projections, Parallel Projections, Perspective Projections, View Volumes**.**

Unit 5: Graphics Programming: OpenGL Introduction: Command Syntax, Drawing and filling images, patterns, filling regular and irregular shapes, Outputting Text, Justifying Text, Animation. Drawing with mouse, building mouse cursors, freehand drawing using mouse, menus using mouse.

Textbooks/References:

1. Computer Graphics, C Version, D. Hearn, M.P. Baker, 2nd Edition, Pearson Education
2. OpenGL Programming Guide, M. Woo, J. Neider, T. Davis, D. Shreiner, 3rd edition, Pearson Education

ELECTIVE III, IV, V, VI, VII (PG Level)

21CSA631 BIG DATA ANALYTICS AND VISUALIZATION L-T-P-C:3-0-0-3

Course Objectives

- To provide an overview of big data analytics by introducing the tools required to manage and analyze big data like Hadoop, NoSql MapReduce with scalability and streaming capability.

Course Outcomes

COs	Description
CO1	Gain the ability to choose the right solution for a commercial task involving big data, including databases, architectures and cloud services.
CO2	Gain an understanding of the analysis of big data including methods to visualise and automatically learn from vast quantities of data.
CO3	Develop the programming skills to build solutions using big data technologies such as Map Reduce, scripting for No-SQL, Apache Mahout, Hive, and the ability to write parallel algorithms for multi-processor execution.
CO4	Understanding of the issues of scalability of databases, data analysis, search and optimization.
CO5	Get insights into different data visualization techniques

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	-	1	1	1	1
CO2	2	1	2	-	-	1	1	1	-	1
CO3	2	2	2	-	-	1	1	2	2	1
CO4	1	-	-	-	-	-	-	1	-	1
CO5	1	-	-	-	-	-	-	-	-	1
CAM	1	2	2	-	-	1	1	1	2	1

Syllabus

Introduction of big data – Big data characteristics - Volume, Veracity, Velocity, and Variety – Data Appliance Challenges and Issues, Case for Big data, Big data sources, Features of data. - Evolution of Big data – Best Practices for Big data Analytics - and Integration tools Introduction to Data Modeling, Data Models Used in Practice: Conceptual data models, Logical data models, Physical data models, Common Data Modeling Notations , How to Model Data : Identify entity types, Identify attributes, Apply naming conventions, Identify relationships,

Apply data model patterns, Assign keys, Normalize to reduce data redundancy, Introduction to elementary data analysis: Measures of center: Mean, Median, Mode, Variance, Standard deviation, Range. Normal Distribution: Center, Spread, Skewed Left, Skewed Right, outlier. Correlations: Correlation Patterns: Direction relationship, Magnitude Relationship. Introduction to Bayesian Modeling: Bayes Rule, Probabilistic Modeling Introduction to Predictive Analytics: Simple Linear regression, Multiple Linear regression, Logistic Linear Regression. History of Visualization, Goals of Visualization, Types of Data Visualization: Scientific Visualization, Information Visualization, Visual Analytics, Impact of visualization Introduction to Data Processing , Map Reduce Framework , Hadoop ,HDFS , S3 Hadoop Distributed file systems, Apache Mahout, Hive,Sharding, Hbase , Impala , Case studies : Analyzing big data with twitter ,Big data for Ecommerce , Big data for blogs.

Textbooks/References:

1. Frank J Ohlhorst, Big Data Analytics: Turning Big Data into Big Money, Wiley and SAS Business m.Series, 2012.
2. Michael C. Reingruber (Author), William W. Gregory(Author),The Data Modeling Handbook: A Best-Practice Approach to Building Quality Data Models, 1st Edition by A Wiley QED publications
3. Colleen Mccue, Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis, Elsevier, 2007
4. Philip Bobko, Correlation and Regression: Applications for Industrial Organizational psychology and Management (Organizational Research Methods) 2nd Edition, SAGE Publications Inc
5. Timothy Z. Keith, Multiple Regression and Beyond: An Introduction to Multiple Regression and Structural Equation Modeling, 2nd Edition, Routledge.

21CSA632	BIOINFORMATICS	L-T-P-C:3-0-0-3

Course Objectives

- The main objective of the course is to get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis. This course gives an overview about biological macromolecular structures and structure prediction methods along with basic understanding on computer aided drug design techniques.

Course Outcomes

COs	Description
CO1	Perform DNA sequence analysis using biological sequence data from online repositories.
CO2	Perform Protein structural analysis and do protein structure prediction.
CO3	Do computer aided drug design, docking, screening, QSAR.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	3	3	3
CO2	3	3	3	-	-	-	-	3	3	3
CO3	3	3	3	-	-	-	-	3	3	3
CAM	3	3	3	-	-	-	-	3	3	3

Syllabus

Unit 1: Introduction to genes and proteins, organization of DNA, RNA and protein, Motifs, Restriction maps and Restriction enzymes, DNA sequence analysis, DNA Databases, Searching scientific information using search engines, Protein structure and function, protein sequence databases, sequence alignment, PAM matrix, Global and local alignment, BLAST: features and scores, Multiple sequence alignment, Conservation score, phylogenetic trees.

Unit 2: Protein sequence analysis, hydrophobicity profiles, non-redundant datasets, Protein secondary structures, Ramachandran plot, propensity, secondary structure prediction, Protein tertiary structure, Protein Data Bank, visualization tools, structural classification, contact maps, Protein structural analysis, protein structure prediction.

Unit 3: Protein stability, energetic contributions, database, stabilizing residues, stability upon mutations, Protein folding rates, proteins interactions, binding site residues, Computer aided drug design, docking, screening, QSAR..

Textbooks/References:

1. M. Michael Gromiha, Protein Bioinformatics: From Sequence to Function, Academic Press, 2010
2. D.E. Krane and M.L. Raymer, Fundamental concepts of bioinformatics, Pearson Education Inc. 2006

21CSA635	DIGITAL IMAGE PROCESSING	L-T-P-C:3-0-0-3

Course Objectives

- This course introduces the basics of image processing and explores the algorithms in spatial and frequency domain relevant to image enhancement, restoration and segmentation applications.
- This course introduces binary, gray scale and color image processing.

Course Outcomes

COs	Description
CO1	Understand fundamental principles of image processing and perform basic operations on pixels.
CO2	Apply the image processing algorithms and filters in spatial domain for image enhancement and restoration.
CO3	Analyze images in the frequency domain and explore the frequency domain filters for image enhancement and restoration**.**
CO4	Apply segmentation algorithms on Images and analyze their performance.
CO5	Apply morphological processing on images for simple image processing applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	1	1	-
CO2	2	2	-	-	-	-	-	3	2	1
CO3	3	1	-	-	-	-	-	2	2	-
CO4	3	3	-	-	-	-	-	2	2	2
CO5	3	3	3	-	-	-	1	1	1	2
CAM	3	3	3	-	-	-	1	2	2	2

Syllabus

Unit 1: Digital Image Fundamentals: Elements of Visual Perception- Image Sensing and Acquisition-Image Sampling and Quantization – Basic Relationships between Pixels - Image interpolation. Intensity Transformations and Spatial Filtering: Basic Intensity transformation Functions – Histogram Processing – Fundamentals of Spatial Filtering –Smoothing and Sharpening Spatial Filters.

Unit 2: Filtering in Frequency Domain: 2D Discrete Fourier Transforms - Basics of filtering - Image Smoothing and Image Sharpening Using Frequency Domain Filters - Selective Filtering, Image Restoration: Noise Models – Restoration using Spatial Filters – Periodic Noise Reduction by Frequency Domain Filters.

Unit 3: Morphological Image Processing: Erosion – Dilation – Opening – Closing – Hit-or-Miss Transform - Extraction of Connected Components. Image Segmentation: Fundamentals – Point, Line and Edge Detection – Thresholding-Region Based Segmentation – Region Growing – Region Splitting and Merging. Color image processing.

Textbooks/References:

1. Gonzalez RC, Woods RE. Digital Image Processing. Third edition;2008**.**
2. Pratt W K.Digital Image Processing, Fourth Edition, John Wiley & Sons;2007.
3. Castleman K R. Digital Image Processing, Prentice Hall;1996.
4. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins. Digital Image Processing Using MATLAB®. Prentice Hall, 2004.
5. Russ JC, Introduction to Image Processing and Analysis. CRC press; 2007

21CSA636	COMPUTATIONAL INTELLIGENCE	L-T-P-C:3-0-0-3

Course Objectives

- The Objective of the course is to make students familiar with basic principles of various computational methods of data processing that can commonly be called computational intelligence. This course introduces the fundamentals of key intelligent systems technologies including knowledge-based systems, neural networks, fuzzy systems, and evolutionary computation

Course Outcomes

COs	Description
CO1	Understand the need for and importance of Computational intelligence
CO2	Understand the concepts of neural networks and backpropagation learning
CO3	Implement associative memory using neural networks
CO4	Understand the idea of fuzzy logic in real world problems
CO5	Understand hybrid approaches to solve real world problems

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	2	-
CO4	2	3	3	-	-	-	-	1	2	-
CO5	2	3	3	-	-	-	-	1	2	-
CAM	3	3	3	-	-	-	-	1	2	-

Syllabus

Artificial Intelligence – a Brief Review – Pitfalls of Traditional AI – Need for ComputationalIntelligence – Importance of Tolerance of Imprecision and Uncertainty – ConstituentTechniques – Overview of Artificial Neural Networks - Fuzzy Logic – EvolutionaryComputation.
Neural Network: Biological and Artificial Neuron, Neural Networks, Supervised andUnsupervised Learning. Single Layer Perceptron - Multilayer Perceptron – BackpropagationLearning.
Neural Networks as Associative Memories - Hopfield Networks, Bidirectional AssociativeMemory. Topologically Organized Neural Networks – Competitive Learning, KohonenMaps.
Fuzzy Logic: Fuzzy Sets – Properties – Membership Functions - Fuzzy Operations. FuzzyLogic and Fuzzy Inference - Applications. Evolutionary Computation – ConstituentAlgorithms. SwarmIntelligence Algorithms - Overview of other Bio-inspired Algorithms - Hybrid Approaches(Neural Networks, Fuzzy Logic, Genetic Algorithms etc.).

Textbooks/References:

1. Laurene Fausett, Fundamentals of Neural Networks, 2nd edition, Pearson, 1993
2. Ross T J, “Fuzzy Logic with Engineering Applications”, McGraw Hill, 1997.
3. Eiben A E and Smith J E, “Introduction to Evolutionary Computing”, Second Edition, Springer, Natural Computing Series, 2007.
4. Kumar S, “Neural Networks - A Classroom Approach”, Tata McGraw Hill, 2004.
5. Engelbrecht, A.P, “Fundamentals of Computational Swarm Intelligence”, John Wiley & Sons, 2006.
6. Konar. A, “Computational Intelligence: Principles, Techniques and Applications”, Springer Verlag,

2005.

21CSA637	COMPUTER GRAPHICS AND VISUALIZATION	L-T-P-C:3-0-0-3

Course Objectives

- To introduce the use of a graphics system and become familiar with building approach of graphics system components and algorithms related with them. Also covers the basic principles of 2D and 3D graphics. And an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition

Course Outcomes

COs	Description
CO1	Understand various types of video displays and colour models.
CO2	Understand and implement various drawing primitives using OPENGL
CO3	Understand fundamental concepts within computer graphics such as geometrical transformations.
CO4	Understand various 3D object representation techniques
CO5	Understand the concept of illumination models, removal of hidden surfaces and rendering.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	2	1	-	1	1	1
CO3	3	2	2	-	-	-	-	-	2	-
CO4	3	2	3	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	2	-
CAM	3	2	3	2	2	1	-	1	2	1

Syllabus

Computer Graphics Fundamentals: Overview of CG - Video Displays -Color Models- Output Primitives. Introduction to OPENGL- Points, Lines – Specifying a 2D World Coordinate Reference Frame in OpenGL-OpenGL Point Functions, Line Functions Polygon Fill Area Functions,Vertex Arrays - Line Drawing Algorithms - Circle Generation Algorithm Filled AreaPrimitives OpenGL fill Area Functions - Scan Line Polygon Filling Algorithms – BoundaryFill - Flood Fill Algorithms
Attributes of Output Primitives. Geometric Transformations: Basic 2Dtransformations-Other Transformations-Reflection and Shearing. OpenGL Geometric Transformation Functions.3D Object Representation: Fractals - Geometrical Transformation for - 3D Objects – Viewing and Clipping 2D Viewing Functions Clipping Operations. Three Dimensional Viewing:Viewing Pipeline, Viewing Coordinates. Projections: Parallel Projections, Perspective Projections. OpenGL Two-Dimensional and Three-Dimensional Viewing Functions-OpenGL Animation.Visible Surface Detection and Illumination Models: Visible SurfaceDetection Methods – Illumination Methods and Surface Rendering – Polygon. Rendering Methods: Constant Intensity Shading, Gouraud Shading, Phong Shading. OpenGL Illumination and Surface Rendering Functions, GUI – OpenGL Interactive Input Device Functions. The User Dialog –Interactive Picture Construction Techniques – Color Models - Computer Animation**.**

Textbooks/References:

1. Donald Hearn and Pauline Baker, “Computer Graphics with OpenGL ”, Third Edition, Prentice Hall of India, 2009.
2. Roy A. Plastock and Gordon Kalley, “Schaum's Outline Series - Theory and Problems ofComputer Graphics”, Second Edition, Tata McGraw-Hill, 2000.
3. Foley J.D, Van Dam A, Eiener S.K. and Hughes J.F., “Computer Graphics Principles andPractice”,

Second Edition, Pearson Education, 1996.
4. Rajiv Chopra , “Computer Graphics – A Practical Approach”

21CSA638	DATABASE ADMINISTRATION	L-T-P-C:3-0-0-3

Course Objectives

- The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS. This course focuses on the administration of a DBMS including creation, management, maintenance, and operation of a database management system.

Course Outcomes

COs	Description
CO1	Establish and in-depth understanding of Database Administration using the Oracle DBMS interfaces
CO2	Analyze and model requirements and constraints for the purposes of installing, configuring, and tuning a DBMS
CO3	Develop methods for implementing security, back-up and recovery measures
CO4	Develop methods for creating and Managing Database Storage Structures and understand network responsibilities for DBA.
CO5	Acquire and apply the knowledge and skills required to Monitoring the Performance of the Database computing.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	2	-
CO2	2	2	2	-	-	-	-	2	2	-
CO3	1	3	2	-	-	-	-	-	2	-
CO4	3	2	2	-	-	-	-	1	2	-
CO5	2	3	3	-	-	-	-	-	2	2
CAM	2	3	2	-	-	-	-	2	2	2

Syllabus

Introduction: DBMS Architecture and Data Independence -DBA Roles and Responsibilities,DBA types.
SQL * PLUS Overview: SQL plus Fundamentals, Producing more readable outputs, Accepting values at Runtime, Using iSQL *Plus. Modifying Data: Using DML, TCL-Managing Constraints -Managing Views. User Access and Security: Creating and Modifying User Accounts- Managing User Groups , granting & revoking authority .
Oracle Overview and Architecture: Overview of Logical and Physical Storage Structures. Managing Oracle Instances. Control and Redo Log Files: Managing the Control Files. Managing Tables, Indexes and Constraints. Managing Users and Security- granting & revoking privileges
Introduction to Network Administration:Network Design Considerations, Network Responsibilities for the DBA, Network Configuration, Overview of Oracle Net Features, Oracle Net Stack Architecture.Storage options - Network attached storage
Backup and Recovery Overview: Defining a Backup and Recovery Strategy,full & incremenal back ups, types of recovery , Testing Recovery Plan ,Disaster Planning - backups for Disaster Recovery, disaster prevention, Introduction to Performance Tuning: Brief Overview of Tuning methodology, General Tuning Concepts

Textbooks/References:

1. Craig S. Mullins, “Database Administration: The Complete Guide to DBA Practices andProcedures”, Second Edition, Addison Wesley, 2012.
2. C.J. Date, “Introduction to DatabaseSystems”, Eighth Edition, Addison Wesley, 2003.
3. Chip Dawes, Biju Thomas, “Introduction to Oracle 9i SQL”, BPB, 2002.

4. Bob Bryla, Biju Thomas, “Oracle 9i DBA Fundamental I”, BPB, 2002.

21CSA639	MALWARE ANALYSIS	L-T-P-C:3-0-0-3

5. Kevin Loney ,"Oracle Database 10g: The Complete Reference",McGraw-Hill

Course Objectives

- This course aims to identify malware types based on static and behavioral analysis, determine malware capabilities and persistence vectors and evaluate potential threat from malware activity on the network.

Course Outcomes

COs	Description
CO1	Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
CO2	Understand executable formats, Windows internals and API, and analysis techniques.
CO3	Extract investigative leads from host and network based indicators associated with a malicious program
CO4	Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti analysis techniques in future malware samples.
CO5	Achieve proficiency with industry standard tools including IDA Pro, OllyDbg, WinDBG, PE Explorer, ProcMon etc.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	1	-	1	-
CO2	3	1	1	-	-	-	1	-	1	-
CO3	3	1	-	-	-	-	1	-	-	-
CO4	3	1	1	-	-	-	1	-	1	-
CO5	3	2	3	-	-	-	2	-	2	-
CAM	3	1	1	-	-	-	1	-	1	-

Syllabus

Introduction to malware, Basic Static and Dynamic Analysis, Overview of Windows file format, PEView.exe, Patching Binaries , Disassembly(objdump, IDA Pro), Introduction to IDA, Introduction to Reverse Engineering, Extended Reverse Engineering using GDB and IDA, Advanced Dynamic Analysis - debugging tools and concepts, Malware Behavior - malicious activities and techniques, Analyzing Windows programs – Win API, Handles ,Networking , COM, Data Encoding, Malware Countermeasures , Covert Launching and Execution, Anti Analysis - Anti Disassembly, VM, Debugging -, Packers – packing and unpacking, Intro to Kernel – Kernel basics, Windows Kernel API, Windows Drivers, Kernel Debugging, Rootkit Techniques- Hooking, Patching, Kernel Object Manipulation , Rootkit Anti-forensics , Covert analysis

Textbooks/References:

1. Michael Sikorski and Andrew Honig, “ Practical Malware Analysis”, No Starch Press,2012
2. Jamie Butler and Greg Hoglund, “Rootkits: Subverting the Windows Kernel”, Addison-Wesley, 2005
3. Dang, Gazet and Bachaalany, “Practical Reverse Engineering”,Wiley,2014
4. Reverend Bill Blunden, “The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System” Second Edition, Jones& Bartlett, 2012.

21CSA640	DEEP LEARNING	L-T-P-C:3-0-0-3

Course Objectives

- This course gives an exposure to neural networks and deep learning architectures.
- This course focuses on implementing, training, and debugging deep feedforward neural networks.
- This course enables the application of Convolutional neural networks and RNN for Images and image sequences.

Course Outcomes

COs	Description
CO1	Understand the main architectures for deep learning algorithms
CO2	Design and implement deep neural network systems.
CO3	Identify new application requirements in the field of computer vision.
CO4	Apply Machine learning algorithms as deep learning models
CO5	Develop algorithms for resolving huge data processing problems

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	1	1	1	1
CO2	3	2	2	-	-	-	1	1	1	1
CO3	2	2	2	-	-	-	1	1	1	1
CO4	2	2	1	-	-	-	1	1	1	1
CO5	2	2	1	-	-	-	1	1	2	1
CAM	2	2	2	-	-	-	1	1	1	1

Syllabus

Unit 1: Deep Feedforward Networks Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms Dataset Augmentation, Noise Robustness Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training**.**

Unit 2: Convolutional Networks the Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features**.**

Unit 3: Sequence Modeling: Recurrent and Recursive Nets Recurrent Neural Networks, Bidirectional RNNs, Encoder- Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory

Textbooks/References:

1. Goodfellow I, Bengio Y, Courville A. Deep learning. MIT press; 2016.
2. Patterson J, Gibson A. Deep learning: A practitioner's approach. " O'Reilly Media, Inc."; 2017.
3. Chollet F. Deep Learning mit Python und Keras: Das Praxis-Handbuch vom Entwickler der Keras-

Bibliothek. MITP-Verlags GmbH & Co. KG; 2018.

Course Objectives

- The aim of this course is to study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open-source operating systems); Hardware and software features that support these systems.

Course Outcomes

COs	Description
CO1	Understand the basic concepts of different operating systems.
CO2	Acquire knowledge on the basic concepts and design of distributed operating systems.
CO3	Understand the concept of distributed file system, shared memory, and distributed scheduling.
CO4	Acquire knowledge on fault tolerance and fault recovery techniques and different types of protection and security measures of distributed systems.
CO5	Understand about multiprocessor OS and database OS.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	1	-
CO3	2	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	2
CO5	1	-	-	-	-	-	-	-	-	-
CAM	2	3	-	-	-	-	-	-	1	2

Syllabus

Unit 1:
Introduction: Review of core Operating systems, network Operating systems, Parallel, Distributed, Embedded & Real Time, Mobile, Cloud and Other Operating System Models

Distributed Operating System- Introduction, design issues, Communication primitives, Limitations of distributed system. Lamp ports logical clocks - vector clocks - casual ordering of messages - global state - cuts of a distributed computation - termination detection.

Unit 2:
Remote Procedure Calls, Distributed Mutual Exclusion:
The RPC Model, Transparency of RPC, Implementation of RPC Mechanism, STUB Generation, RPC Messages, Server Management, Parameter Passing, Call Semantics, Communication Protocol for RPCs, Complicated RPC, Client-Server Binding, Security.

Token based Algorithms, non-taken based algorithms, comparative analysis, Deadlock handling Strategies, Classification of agreement Problems.

Unit 3

Distributed File system, shared Memory and Distributed scheduling:
Distributed File system-Mechanisms, design issues, Distributed Shared Memory: Architecture, Algorithms for implementing DSM, Memory coherence, coherence protocols, Design issues.
Distributed Scheduling- Issues, Components, Load distributing algorithms, Performance comparison.

Unit 4
Failure Recovery, Fault Tolerance, Protection and Security:
Failure Recovery and Fault Tolerance -Basic concepts, Classification of failures, Backward and forward recovery, Basic approaches, recovery in concurrent systems, Fault tolerance issues, Atomic actions & protocols, Commit, non-blocking, voting-static, dynamic protocols.

Protection & Security: Preliminaries, Access matrix model, Implementation and safety, Data security- model, conventional, modern, private-public key Cryptography, multiple encryptions, Authentication, Digital Signatures.

Unit 5
Multiprocessor Operating Systems and Database Operating system:
Multiprocessor Operating System: Introduction, Architecture, Interconnection networks for Multiprocessing, Caching, Structure of multiprocessing Operating System, Threads. Various types of Threads, processor synchronization.

Database operating systems: Introduction, requirements of Database OS, database systems, Concurrency control-model, problem, distributed database systems Concurrency control algorithms – synchronization primitives, lock based, timestamp based and data replication algorithms.

Textbooks/References:

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", Tata McGraw-Hill Publishing Company Limited.
2. Silberschatz-Galvin, “Operating System Concepts” 6th edition. Addison Willey Publications. (only for first unit: review of OS)
3. Andrew S.Tanenbaum, "Modern operating system", PHI
4. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI
5. Andrew S.Tanenbaum, "Distributed operating system", Pearson Education
6. Relevant Research Papers from the Journals/Conferences.

21CSA642	INFORMATION RETRIEVAL	L-T-P-C:3-0-0-3

Course Objectives

- The main objective of this course is to present the scientific support in the field of information search and retrieval.

Course Outcomes

COs	Description
CO1	Understand the concepts of indexing, vocabulary, normalization, and dictionary in Information Retrieval.
CO2	Define a Boolean model and a vector space model and explain the differences between them.
CO3	Evaluate information retrieval algorithms and give an account of the difficulties of evaluation.
CO4	Understand various methods of text classification.
CO5	Understand the basics of XML and Web search

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	1	-	-	1
CO2	2	1	1	-	-	-	1	-	1	1
CO3	1	1	2	-	-	-	1	1	1	1
CO4	2	2	2	-	-	-	1	1	1	1
CO5	2	2	2	-	-	-	1	1	1	1
CAM	2	1	2	-	-	-	1	1	1	1

Syllabus

Unit 1: Introduction : Information Retrieval Early Developments, Information Retrieval in Libraries and Digital Libraries, Information Retrieval Problem, Information Retrieval System, Information Retrieval Web**.**
Unit 2: Boolean Expression Based Retrieval: Vocabulary and Postings, Lists, Dictionaries and Tolerant Retrieval, Index Construction and Compression, Scoring and Vector Space Model, Score Computation, Evaluating Information**.**
Unit 3: Retrieval Systems: Relevance Feedback and Query Expansion, XML Based Retrieval, Retrieval Metrics, Implicit Feedback through Global Analysis.
Unit 4: Probabilistic Models, Language Models, Text Classification, Vector Space Classification, SVM Based Document Classification.
Unit 5: Latent Semantic Indexing, Web Search, Web Crawlers, Link Analysis, Unstructured Data Retrieval Semantic Web, Ontology, Implementations using Natural Language Toolkit**.**

Textbooks/References:

1. C. Manning, P. Raghavan and H. Schütze, “Introduction to Information Retrieval”,Cambridge University Press, 2008.
2. R. Baeza-Yates and B. Ribeiro Neto, “Modern Information Retrieval: The Conceptsand Technology Behind Search”, Second Edition, Addison Wesley, 2011.
3. David A. Grossman and Ophir Frieder “Information Retrieval: Algorithms andHeuristics”, Second Edition, Springer 2004.

21CSA643	CONNECTED INTERNET OF THINGS DEVICES	L-T-P-C:3-0-0-3

Course Objectives

- To learn to specify, design and program modern connected electronic systems based on commodity smartphones and sensor networks.

Course Outcomes

COs	Description
CO1	Enables student to understand the basics of Internet of things and protocols.
CO2	Introduces some of the application areas where Internet of Things can be applied.
CO3	Students will learn about the middleware for Internet of Things.
CO4	Understand the concepts of Web of Things

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	1	1	2	2
CO2	2	3	2	-	-	-	1	1	2	2
CO3	3	1	2	-	-	-	1	1	1	1
CO4	2	1	-	-	-	-	1	1	-	-
CAM	3	1	2	-	-	-	1	1	2	2

Syllabus

Unit 1: IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues
Unit 2: IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4– BACNet Protocol– Mod bus – KNX – Zigbee– Network layer – APS layer – Security
Unit 3: IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.
Unit 4: WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.
Unit 5: IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc

Textbooks/References:

1. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
3. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
5. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”,1st Edition, VPT, 2014
6. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything”, 1st Edition, Apress Publications, 2013

7. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1- 4493-9357-1

21CSA644	CLOUD SECURITY	L-T-P-C:3-0-0-3

Course Objectives

- To explore high-level concepts of cloud landscape, architectural principles, techniques, design patterns and real-world best practices applied to Cloud service providers and consumers and delivering secure Cloud based services.
- To explore the guiding security design principles, design patterns, industry standards, applied technologies and addressing regulatory compliance requirements critical to design, implement, deliver and manage secure cloud-based services.

Course Outcomes

COs	Description
CO1	Provide overview of cloud computing architectures, protocols, and models
CO2	Identify the known threats, risks, vulnerabilities, and privacy issues associated with Cloud based IT services.
CO3	Understand the concepts and guiding principles for designing and implementing appropriate safeguards and countermeasures for Cloud based IT services.
CO4	Understand security architectures that assures secure isolation of physical and logical infrastructures including computer, network, and storage.
CO5	Understand the industry security standards, regulatory mandates, policies and compliance requirements for Cloud based infrastructures.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	2	-	-	-	3	-	-
CO2	3	1		2	-	-	2	1	-	-
CO3	3	1	-	-	-	-	2	2	2	-
CO4	3	1	-	-	-	-	-	2	2	1
CO5	3	1	-	2	-	-	-	1	2	1
CAM	3	1	-	2	-	-	2	2	2	1

Syllabus

Introduction to cloud computing: - Evolution of cloud computing-Definition of cloud computing, Architectural and Technological Influences of Cloud Computing -NIST reference model, Service delivery model, Deployment models, Cloud Computing Roles - Risks and Security Concerns Benefits and challenges of cloud adoption-Introduction to popular cloud platforms, Virtualization, Containers Security Introduction and Distributed Computation: -Security design principles for Cloud Computing-Concepts of security, Security Patterns for Cloud Computing-Network Security, Identity & Access Management & Trust- Threats and Risk analysis, Attacks in cloud, STRIDE model, Infrastructure security, virtualization and container security, Distributed computation-benefits and challenges, map-reduce concept-Advanced Security Concepts:- Trustworthy cloud infrastructures, Differential privacy, Secure computations, High-availability and integrity layer for cloud storage, Homomorphic encryption, Malware and cloud, Cloud forensics-Cloud-centric regulatory compliance issues and mechanisms

Textbooks/References:

1. Tim Mather, S. Kumaraswamy and S. Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, O’Reilly Media, 2009
2. Ronald L. Krutz Russell Dean Vines "Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley ,2010
3. [Paper] Roy, Indrajit, et al. "Airavat: Security and Privacy for MapReduce." NSDI. Vol. 10. 2010.
4. [Paper] Bowers, Kevin D., Ari Juels, and AlinaOprea. "HAIL: a high-availability and integrity layer for cloud storage" Proceedings of the 16th ACM conference on Computer and communications security. ACM, 2009.
5. [Paper] Dean, Jeffrey, and Sanjay Ghemawat. "MapReduce: simplified data processing on large clusters" Communications of the ACM 51.1 (2008): 107-113.

21CSA645	LAN SWITCHING AND ADVANCED ROUTING	L-T-P-C:3-0-0-3

Course Objectives

- To introduce students to more advanced IP routing concepts including: Cisco router spanning tree protocol, ipv4 routing protocols, virtual private networks, ipv6 routing protocols, wide-area networks, and routing troubleshooting techniques. Also introduce students to a broad range TCP/IP topics including: IP addressing, protocols, ports, sockets, communications, packet fragmentation and sequencing, subnetting, and packet sniffers.

Course Outcomes

COs	Description
CO1	Demonstrate a detailed knowledge of routing and switching terminology
CO2	Demonstrate a detailed knowledge of the operation and configuration of switches and routers including protocols and addressing.
CO3	Design and implement a hierarchical IPv4 and IPv6 addressing and subnetting scheme.
CO4	Access various router components, remotely access routers, and test network connectivity.
CO5	Understand protocols such as Spanning Tree protocol (STP), RIP and IGRP.
CO6	Configure and understand the role of Virtual LANs (VLANs) and WLAN in a switched LAN

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	-	2	-	-	2
CO2	3	-	2	-	1	1	2	1	3	1
CO3	3	2	1	-	1	1	2	1	3	1
CO4	2	2	-	1	1	1	1	1	-	1
CO5	3	-	-	-	-	-	2	-	2	-
CO6	3	3	3	2	2	2	1	1	3	2
CAM	3	2	3	2	1	1	2	1	3	1

Syllabus

Unit 1: IPv4 4 & IP V6 Network Addresses, IPv6 Network Addresses, Subnetting IP Networks, Network Design & trouble shooting for IPv4 & IPv6. Introduction to Switched Networks, LAN Design.
Unit 2: Basic Switching Concepts and Configuration, Switch Security: Management and Implementation, VLANs.
Unit 3: Routing Concepts & operations, Configuration of a Router, Media Access Control, Inter-VLAN Routing, Layer 3 Switching, Static Routing Implementation, Configure Static and Default Routes, CIDR and VLSM.
Unit 4: Network security, Dynamic Routing Protocols, Distance Vector Routing Protocols, RIP(IPv4) and RIPng(IPv6) Routing, Link-State Dynamic Routing, The Routing Table, Single-Area OSPF, Configuring Single-Area OSPFv2 (IPv4) & v3(IPv6).
Unit 5: Access Control Lists and operations, Configuring and Troubleshooting Standard & extended IPv4 ACLs, IPv6 ACLs, DHCPv4 (IPV4) DHCPv6(IPv6).

Textbooks/References:

1. James F. Kurose and Keith W. Ross “Computer Networking: A Top-Down Approach”, 4thEdition, Addison-Wesley, 2008.
2. Andrew S.Tanenbaum, “Computer Networks”, 3rd Edition, PHI, 2004.

3. Introduction to Networks-Course Booklet “,Cisco Press
4. Routing and Switching Essentials – Course Booklet”, Cisco Press

21CSA646	NETWORK SECURITY	L-T-P-C:3-0-0-3

Course Objectives

- To provide an understanding of the principle concepts and protocols used to provide authentication, email and web security. To be able to secure a message over insecure channel by various means and learn about how to maintain the Confidentiality, Integrity and Availability of a data and to understand various protocols for network security to protect against the threats in the networks

Course Outcomes

Cos	Description
CO1	Understand network security models and analyze authentication mechanisms for challenge response scenarios. Identify and classify particular examples of attacks. Define the terms vulnerability, threat and attack Able to apply cryptographic protocols in various applications to provide confidentiality, integrity and Availability (CIA).
CO2	Understand the working of authentication applications. Identify physical points of vulnerability in simple networks. . Identify some of the factors driving the need for network security. Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack.
CO3	Understand e-mail architecture and standards for securing mail communication. Learn to protect the email services using PGP and SMIME.(Email security protocols).
CO4	Understand Internet Security Protocol and explore common solutions for security issues Gives knowledge about providing security in network at packet level using IPsec.(IP security).
CO5	Apply and analyze Web security protocols for E-Commerce applications. Able to develop secure web application and e commerce site using SSL/TLS and SET(web security).

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	-	1	1	1	1	1	2	-
CO2	3	2	1	1	1	1	1	3	1	1
CO3	3	2	2	-	-	-	2	-	-	2
CO4	3	2	2	-	-	-	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2
CAM	3	2	2	1	1	1	2	2	2	2

Syllabus

Network vulnerability, attacks. Network Access Control-IDS/IPS,Key Management and Distribution(Symmetric/A Symmetric key).Digital Signature and Authentication Schemes: Digital signature-Digital Signature Schemes and their Variants- Digital Signature Standards-Authentication: Overview, Remote User-Authentication Principles, Authentication Requirements, Authentication Protocols -Applications - Kerberos -X.509 Directory Services. Electronic mail security: Email Architecture -PGP – Operational Descriptions- Key management- Trust Model- S/MIME.IP Security: Overview- Architecture - ESP, AH Protocols IPSec Modes – Security association - Key management. Web Security: Requirements- Secure Sockets Layer- Objectives-Layers -SSL secure communication-Protocols - Transport Level Security. Secure Electronic Transaction- Entities DS Verification-SET processing. Blockchains, Cloud Security and IoT security

Textbooks/References:

1. William Stallings-Cryptography and Network security PHI-3rd edition 2003
2. Dr.T.R Padmanabhan N Harini “Cryptography and Security paper back”Wiley India.
3. Behrouz A. Forouzan, “Cryptography and Network Security”, Tata McGraw-Hill Publishing.
4. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education
5. Manuel Mogollon, “Cryptography and Security Services – Mechanisms and Applications”, Cybertech Publishing
6. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C.

Kaufman, Prentice Hall, 2002.

Course Objectives

- The objective of this course is to introduce students to open source software. Students will study common open source software licenses, open source project structure, distributed team software development, and current events in the open source world.

Course Outcomes

Cos	Description
CO1	Understand the difference between open-source software and commercial software.
CO2	Exposed to the context and operation of Open-Source Communities and associated software projects.
CO3	Get familiar with participating in an open-source project using Git and GitHub
CO4	Get insights into different development models and frameworks used in the open-source community.
CO5	Learn open-source programming using Python

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	3	-	-	1
CO2	2	1	-	-	2	2	1	-	-	1
CO3	2	2	2	3	3	3	3	2	3	2
CO4	2	1	3	2	2	2	2	2	2	2
CO5	3	3	3	1	1	1	1	1	1	1
CAM	2	2	3	2	2	2	2	2	2	1

Syllabus

Overview of Open Source System: Definition –The FOSS Philosophy–The Free Software Foundation –Taboos and Norms in OSS Development –Open Source Software Development Models–Licensing –BSD –Linux –Apache –Mozilla.
Open Source Development: Infrastructure needed for an open-source project–Software Development Life Cycle –Building a Community –Joining an Existing Open Source Project –Ending an Open-Source Project –Open Source within a Company –Using Git and GitHub for Open Source Development -FOSS Programmingin Python Deriving a Framework for Analyzing OSS: Zachman'sFramework for IS Architecture –CATWOE and Soft System Method –Deriving the Analytical Framework for OSS Environment –Classifying OSS Motivations –Technological Micro-level Motivation –Economic Micro level and Macro-level Motivation –Socio-Political Micro-level and Macro-level Motivation.
Open Source Server Applications: Infrastructure Services –Web Servers –Database Servers –Mail Servers –Open Source Desktop Applications: Graphical Desktops –Web Browsers –The Office Suite –Mail Clients –Personal Software –Case Studies on OSS.

Textbooks/References:

1. Joseph Feller, Brian Fitzgerald and Eric S. Raymond, “Understanding Open Source Software Development”, Addison Wesley Professional, 2000.
2. E-Book “Producing Open Source Software” which is available at: https://producingoss.com/

21CSA648	SEMANTIC WEB TECHNOLOGIES	L-T-P-C:3-0-0-3

Course Objectives

- This course will cover the core concepts of Semantic Web that promises to dramatically improve World Wide Web (WWW) and its use.
- This course covers key technologies include explicit metadata, ontologies, logic, inferencing, and intelligent agents.

Course Outcomes

COs	Description
CO1	Understand and discuss fundamental concepts, advantages and limits of the semantic web.
CO2	Understand and use ontologies in the context of Computer Science and the semantic web.
CO3	Understand the relationship between Semantic Web and Web 2.0.
CO4	Apply the RDF framework for Semantic Web.
CO5	Understand the concepts of metadata, semantics of knowledge and resource, ontology, and their descriptions in XML-based syntax and web ontology language (OWL).

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	-	-	1
CO2	2	1	-	-	-	-	1	-	-	1
CO3	2	2	2	-	-	-	3	2	3	2
CO4	2	1	3	-	-	-	2	2	2	2
CO5	3	3	3	-	-	-	1	1	1	1
CAM	2	1	3	-	-	-	2	2	2	1

Syllabus

Unit 1: The World Wide Web - Limitations of Today's Web – The Next Generation Web – Semantic Web - Layers –Semantic Web technologies – Semantics in Semantic Web – XML: Basics – Well-formed and valid Documents – Namespaces- XML schema – Addressing – Querying - Document Object Model (DOM) – XML Applications – XML limitations.
Unit 2: RDF Basic Ideas - RDF Specification – RDF Syntax: XML and Non- XML – RDF elements – RDF relationship:Reification, Container, and collaboration – RDF Schema – Editing, Parsing, and Browsing RDF/XML – DiscoveringInformation – Querying (RQL, SPARQL) – Web Ontology Language (OWL) - Classes, Instances and Properties inOWL - Complex Classes - Property Restrictions - Role Inclusion.
Unit 3: Ontology - Ontology Types – Logic - Description Logics - Rules - Inference and Reasoning - Ontology Engineering: Introduction – Constructing ontologies – Tools used in building and storing ontologies (Sesame, Jena, Protégé,NeOn) – Reusing ontologies – ontology reasoning. The web of data - Data on the web -shallow and deep web – Linkedopen data - linked data principles - Linked data design - Publishing linked data - Consuming and aggregating linked data.

Textbooks/References:

1. Paul Groth, Frank van Harmelen, Rinke Hoekstra. A Semantic Web Primer, Third Edition, MIT press; 2012.
2. Gómez-Pérez, A. Fernández-López, M. Corcho, O. Ontological Engineering. Springer Verlag; 2003.
3. Michael C. Daconta, Leo J. Obrst, Kevin T. Smith. The Semantic Web: A Guide to the Future of XML, Web Services and Knowledge Management, Fourth Edition, Willey Publishing; 2003.
4. John Davies, Rudi Studer, Paul Warren. Semantic Web Technologies: Trends and Research in

Ontology-based Systems, Wiley & Sons; 2006.

Course Objectives

- This course introduces the concepts and methods required for effective and efficient SQA. It aims to develop a broad understanding of SQA processes from planning until execution and complements this with a detailed knowledge of techniques in an appropriate engineering and management context.

Course Outcomes

COs	Description
CO1	Understand and distinguish various quality management processes
CO2	Understand of how the SQA components can be integrated into the project life cycle.
CO3	Understand the importance of standards in the quality management process and their impact on the final product.
CO4	Maintain Quality records and quality trends

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	1	1	1
CO2	3	2	1	3	2	2	2	-	3	1
CO3	3	2	1	3	2	2	2	1	2	1
CO4	2	-	2	2	2	2	2	1	-	1
CAM	3	2	2	3	2	2	2	1	2	1

Syllabus

Introduction: The Software Quality Challenge - Software Quality Factors-The Components of Software Quality System-Integrating Quality Activities in the Project Life Cycle.
Software Testing: Strategies and Implementation-Building the Software Testing Process-Software Quality Management Components: Metrics and Costs-Software Quality in the Business Context- Product Quality and Process Quality.
Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools for software quality – Software maintenance quality – Project Management.
Software CMM and other Process Improvement Models-Software Configuration Management-Introduction to Six Sigma - Case Studies: Indian Software Industry in Perspective.

Textbooks/References:

1. Daniel Galin, “Software Quality Assurance: From theory to Implementation”, Pearson Education, 2008
2. Nina Godbole, “Software Quality Assurance, Principles and Practice”, Narosa Publications, 2011.
3. William Perry, “Effective Methods of Software Testing”, Third Edition, Wiley, 2006.

21CSA650 STRUCTURE AND INTERPRETATION OF COMPUTER PROGRAMS L-T-P-C:3-0-0-3

Course Objectives

- This course covers the basic elements of programming languages to analyze computational systems, and to generate computational solutions to abstract problems.

Course Outcomes

Cos	Description
CO1	Understand elements and types of various programming languages
CO2	Understand the elements of programming procedures and formulating abstractions
CO3	Understand the concept of data abstraction and representation.
CO4	Design and implement programs in Scheme that demonstrate the concepts
CO5	Implement programs using PROLOG.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-
CO3	1	1	-	-	-	-	-	-	-	-
CO4	1	1	-	-	-	-	-	-	1	-
CO5	1	1	-	-	-	-	-	-	1	-
CAM	1	1	-	-	-	-	-	-	1	-

Syllabus

Unit 1: Introduction to the Elements of Programming Languages: Different Types of Programming Languages: Syntax, Operational Semantics, Types - Modeling Programming Languages, Computability versus Complexity and Computer Science for Computation.

Unit 2: Introduction to LISP and Scheme - Building Abstractions with Procedures - The Elements of Programming Procedures and the Process they Generate – Formulating Abstractions with Higher-Order Procedures.

Unit 3: Building Abstractions with Data: Introduction to Data Abstraction - Hierarchical Data and the Closure Property: Hierarchical Structures - Symbolic Data – Multiple Representations for Abstract Data – Systems with Generic Operations: Generic Arithmetic Operations, Combining Data of Different Types.

Unit 4: Modularity, Objects, and State: Assignment and Local state: Local state variables, benefits and cost of introducing an assignment – The Environment Model of Evaluation: The Rules for Evaluation, Applying Simple Functions, Internal declarations – Modeling with Mutable Data: Mutable List Structure – Concurrency: The Nature of Time in Concurrent Systems, Mechanisms for Controlling Concurrency – Streams: Delayed Lists, Infinite streams, Exploiting the Stream Paradigm, Streams and Delayed Evaluation.

Unit 5: Meta-linguistic Abstraction: The Meta-circular Evaluator: The Core of the Evaluator, Representing Components, Evaluator Data Structures, Running the Evaluator as a Program, Data as Programs Internal Declarations, Separating Syntactic Analysis from Execution – Lazy Evaluation: Normal Order and Applicative Order, An Interpreter with Lazy Evaluation - Variation on a Scheme - Nondeterministic Computing – Logic Programming: Syntax, Operational semantics, Data Structures – Introduction to PROLOG.

Textbooks/References:

1. Abelson H and Sussman G J, “Structure and Interpretation of Computer Programs”, Second Edition, MIT Press, 2005.
2. Sebesta R W, “Concepts of Programming Languages”, Ninth Edition, AddisonWesley, 2009.
3. Pierce B C, “Types and Programming Languages”, MIT Press, 2002.
4. Sethi R, “Programming Languages Concepts and Constructs”, Second Edition, Addison Wesley, 1996.
5. T W Pratt and Marvin V Z, “Programming Languages: Design and Implementation”, Third Edition, Prentice Hall, 1995.
6. “Principles of Programming Languages”, 2009 Edition by Gilles Dowek, Springer Publication.
7. “Programming Language Concepts”, Third edition, by Mehdi Jazayeri Carlo Ghezzi.
8. “Programming Languages: Concepts and Constructs”, Second edition, Paperback, by Ravi Sethi.

21CSA651	COMPLEX NETWORKS	L-T-P-C:3-0-0-3

Course Objectives

- The objective of this course is to impart fundamental and advanced concepts n the areas of complex networks and network science that focus on study of the models and behaviours of networked systems. Network science is an evolving field with theoretical and applied settings. The arrival of large data sets derived from social, economic, and biological networks, along with modern computational power, has increased relevance. The goal of this advanced undergraduate/introductory graduate course is to provide a mathematical foundation for analysing the structure of complex networks. The subject material is interdisciplinary, with topics of graph theory, probability theory, statistical physics, and computer science.

Course Outcomes

COs	Description
CO1	Learn fundamentals of graph theory and network mathematics as well as the statistical physics approach to large scale networks.
CO2	Learn how to construct and analyse networks from real world data.
CO3	Learn the fundamentals for generating random network models on a computer.
CO4	Learn to investigate dynamical processes that evolve on networks.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	1	-
CO2	3	1	2	-	-	-	2	-	1	-
CO3	3	1	2	-	-	-	-	-	1	-
CO4	3	1	-	-	-	-	2	-	-	-
CAM	3	1	2	-	-	-	2	-	1	-

Syllabus

Unit 1: Introduction,Overview of Network science, , Review of topics in probability, linear algebra, Examples of real-world networks and their properties, Large scale dynamic networks, Challenges of graph theory, transitivity and clustering, centrality, spectral properties of adjacency matrix, maximum degree, degree distributions, degree correlations, community structure, diameter, Small world effect

Unit 2: Basic concepts of network communities, community structures, network navigation, Modularity, Girvan-Newman Algorithm, Spectral Bisection Algorithm, Radicchi Edge Clustering Algorithm, Wu-Hubermann Algorithm, Random Walk based Algorithm

Unit 3: Generalized random graphs, Poisson random graphs, the configuration model, generating functions, power-law degree distribution, directed graph, bipartite graph, Models of Network Growth-Price model, Barabasi & Albert model, other growth models, vertex copying models, Bipartite Network

Unit 4: Percolation theory and network resilience, Epidemiological processes, Cascades and information spread, Homophily, Cohesiveness, Cliques, Clans, Clubs, Plex, Equivalence of ties, Ego-centric networks, Cascade formation and information diffusion in Social media.

Unit 5: Search on networks, exhaustive network search, guided network search, network navigation; network visualization and semantic zooming, Temporal network, Multilayer networks, Interdependent networks, Controllability of complex networks, Economic and financial network analytics.

Textbooks/References:

1. The structure and function of complex networks.
2. Statistical mechanics of complex networks, Rev. Mod. Phys., 74(1), 2002.
3. Complex Graphs and Networks, by F. Chung and L. Lu

21CSA652	AI/ML APPLICATIONS FOR CYBER SECURITY	L-T-P-C:3-0-0-3

Course Objectives

- The course describes the fundamentals of machine learning for cyber security and focuses to tackle several security issues related to AI and ML.

Course Outcomes

COs	Description
CO1	Understand various methods used in Artificial Intelligence (AI) and Machine Learning (ML).
CO2	Understand the importance and security issues in AI and ML for cyber security.
CO3	Understand the implications of AI in privacy and applications of machine learning in security.
CO4	Comprehend different Machine Learning techniques and their use in Cyber security.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	2	2	-	3
CO2	3	3	2	-	-	-	1	1	1	1
CO3	3	3	2	-	-	-	1	1	1	1
CO4	2	2	3	1	1	1	1	1	1	3
CAM	3	3	2	1	1	1	1	1	1	2

Syllabus

Fundamentals of Machine Learning for Cyber Security, Supervised Learning- Linear Regression, Decision Trees, Random Forests, SVM and Neural Networks. Anomaly Detection, Unsupervised Learning- Dimensionality Reduction, PCA, T-SNE, Clustering, K-means, Model Validation and Evaluation- Train Test Split, Cross Validation, Learning Curves, Model Complexity Curves, Over fitting vs. Under fitting, Security Issues in Machine Learning- Adversarial Attacks and Defenses, Privacy Attacks (differential privacy as defense) Lab-projects-Malware detection, Intrusion detection systems and Phishing detection

Textbooks/References:

1. Tom M Mitchell, Machine Learning, McGraw Hill, 1997
2. Sumeet Dua , Xian Du, Data Mining and Machine Learning in Cybersecurity, Auerbach Publications,2011

21CSA653	WIRELESS COMMUNICATION AND NETWORKS	L-T-P-C:3-0-0-3

Course Objectives

- The purpose of this course is to provide an introduction to wireless networks and wireless communication systems.
- This course is designed to give a clear understanding of how wireless networks, including wireless LANs to the massive and global internet, are built and how they allow us to use wireless devices to share information and communicate with one another.

Course Outcomes

COs	Description
CO1	Explain the concepts and features of wireless communication and transmission technologies.
CO2	Describe the design and working of different wireless communication methods, its signaling and channel access mechanism.
CO3	Describe the architecture and working of wireless communication networks and protocols.
CO4	To explore the characteristics of different types of Wireless LAN networks.
CO5	Explain the working of wireless routing protocols.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	-	2	-	-	-
CO3	3	1	2	-	-	-	1	-	-	-
CO4	3	1	2	-	-	-	-	-	1	-
CO5	3	1	1	-	-	-	1	-	2	-
CAM	3	1	2	-	-	-	2	-	2	-

Syllabus

Introduction to Wireless Systems: Brief History of Wireless Communication. Transmission Fundamentals: Time Domain, Frequency Domain, Bandwidth vs. Data Rate – Channel Capacity - Transmission Media –Protocols and TCP/IP Suite: TCP/IP Protocol Architecture - OSI Model. Antennas and Wave Propagation: Antennas, Propagation Modes, Fading in the Mobile Environment - Free Space Propagation.
Modulation Techniques: Signal Encoding, Digital Data - Analog Signal, Analog Data -Analog Signal, Analog Data - Digital Signal, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), Code Division Multiple Access (CDMA).
Wireless Networking: Satellite Communications- Capacity Allocation – Frequency Division, Time Division, WiMax and IEEE 802.16 Broadband Wireless Access Standards. Wireless LAN Technology: Infrared, Spread Spectrum, Narrowband LANS- Wi-Fi and IEEE 802.11 Standard, Bluetooth and IEEE 802.15 Standard.
Wireless Routing Protocols: Infrastructure, AdHoc Networks, ProActivevs.ReActive,Dynamic Source Routing(DSR), AdHoc On Demand Distance Vector (AODV),Temporarily Ordered Routing Algorithm(TORA), Destination Sequenced Distance Vector(DSDV). Case Study using NS2 / NS3

Textbooks/References:

1. William Stallings,"Wireless Communication and Networks", Pearson Education, Third Edition, 2002.
2. Wireless Communications: Principles and Practice by Rappaport, Pearson, Second Edition.

21CSA654	AI FOR DRUG DISCOVERY AND TARGET VALIDATION	L-T-P-C:3-0-0-3

Course Objectives

- This course aims to provide knowledge on how artificial intelligence can be used for target identification, drug design and optimization.
- This also gives an introduction to protein modelling.

Course Outcomes

COs	Description
CO1	Understand the state-of-the art methods and techniques now a day's applied in CADD.
CO2	Choose the appropriate method (in terms of applicability, accuracy, and economy) for a given problem.
CO3	Solve problems like lead optimization, structure-based design, investigation of ligand receptor interaction.
CO4	Understand modelling ranging from molecular mechanics, molecular dynamics over computer graphics, data visualization.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-
CO3	1	2	1	-	-	-	-	-	2	-
CO4	1	1	1	-	-	-	-	-	2	-
CAM	1	2	1	-	-	-	-	-	2	-

Syllabus

Unit 1: DRUG DESIGN and CADD
What is a drug, the role of drugs in the practice of medicine, the role of Pharmaceutical Chemistry, The history of Pharmaceutical Chemistry, Natural substances as drugs. What is CADD, Explanation of some basic terms, Pharmacophore, Lock-Key principle and induced fit theory, Molecular Recognition and Molecular Docking, What makes a compound bioactive, The objects of CADD and Molecular Modeling.

Unit 2: ARTIFICIAL NEURAL NETWORKS (ANN)
Background and basics of ANN, What can neural networks do, Artificial neuron, Net input, net and weight, How to get the best weights. Transfer functions in neurons, Bias, Linking neurons to networks, Architecture, The Kohonen network, Special characteristics, Competitive learning, An example: mapping from dimensions, Counterpropagation, Supervised competitive learning, Error-backpropagation learning, When is the training finished. Overtraining,

Unit 3:AI and DRUG DESIGN
AI in drug screening, Prediction of the physicochemical properties, AI in designing drug molecules, Applications of ANNs in Drug design, ANN in Quantitive structure activity relationships, ANN to determine the secondary structure of proteins.

Unit 4:PROTEIN MODELLING
The Protein Data Bank (PDB), Relationship between sequence and 3D structure of a protein. Alignment of protein sequences, Needleman-Wunsch alignment method, Multiple sequence alignments (MSA), Homology modeling of proteins, Construction of the core, Construction of loops and turns1, Construction of the Side chains, Refinement of the homology model, Prediction of protein structures by threading, Comparison of various strategies in homology modeling1, Protein folding,Thermodynamics of protein folding.

Textbooks/References:

1. Molecular Modelling: Principles and Applications (Paperback), by Andrew R. Leach, Pearson Higher Education, USA, 2001 (ISBN 0582382106).
2. Agrawal, P. (2018). Artificial intelligence in drug discovery and development. J Pharmacovigil, 6(2).

21CSA655	SOCIAL MEDIA ANALYTICS	L-T-P-C: 3-0-0-3

Course Objectives

- Social media provide a abundance of data that can help organizations better understand and build relationships with their publicThe aim of this module is to study, learn, and understand the learners with the concept of social media analytics and understand its significance. Familiarize the learners with the tools of social media analytics. Enable the learners to develop skills required for analyzing the effectiveness of social media for business purposes.

Course Outcomes

COs	Description
CO1	Understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics;
CO2	Identify and select key performance indicators to accurately measure the success of social media efforts
CO3	Analyze social media data using native analytics (e.g. Facebook, Twitter, Instagram) and social media measurement tools;
CO4	Draw meaningful insights and provide actionable and strategic recommendations based on thorough social media data analysis;

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	-	-	-
CO2	3	1	1	-	-	-	1	-	-	-
CO3	3	2	1	-	-	-	2	-	1	-
CO4	3	2	1	-	-	-	2	-	-	-
CAM	3	2	1	-	-	-	2	-	1	-

Syllabus

Unit 1: Introduction to Social Media Analytics (SMA): Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas. Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization.

Unit 2: Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity. Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis.

Unit 3: Facebook Analytics: Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis. 9 (LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction. (Websites).

Unit 4: Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective Classification, Applications in Advertising and Game Analytics Introduction to Python Programming, Collecting and analyzing social media data; visualization and exploration

Textbooks / References:

1. Jurafsky and James H. Martin. Speech and Language Processing (3rd ed.)
2. Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing
3. Ian Goodfellow, YoshuaBengio, and Aaron Courville. Deep Learning. MIT Press.

21CSA656	NATURAL LANGUAGE PROCESSING	L-T-P-C: 3-0-0-3

Course Objectives

- To explore fundamental concepts of NLP and its role in current and emerging technologies.
- Gain a thorough understanding of modern neural network algorithms for the processing of linguistic information.

Course Outcomes

COs	Description
CO1	Understand the basics of NLP.
CO2	Understand global vectors for word representations
CO3	Recognize named entity using neural networks.
CO4	Model languages and perform sentimental analysis.
CO5	Understand dynamic memory networks for NLP

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-
CO2	2	-	3	-	-	-	1	-	2	-
CO3	1	3	3	-	-	-	1	-	2	-
CO4	1	3	3	-	-	-	1	-	2	-
CO5	1	3	3	-	-	-	1	-	2	-
CAM	1	3	3	-	-	-	1	-	2	-

Syllabus

Introduction to NLP, Simple Word Vector representations: word2vec-GloVe: Global Vectors for Word Representation
Advanced word vector representations: language models, softmax, single layer networks-Neural Networks and back propagation for named entity recognition
Introduction to Tensorflow-Recurrent neural networks for language modelling and other tasks-RUs and LSTMs for machine translation-Recursive neural networks for parsing-Parsing with Compositional Vector Grammars-Recursive neural networks for different tasks (e.g. sentiment analysis)
Convolutional neural networks for sentence classification-The future of Deep Learning for NLP: Dynamic Memory Networks

Textbooks / References:

1. Jurafsky and James H. Martin. Speech and Language Processing (3rd ed.)
2. Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press.

21CSA657	SOFTWARE TESTING	L-T-P-C: 3-0-0-3

Course Objectives

- This course provides fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.
- This also expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.

Course Outcomes

COs	Description
CO1	Introduce different software testing techniques, process and errors handled in software projects.
CO2	Distinguish black box and white box testing techniques for functional and structural testing and testcase designing.
CO3	To understand the different testing activities and levels of testing which aims to uncover the defects in all the stages of project.
CO4	Discuss about the non-functional testing and debugging methods.
CO5	Demonstrate various issues for object-oriented testing and tools for testing.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	1	-	-
CO3	3	2	2	-	1	1	-	1	1	-
CO4	3	3	-	-	1	1	-	1	-	-
CO5	2	3	2	-	1	1	-	1	1	-
CAM	3	2	2	-	1	1	-	1	1	-

Syllabus

Introduction: Introduction to software testing and analysis, Error, Fault, Failure, Incident, Test Cases, Testing Process, Limitations of Testing, No absolute proof of correctness.
Specification-based testing techniques, code-based testing techniques, Model-based testing,
Blackbox box testing- Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.
Whitebox testing- Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing, Static Analysis, Dynamic Analysis
Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing, Slice-based testing Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing, Regression Testing, Acceptance testing
Object Oriented Testing: Issues in Object Oriented Testing, Class Testing, GUI Testing, Object Oriented Integration and System Testing, Methods of test data generation and validation.
Program slicing and its application, Reliability analysis, Formal methods; verification methods; oracles. Testing Tools: Static Testing Tools, Dynamic Testing Tools, and Characteristics of Modern Tools

Textbooks / References:

1. William Perry, “Effective Methods for Software Testing”, John Wiley & Sons, New York, 2007.

2. CemKaner, Jack Falk, Nguyen Quoc, “Testing Computer Software”, Second Edition, Van Nostrand Reinhold, New York, 2000.
3. Boris Beizer, “Software Testing Techniques”, Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.
4. Louise Tamres, “Software Testing”, Pearson Education Asia, 2002
5. "Software Testing: A Craftsman's Approach, Second Edition," by Paul C Jorgensen, CRC Press, June 26, 2002.

21CSA658	SOFTWARE DEFINED NETWORKS	L-T-P-C: 3-0-0-3

Course Objectives

- This course aims to develop knowledge in networking fundamentals, gain conceptual understanding of Software Defined Networks (SDN) and the study of industrial deployment use-cases of SDN.

Course Outcomes

COs	Description
CO1	Differentiate between traditional networks and software defined networks and learn the fundamentals of software defined networks.
CO2	Understand advanced and emerging networking technologies, separation of the data plane and control plane.
CO3	Improves the advanced networking research skills.
CO4	Study of the SDN Programming and analyze the performance of varying and complex networking tasks.
CO5	Expand the knowledge learned about SDN concepts and apply it to solve real time world problems

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-
CO2	3	1	1	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	2	-	-	-
CO4	3	2	2	-	-	-	2	-	1	-
CO5	3	2	2	-	-	-	2	-	1	-
CAM	3	2	2	-	-	-	2	-	1	-

Syllabus

Unit 1: Basic Packet Switching Terminology, Historical Background, The Modern Data Center, Traditional Switch Architecture, Autonomous and Dynamic Forwarding Tables, Open Source and Technological Shifts. Why SDN? Genesis of SDN

Unit 2: Working of SDN- Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods. Introduction to OpenFlow Specification, Improving OpenFlow Interoperability, OpenFlow Limitations, Optical Transport Protocol Extensions

Unit 3: Introduction to Open SDN and its limitations, SDN via APIs, SDN via Hypervisor Based Overlays, SDN via Opening up the Device, Introduction of SDN Controllers and its general concepts, Layer 3 Centric, Plexxi, Cisco OnePK. Introduction of Network Programmability, Management Interface, Application-Network Divide, Modern Programmatic Interfaces, I2RS, Modern Orchestration
Module: 4

Unit 4:SDN in the Data Center- Introduction of Data Center and its demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN, Overlays and APIs, Real-World Data Center Implementations

Unit 5: Introduction SDN application and its usages, SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases – The Open Network Operating System.

Textbooks / References:

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, Second Edition, Morgan Kaufmann, 2014.
2. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas Nadeau, Ken Gray, Publisher: O'Reilly Media.
3. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud 1st Edition, Kindle Edition, by William Stallings.
4. SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization 1st Edition, Kindle Edition, by Jim Doherty.

21CSA659	PATTERN RECOGNITION	L-T-P-C: 3-0-0-3

Course Objectives

- The primary objective of this course is to equip students with mathematical and statistical techniques used in pattern recognition and enable students to develop machine learning algorithms for real life problems.

Course Outcomes

COs	Description
CO1	Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms and applications of PR system.
CO2	Understand the basic methods of feature extraction, feature evaluation, analyse and relate research in the pattern recognition area.
CO3	Understand and apply both supervised and unsupervised classification methods to develop PR system in real-world data.
CO4	Apply pattern recognition techniques to real-world problems such as object detection and recognition.
CO5	To implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.
CO6	To summarize, analyse, and relate research in the pattern recognition area verbally and in writing.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-
CO4	1	3	3	-	-	-	-	1	2	-
CO5	1	3	3	-	-	-	-	1	2	-
CO6	1	3	3	-	-	-	-	1	2	-
CAM	2	3	3	-	-	-	-	1	2	-

Syllabus

Introduction to Pattern Recognition- Tree Classifiers Getting our feet wet with real classifiers-Decision Trees: CART, C4.5, ID3- Random Forests-Bayesian Decision Theory Grounding our inquiry- Linear Discriminants Discriminative Classifiers: The Decision Boundary, Separability, Perceptrons, Support Vector Machines, Parametric Techniques Generative Methods grounded in Bayesian Decision Theory, Maximum Likelihood Estimation- Bayesian Parameter Estimation. Non-Parametric Techniques- Kernel Density Estimators- Nearest Neighbor Methods - Unsupervised Methods Exploring the Data for Latent Structure - Component Analysis and Dimension Reduction- The Curse of Dimensionality, Principal Component Analysis, Fisher Linear Discriminant, Locally Linear Embedding, Clustering, K-Means. Expectation Maximization, Mean Shift, Classifier Ensembles, Bagging, Boosting / AdaBoost.

Textbooks / References:

1. Duda, Hart and Stork, Pattern Classification, Second Edition, Wiley, 2001.
2. T.M. Mitchell, Machine learning, McGraw-Hill, New York, 1997.
3. S. Theodoridis, K. Koutroumbas, Pattern Recognition, Academic Press, 1999

21CSA660	BLOCKCHAIN TECHNOLOGIES	L-T-P-C: 3-0-0-3

Course Objectives

- This course examines the foundations of blockchain technology from multiple perspectives. It is designed to provide students with an understanding of key concepts and developments around crypto currencies and distributed ledger systems.

Course Outcomes

COs	Description
CO1	Explain design principles of Bitcoin and Ethereum.
CO2	Explain Nakamoto consensus.
CO3	Explain the Simplified Payment Verification protocol.
CO4	List and describe differences between proof-of-work and proof-of-stake consensus.
CO5	Interact with a blockchain system by sending and reading transactions.
CO6	Design, build, and deploy a distributed application.
CO7	Evaluate security, privacy, and efficiency of a given blockchain system.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	1	1	1	1	-
CO2	2	1	2	-	2	1	1	1	2	-
CO3	1	3	2	-	1	-	1	2	3	1
CO4	3	3	1	-	-	-	1	2	3	1
CO5	2	2	3	1	1	-	1	2	2	2
CO6	2	-	3	-	-	-	1	2	2	1
CO7	2	2	3	-	-	-	1	3	3	3
CAM	2	2	3	1	1	1	1	2	2	1

Syllabus

Introduction: Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Block chain based crypto currency? Technologies Borrowed in Block chain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

Basic Distributed Computing: Atomic Broadcast, Consensus, Byzantine Models of fault tolerance
Basic Crypto primitives: Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

Blockchain 1.0 : Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use

Blockchain 2.0: Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts

Blockchain 3.0: Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain

Privacy, Security issues in Blockchain: Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these.

Textbooks/References:

1. Imran Bashir, Mastering Blockchain, Packt Publishing, 2018.
2. Drescher, Daniel. "Blockchain basics", Apress, 2017.
3. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

21CSA661	CYBER FORENSICS	L-T-P-C: 3-0-0-3

Course Objectives

- The objective of this course is to emphasize the fundamentals and importance of digital forensics. It presents an overview of the principles and practices of digital investigation. This course focuses mainly on different forensic tools, analysis of forensic data and also ethical hacking techniques and also provides theoretical and practical knowledge, as well as current research on Cyber Forensics.

Course Outcomes

COs	Description
CO1	Understand the basics of computer forensics
CO2	Apply a number of different computer forensic tools to a given scenario
CO3	Analyze and validate forensics data
CO4	Identify the vulnerabilities in a given network infrastructure
CO5	Implement real-world hacking techniques to test system security

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	1	1	1	-
CO2	2	2	2	-	1	1	2	1	2	-
CO3	2	3	2	-	1	1	2	2	3	1
CO4	2	3	2	1	1	1	2	2	3	1
CO5	2	2	3	1	1	1	2	2	2	2
CAM	2	3	2	1	1	1	2	2	2	1

Syllabus

Introduction to computer forensics: Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques – Incident and incident response methodology – Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. – Forensics Technology and Systems – Understanding Computer Investigation – Data Acquisition.

Evidence collection and forensics tools: Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

Analysis and validation: Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

Ethical hacking: Introduction to Ethical Hacking – Footprinting and Reconnaissance – Scanning Networks – Enumeration – System Hacking – Malware Threats – Sniffing

Ethical hacking in web: Social Engineering – Denial of Service – Session Hijacking – Hacking Web servers – Hacking Web Applications – SQL Injection – Hacking Wireless Networks – Hacking Mobile Platforms.

Textbooks/References:

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations, Cengage Learning, India Edition, 2016.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.
3. John R.Vacca, ―Computer Forensics, Cengage Learning, 2005
4. MarjieT.Britz, ―Computer Forensics and Cyber Crime: An Introduction, 3rd Edition, Prentice Hall, 2013.
5. AnkitFadia ― Ethical Hacking Second Edition, Macmillan India Ltd, 2006.
6. Kenneth C.Brancik ―Insider Computer Fraud Auerbach Publications, Taylor & Francis Group–2008.

21CSA662	PARALLEL COMPUTING	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the foundations of parallel computing, including parallel architectures, parallel programming methods and techniques, parallel algorithm designs, and parallel performance analysis.

Course Outcomes

COs	Description
CO1	Understand different parallel architectures and programming models
CO2	Understand and apply various parallel programming techniques
CO3	Apply a parallel algorithm using MPI, OpenMP or a combination of MPI and OpenMP.
CO4	Understanding parallel programming in heterogeneous systems CUDA and OpenCL
CO5	Understand how to measure the performance of parallel and distributed programs.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	1	1	1	-
CO2	2	2	2	-	1	1	2	1	2	-
CO3	2	3	2	-	1	1	2	2	3	1
CO4	2	3	2	1	1	1	1	2	3	1
CO5	2	2	3	1	1	1	2	2	2	2
CAM	2	3	2	1	1	1	2	2	2	1

Syllabus

Overview of Parallel Computing-parallel computer architectures - standard programming models-Shared Memory Multiprocessing–Distributed Shared Memory–Message Passing Parallel Computers-Shared Memory Programming–General Model of Shared Memory Programming–Forking-Creating Processes–Joining Processes-Process Model Under UNIX-

Parallel Programming Techniques-Loop Splitting–Ideal Speedup–Spin-Locks, Contention and Self-Scheduling Scheduling -Loop Scheduling–Variations on Loop Scheduling–Self-Scheduling–Variations on Self-Scheduling–Indirect Scheduling–Block Scheduling-Barriers And Race Conditions-Thread-Based Implementation-Thread Management–The POSIX Threads

Shared Memory Parallel Programming with OpenMP. OpenMP directives, syntax, and operation; Distributed Memory Programming with the Message Passing Interface (MPI) library. MPI communication operations and data structures, syntax and features- Combining MPI and OpenMP algorithms-Programming heterogeneous systems - CUDA and OpenCL -OpenACC and OpenMP

Analytical modeling of parallel program -Scalability of parallel systems - Sources of overhead in parallel programs - Asymptotic analysis of parallel programs

Basic communication operations -Graph algorithms -Dense matrix algorithms -Numerical algorithms - Search algorithm for discrete optimization

Textbooks / References:

1. Introduction to Parallel Programming- by Steven Brawer.
2. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar. Introduction to Parallel Computing Addison Wesley,
3. Introduction To Parallel Processing–By M.Sasikumar, Dinesh ShikhareAnd P.Ravi Prakash
4. Parallel Programming in C with MPI and OpenMP by M.J. Quinn, McGraw-Hill

Science/Engineering/Math, 1st edition, 2003, ISBN: 0072822562.

21HU631	SOFTWARE PROJECT MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

- This course is aimed at introducing the primary important concepts of project management related to managing software development projects. They will also get familiar with the different activities involved in Software Project Management. Further, they will also come to know how to successfully plan and implement a software project management activity, and to complete a specific project in time with the available budget.

Course Outcomes

COs	Description
CO1	Understand the basics of software project management activities for the success of a project.
CO2	Project Evaluation and program management techniques.
CO3	Understand the basic steps that need to be carried out by a Project Manager.
CO4	Learn the effort and duration estimation techniques.
CO5	Identify project activity planning based on estimations.
CO6	Study various risk management approaches and its simulations.
CO7	Identify the resource allocations and issues.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	1	-	-	-
CO2	3	2	-	2	-	-	1	-	1	-
CO3	3	2	-	3	-	-	1	-	1	1
CO4	3	2	-	3	-	-	1	1	1	1
CO5	2	2	-	3	-	-	1	-	1	1
CO6	3	2	-	2	-	-	-	1	1	1
CO7	2	2	-	3	-	1	1		1	1
CAM	3	2	-	3	-	1	1	1	1	1

Syllabus

Introduction to Software Project Management: Software Projects-Other Types of Projects -Problems with Software Projects. Project Evaluation and Program Management:

Evaluation of Individual Projects – Cost Benefit Evaluation Techniques – Risk Evaluation. Step Wise: An Overview of Project Planning. Selection of an Appropriate Project Approach: Build or Buy? - Waterfall Model – Spiral Model – Prototyping – Incremental Delivery–RAD – Agile Methods – XP - Scrum.

Software Effort Estimation: Bottom up Estimating – Top-down Estimating – FP Analysis –COCOMO II – Cost Estimation. Activity Planning: Project Schedules - Sequencing and Scheduling Projects - Network Planning Models – AOA – AON - CPM - Shortening Project Duration – Crashing - Identifying Critical Activities.

Risk Management: A Framework for Dealing with Risk – Risk Management – PERT. Resource Allocation: Identifying Resource Requirements – Scheduling Resources –Publishing Resource Schedule – Cost Schedule.

Monitoring and Control: Visualizing Progress - Earned Value Analysis. Managing People in SW Environments: Organizational Behavior – Motivation.

Working in Teams: Organizing Teams. Software Quality Management: Defining Software Quality – Metrics – Process Capability Models – Software Reliability. Case Study: PMBOK - MS Project.

Textbooks / References:

1. Mike Cotterell and Bob Hughes, “Software Project Management”, Fifth Edition, Tata McGraw-Hill, 2010.
2. Roger S. Pressman, “Software Engineering a Practitioner’s Approach”, Seventh Edition, Tata McGraw-Hill, 2010.
3. Jalote P, “Software Project Management in Practice”, Addison Wesley, 2002

21HU632	PRINCIPLES OF ECONOMICS AND MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

- The objective of this course is to develop the ability to apply the concepts, tools and techniques of economics in analysing and interpreting business decisions.

Course Outcomes

COs	Description
CO1	Define and explain how basic concepts of microeconomics (such as elasticity, scarcity or choice) can be used to explain the behavior of individuals, household or firms.
CO2	Represent supply and demand, in graphical form, including the downward/upward slope of the curves and what shifts/moves along the curves.
CO3	To understand the importance of market structures, on the question of the stability and failure of markets.
CO4	Describe and explain how basic macroeconomic policies (such as fiscal or monetary) can be used to analyse the economy as a whole
CO5	Explain basic management, business and marketing principles to be able to continue studies on a higher level.
CO6	To understand the role of PESTLE factors on the SWOT of corporations, in the domestic and the international business environment.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	1	1	-	-
CO2	1	-	-	-	1	1	1	1	-	-
CO3	1	2	-	1	1	2	2	-	1	-
CO4	1	2	1	-	1	-	1	-	-	-
CO5	1	1	1	1	1	-	3	-	2	1
CO6	1	-	-	1	-	-	1	1	1	1
CAM	1	2	1	1	1	2	2	1	1	1

Syllabus

Introduction to Management: Managers and Management - History Module - The Historical Roots of Contemporary Management Practices, The Management Environment.
Planning: Foundations of Planning - Foundations of Decision Making - Quantitative Module Quantitative Decision-Making Aids. Organizing:
Basic Organization Designs - Staffing and Human Resource Management - Career Module Building Your Career - Managing Change, Stress, and Innovation .Leading-Foundations of Individual and Group Behavior - Understanding Work Teams – Motivating and Rewarding Employees
- Leadership and Trust - Communication and Interpersonal Skills. Introduction to Economics: The Firm and Its Goals - Review of Mathematical Concepts usedin Managerial Economics, Supply and Demand -
The Mathematics of Supply and Demand,Demand Elasticity - Applications of Supply and Demand, Demand Estimation andForecasting, The Theory and Estimation of Production - The Multiple-Input Case -Expressing the Production Function with the Use of Calculus, The Theory and Estimation of cost - A Mathematical Restatement of the Short-Run Cost Function - The Estimation of Cost.
Pricing and Output Decisions: Perfect Competition and Monopoly - The Use of Calculus in Pricing and Output Decisions - Break-Even Analysis (Volume-Cost-Profit), MonopolisticCompetition and Oligopoly - Special Pricing Practices.

Textbooks / References:

1. Stephen P, Robbins David A. De Cenzo, “Fundamentals of Management”, Prentice Hall, Sixth Edition, 2008.

2. Philip K. Y. Young, Steve Erfle and Paul G. Keat, “Managerial Economics: Economic Tools for Today's Decision Makers”, Pearson, Seventh Edition, 2013.

21HU633	MANAGEMENT AND ORGANIZATIONAL BEHAVIOUR	L-T-P-C: 3-0-0-3

Course Objectives

- The objective of the course is to improve students understanding of human behaviour in an organization and the ability to lead people to achieve more effectively towards increased organizational performance.

Course Outcomes

COs	Description
CO1	Understand the concepts related to Business and demonstrate the roles, skills and functions of management.
CO2	Demonstrate the applicability of the concept of organizational behaviour to understand the behaviour of people in the organization.
CO3	Analyse the complexities associated with management of the group behaviour in the organization.
CO4	Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	1	-	-	-
CO2	3	3	-	2	1	1	1	-	1	1
CO3	3	3	2	2	1	1	1	-	1	1
CO4	2	2	2	2	2	2	1	-	1	1
CAM	3	3	2	2	1	1	1	-	1	1

Syllabus

Unit 1: Introduction to Management
Management: Introduction, Definition of management, Nature, Purpose and Functions, Levels and types of managers, managerial roles, skills for managers, evolution of management thought, Fayol's fourteen principles of management, Recent trends in management.

Unit 2: Managerial Functions
Planning: Nature of Planning, Planning Process, Objectives, MBO, Strategies, level of strategies, Organizing: Formal and informal organizations, Principles of organizations-chain of command, span of control, delegation, decentralization, and empowerment, Staffing: definition – importance of staffing – recruitment & selection – training & development, Controlling: definition – importance – characteristics & limitations.

Unit 3: Introduction to OB Introduction: Organizational Behaviour: Introduction, definition, historical development, fundamental principles of OB, contributing disciplines, challenges and opportunities. Foundations of Individual Behaviour: Individual behaviour: Foundations of individual behaviour. Ability: Intellectual abilities, Physical ability, the role of disabilities. Personality: Meaning, formation, determinants, traits of personality, big five and MBTI, personality attributes influencing OB.

Unit4: Group Behaviour Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms - Leadership styles – Group decision making techniques – Team building - Organizational behaviour modification - Interpersonal relations – Communication – Control.

Unit 5: Dynamics of organizational behaviour Organizational culture and climate – Factors affecting organizational climate – Importance - Job satisfaction – Determinants – Measurements – Influence on behaviour, Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change, Stress – Work Stressors – Prevention and Management of stress –

Balancing work and Life, Organizational development – Characteristics – objectives –. Organizational effectiveness

Textbooks/References:

1. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.
2. Fred Luthans, Organisational Behavior, McGraw Hill, 11th Edition, 2001
3. Schermerhorn, Hunt and Osborn, Organisational behavior, John Wiley, 9th Edition, 2008.
4. UdaiPareek, Understanding OrganisationalBehaviour, 2nd Edition, Oxford Higher Education, 2004.
5. Mc Shane & Von Glinov, OrganisationalBehaviour, 4th Edition, Tata McGraw Hill, 2007.
6. Hellrigal, Slocum and Woodman, Organisational Behavior, Cengage Learning, 11th Edition 2007.
7. Ivancevich, Konopaske&Maheson, OranisationalBehaviour& Management, 7th edition, Tata McGraw Hill, 2008

21HU634	BUSINESS INTELLIGENCE	L-T-P-C: 3-0-0-3

Course Objectives

- The course offers an entrenched knowledge of Business Intelligence (BI) principles and techniques by introducing the relationship between managerial and technological perspectives. It also help expose students to the frontiers of BI-intensive BIG data computing and information systems, while providing a sufficiently strong foundation to encourage further research.

Course Outcomes

COs	Description
CO1	Outlines the basic concepts of Business Intelligence and Data Warehouses
CO2	Identify the basic ETL procedures for data integration
CO3	Understand the operation of basic OLAP technologies
CO4	Recognise basic BI tools
CO5	Realize Business metrics and KPIs

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	-	-	1
CO2	3	1	2	-	-	-	1	1	2	1
CO3	3	1	1	-	-	-	1	1	1	1
CO4	2	1	2	-	-	-	1	1	1	1
CO5	2	1		-	-	-	-	-	-	1
CAM	3	1	2	-	-	-	1	1	1	1

Syllabus

Introduction to Business Intelligence: Introduction to OLTP and OLAP, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components –BI Process, BI Technology, BI Roles & Responsibilities, 3-tier data warehouse architecture, Data Marts
Data integration: Basics of Data Integration (Extraction Transformation Loading)-Concepts of data integration need and advantages of using data integration. Introduction to common data integration approaches, Introduction to ETL using SSIS, Introduction to data quality, data profiling concepts and applications.
Introduction to Multi-Dimensional Data Modeling -Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi-dimensional modeling, OLAP operations, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, OLAP Servers –MOLAP, ROLAP, OLAP query model and query processing, indexing OLAP Data, Data Warehouse Implementation
Introduction to business metrics and KPIs, creating cubes using SSAS. Basics of Enterprise Reporting-Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, introduction to SSRS Architecture, enterprise reporting using SSRS.

Textbooks / References:

1. Loshin D, “Business Intelligence”, First Edition, Elsevier Science (USA), 2003.
2. Jiawei Han, Micheline Kamber and Jian Pei, “Data mining concepts and Techniques”, Third Edition, Elsevier Publisher, 2006.
3. Biere M, “ Business intelligence for the enterprise” , Second Edition, IBM Press,2003.
4. Moss L T, Atre S, “Business intelligence roadmap”, First Edition, Addison-Wesley Longman Publishing Co., Inc., 2003.

21CSA342	IOT ARCHITECTURES AND PROGRAMMING	L-T-P-C: 3-0-1-4

Course Objectives

- This course presents an in-depth discussion of the most important networking protocols comprising the TCP/IP protocol suite.
- Students will be able to understand state of the art in network protocols, architectures, and applications.

Course Outcomes

COs	Description
CO1	Understand theoretical foundation of IoT architectures.
CO2	Systematic professional knowledge and strong practical skills in the IoT Platform and System Design.
CO3	Understand the vision of IoT from a global perspective and its applications
CO4	Determine its market perspective, using gateways, devices and data management
CO5	Building a state of art architecture in IoT and its applications in commercial building automation and real-world design constraints.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	1	1	1	-
CO2	2	2	2	-	1	1	2	1	2	-
CO3	2	3	2	-	1	1	3	2	3	1
CO4	2	3	2	1	1	1	1	2	3	1
CO5	2	2	3	1	1	1	2	2	2	2
CAM	2	3	2	1	1	1	2	2	2	1

Syllabus

Unit 1: IoT Networking Core Technologies involved in IoT development, Internet web and Networking technologies, Infrastructure, Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards, Wireless networking equipment and configurations, accessing hardware and device file interactions.

Unit 2: M2M to IoT Role of M2M in IoT, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations

Unit 3: IoT Architecture -State of the Art IoT reference Model and Architecture- Functional View, Information View, Deployment and Operational View, Other Relevant architectural views, Middleware Introduction-FiWare etc., Remote monitoring and sensing, remote controlling and performance analysis, layering concepts, communication pattern, 6LoWPAN, Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino)

Unit 4: IoT Application Development Application protocols: MQTT, REST/HTTP, CoAP, MySQL, Back-end Application Designing Apache for handling HTTP Requests, MongoDB Object type Database, HTML, CSS & jQuery for UI Designing, JSON lib for data processing, Security & Privacy during development

Unit 5: IoT Security and case studies Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First

Steps towards a Secure Platform, Smarty Approach. Data Aggregation for the IoT in Smart Cities

Textbooks/References:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1 st Edition, VPT, 2014
2. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, November 2013, John Wiley and Sons.
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1 st Edition, Apress Publications, 2013
4. CunoPfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1- 4493-9357-1
5. Zach Shelby, Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet”, John Wiley and Sons.
6. Dr. OvidiuVermesan, Dr. Peter Friess “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers

21CSA343 ADVANCED SOFTWARE ENGINEERING AND DESIGN PATTERNS L-T-P-C: 3-0-1-4

Course Objectives

- Advanced Software Engineering presents a broad perspective on software systems engineering, concentrating on widely used techniques for developing large-scale software systems covering a wide spectrum of software processes from initial requirements elicitation through design and development to system evolution. The course also covers a wide range of software development abilities and skills from analyzing a problem to implement a solution, by discussing the design patterns in Smalltalk MVC architecture, Express representation invariants, understand their impact on efficiency and ease of implementation, and implement them as runtime assertions by differentiating between structural patterns and behavioral patterns involved in a software development process.

Course Outcomes

COs	Description
CO1	Illustrate the idea of the software myths, basics of software engineering, SRS and its phases with different Process Models.
CO2	Describe the design and working of ERD, DFD, Design Methods and architectural views.
CO3	Understand Testing strategies, different methods, design transformation to understand the structure of application development. Design a module structure to solve a problem, and evaluate alternatives in software applications.
CO4	Analyze and Design a model by exploiting the well-known design patterns (such as Iterator, Observer, Factory and Visitor)
CO5	Understand and apply common design patterns to incremental/iterative development.
CO6	Identify appropriate patterns for designing solution to the given problem by applying the software development concepts for implementing a solution.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	1	-	-
CO2	3	2	2	-	-	-	-	1	-	-
CO3	3	2	2	-	-	-	-	1	1	-
CO4	3	3	-	1	1	-	-	1	1	-
CO5	2	3	2	1	1	-	-	1	1	-
CO6	2	3	2	1	1	-	-	1	1	-
CAM	3	3	2	1	1	-	-	1	1	-

Syllabus

Introductions to Software Engineering: Software Myths and Types, Process and Products, Software Characteristics, SDLC process, Software requirements specification, approaches and paradigms. Prototyping, RAD, SCRUM, Incremental and Agile process models.

Design process consideration: Design Concepts, Design Architecture, Description and Principles, UML Modeling: Use case and Class Diagrams, State Transition Diagrams and Interaction Diagrams. Analysis to Design Modeling: Transformations. Testing fundamentals: Testing Principles, Processes and Methods used for evaluating a software.

Introductions to Design Pattern, Catalog of Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design

Pattern.

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems. Creational Patterns: Abstract Factory, Builder, Factory Method and Prototype Patterns.

Categories of Patterns: Structural Patterns: Adapter, Bridge, Composite and Decorator. Behavioral Patterns: Observer, Mediator, Interpreter and Iterator. Differences between Structural and Behavioral Patterns. Discussion of real-time examples

Textbooks/References:

1. Roger S Pressman, "Software Engineering", Tata McGraw-Hill Publishing Company Pvt. Ltd., Sixth Edition
2. Design Patterns by Erich Gamma, Pearson Education.
3. Shooman, "Software Engineering", Tata McGraw-Hill Publishing Company Pvt. Ltd., 1987
4. Design Patterns Explained by Alan Shalloway, Pearson Education.
5. Pattern Oriented Software Architecture, F. Buschmann & Others, John Wiley & Sons.

21CSA344	ADVANCED DATA MINING AND APPLICATIONS	L-T-P-C: 3-0-1-4

Course Objectives

- This course focuses on advanced data mining concepts and techniques for discovering interesting patterns from data in various applications It emphasizes techniques for developing effective, efficient, and scalable data mining tools.

Course Outcomes

COs	Description
CO1	To remember the difference between database and data mining and it applications, classification and issues.
CO2	Understand the various data pre-processing methods like cleaning, integration, transformation, reduction.
CO3	Apply the frequent pattern mining algorithms to find the frequent pattern and understand the various patterns and its rules.
CO4	Understand the various classification and prediction algorithms and evaluate the performance of classifiers.
CO5	To analyse the nature of data, based on the nature apply various clustering algorithm and detect the outliers and process the outlier using various methods.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	-	-	1
CO2	3	2	2	-	-	-	1	1	1	1
CO3	3	3	3	-	-	1	1	1	1	1
CO4	3	3	3	-	-	1	1	1	1	1
CO5	3	3	3	-	-	1	1	1	1	1
CAM	3	3	3	-	-	1	1	1	1	1

Syllabus

Introduction to data mining; Data preprocessing; Data cleaning; Data integration; Data reduction techniques; Data Transformation and Discretization.

Mining Frequent Patterns: Basic Concept –Apriori algorithm-Pattern-growth approach for mining Frequent Item Set Mining Methods – Mining Association Rules – Association to Correlation Analysis-pattern mining-road map, pattern mining in multilevel, multidimensional space, constraint-based frequent pattern mining-mining, high-dimensional and colossal patterns-pattern exploration and applications.

Classification and Prediction: Basic Concept - Decision Tree Induction - Bayesian Classification – k-Nearest-Neighbour ,Classification by back propagation-- Linear SVM - Regression – Linear, Logistic – Model evaluation and selection-metric for evaluating classifier performance-holdout method and random subsampling, cross validation-bootstrap, ROC, Technique for improve classification accuracy–Introduction to Ensemble methods-Bagging-boosting and AdaBoost, Random forest-Multiclass classification-Semi-supervised classification-Active learning-Transfer learning.

Clustering: What is cluster analysis, requirements for cluster analysis, Overview of basic clustering methods-Partitioning Methods, k-Means, k-Medoids. Hierarchical Methods- Agglomerative and Divisive hierarchical clustering, Single, Average and Complete linkage, BIRCH, CHAMELEON. Density-Based Methods-DBSCAN-OPTICS, DENCLUE, Grid-Based Methods-STING,CLIQUE , Evaluation in Clustering, Advanced clustering-Probabilistic Model-Based Cluster-EM algorithm, Outlier Detection- Outlier and Outlier analysis-what are outliers, type of outliers, Outlier detection methods-, Statistical approaches-parametric methods, nonparametric methods, Proximity-based approaches-a grid-based method, density-based outlier detection,

clustering-based approach, classification based approaches, clustering based approaches.

LAB-Tools :Implementation of Data mining algorithms using Latest Open Source Data mining Tool-Python, Jupyter notebook, Spider, R-programming.

Textbooks / References:

1. Jiawei Han, Micheline Kamber and Jian Pei, “Data mining concepts and Techniques”, Third Edition, Elsevier Publisher, 2006.
2. K.P.Soman, Shyam Diwakar and V.Ajay, “Insight into data mining Theory and Practice”, Prentice Hall of India, 2006.

21CSA345	CLOUD COMPUTING	L-T-P-C: 3-0-1-4

Course Objectives

- To Familiarize the Cloud computing environment, services and delivery models and also analyze the cloud deployment models, QoS parameters, Accounting and Security.

Course Outcomes

COs	Description
CO1	Familiarize the various Computing platforms and features
CO2	Analyze the features of virtualization
CO3	Understand the architecture, cloud services and cloud platforms
CO4	Analyze Cloud delivery models and deployment models
CO5	Understand the concepts of cloud Accounting and Security
CO6	Develop a Cloud platform, VM containers and analyze services, and QoS performance

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	1	1	1	-
CO2	2	2	2	-	1	1	1	1	2	-
CO3	2	3	2	-	1	1	3	2	3	1
CO4	2	3	2	1	1	1	2	2	3	1
CO5	2	2	3	1	1	1	2	2	2	2
CO6	2	1	2	1	1	1	2	1	2	2
CAM	2	3	2	1	1	1	2	1	2	2

Syllabus

Cloud Computing Overview: Cloud and Grid and Web2.0 and Other Computing- Cloud Computing Environments- Platforms. Parallel and Distributed Computing- Virtualization: Characteristics-Taxonomy- Pros and Cons – Xen- VMware- Hyper V. Cloud Computing Architecture-Service Models Deployment Models-Infrastructure as a Service Resource Virtualization-Server-Storage-Network-Platform as a Service-Cloud Platform and Management-Software as a Service-Case Study on Open Nebula. Service Management in Cloud Computing Service Level Agreement-Billing and Accounting-Managing Data. Cloud Security: Infrastructure, Data and Storage Security.

Lab

Cloud Computing:- Familiarize various public and private cloud platforms, Create configure VMs, Working with Containers and docker, to implement IAAS and PAAS model services.
Application development and deployment in cloud with a scenario application, Containerizing and orchestrating apps, Different storage options, Monitoring and load-balancing, build a private Cloud

Textbooks / References:

1. Rajkumar Buyya,Christian Vecchiola and S.ThamaraiSelvi,"Mastering Cloud Computing: Foundations and Applications Programming" , First Edition, McGrawHill Education,2013.
2. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski,"Cloud Computing: Principles and Paradigms", First Edition, Wiley, 2011.
3. Barrie Sisisky, "Cloud Computing Bible", First Edition , Wiley-India, 2010.

4. Nikos Antonpoulos, Lee Gillam,“Cloud Computing: Principles, Systems and Applications”,First Edition , Springer, 2012.
5. Ronald L. Krutz, Russell Dean Vines“Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, First Edition, Wiley-India, 2010
6. https://www.qwiklabs.com/
7. https://sites.google.com/google.com/gcp-teachingresources/home?pli=1&authuser=1
8. https://opennebula.io/docs/

21CSA346	SYSTEM SECURITY	L-T-P-C: 3-0-1-4

Course Objectives

- This course provides basic knowledge and skills in the fundamental theories and practices of cyber security.
- It provides an overview of the field of security and assurance emphasizing the need to protect information being transmitted electronically.

Course Outcomes

COs	Description
CO1	Understand various attacks on the system and the need for security.
CO2	Understand various malicious and non-malicious program errors and learn to develop secure programs.
CO3	Learn various protection mechanisms provided by operating system and to manage it.
CO4	Review the security services provided by the database systems.
CO5	Understand the threats in computer networks, ethical issues, privacy and copyright laws.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	1	1	1	-
CO2	2	2	2	-	1	1	2	1	2	-
CO3	2	3	2	-	1	1	2	2	3	1
CO4	2	3	2	1	1	1	2	2	3	1
CO5	2	2	3	1	1	1	2	2	2	2
CAM	2	3	2	1	1	1	2	2	2	1

Syllabus

Unit 1: Basics of Computer Security: Overview – Definition of terms – Security goals – Shortcomings – Attack and defense – Malicious code – Worms – Intruders – Error detection and correction Encryption and Cryptography: Ciphers and codes – Public key algorithms – Key distribution – Digital signatures.

Unit 2: Security Services: Authentication and Key Exchange Protocols - Access control matrix – User authentication –Directory authentication service – Diffie-Hellman key exchange – Kerberos.

Unit 3: System security and Security models: Disaster recovery - Protection policies. E-mail Security: Pretty good privacy - Database Security: Integrity constraints - Multi-phase commit protocols - Networks Security: Threats in networks - DS authentication -Web and Electronic Commerce: Secure socket layer - Client-side certificates - Trusted Systems : Memory protection.

Textbooks / References:

1. Stallings William, Cryptography and Network Security: Principles and Practice, 7th Edition, Pearson/Prentice- Hall, 2018.
2. Forouzan B A, Cryptography and Network Security, Special Indian Edition, Tata McGraw Hill, 2007.
3. Padmanabhan TR, Shyamala C K, and Harini N, Cryptography and Security, First Edition, Wiley India Publications, 2011.

21CSA347 ARCHITECTURE AND DEPLOYMENT OF SECURE AND SCALABLE WAN L-T-P-C: 3-0-1-4

Course Objectives

- This Course provides an introduction about secure and scalable WAN, configuration of WLAN and WAN technologies. It also introduces various protocols and troubleshooting of networks using various tools.

Course Outcomes

COs	Description
CO1	Understand the design considerations for the enterprise network.
CO2	Learn to configure and troubleshoot WLAN.
CO3	Understand the operation and configuration of WAN technologies.
CO4	Learn datalink protocol like PPP, HDLC and NAT concepts.
CO5	Understand VPNs and IPsec; troubleshoot and monitor the network using various tools.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	-	-	-
CO2	3	2	3	-	-	-	-	-	1	-
CO3	3	2	3	-	-	-	1	-	1	-
CO4	3	2	3	-	-	-	1	-	1	-
CO5	3	1	3	-	-	-	2	-	-	-
CAM	3	2	3	-	-	-	1	-	1	-

Syllabus

Unit 1: Introduction to Scaling Networks, implementing a Network Design, LAN Redundancy, Spanning Tree Concepts and protocols.

Unit 2: Link Aggregation Concepts and Configuration, Wireless LAN Concepts, operations and Security, Wireless LAN Configuration, Troubleshoot Single-Area OSPF, Multiarea OSPF

Unit 3: Operation and configuration. Hierarchical Network Design, WAN Technologies, Spanning Tree Configuration, First-Hop Redundancy Protocols, Point-to-Point Connections.

Unit 4: PPP Operation and Configuration, HDLC protocol, Troubleshoot WAN Connectivity, Frame Relay concepts and Configurations, NAT Operation & Configuration, Troubleshooting NAT

Unit 5: Tele working, Broadband Solutions, Configuring xDSL Connectivity, Securing Site-to-Site Connectivity, VPNs, Site-to-Site GRE Tunnels, IPsec, Monitoring the Network – Syslog, SNMP, Netflow, Network Troubleshooting with a Systematic Approach.

Textbooks/ References:

1. Youlu Zheng and ShakilAkhtar,"Networks for Computer Scientists and Engineers".
2. Peterson & Davie, "Computer Networks, A Systems Approach", 5th Edition, Morgan Kaufmann, 2011.
3. "Scaling Networks - Course Booklet ", Cisco Press.
4. "Switched Networks - Course Booklet", Cisco Press.

21CSA348 INTRODUCTION TO BUSINESS ANALYTICS AND VISUALIZATION L-T-P-C: 3-0-1-4

Course Objectives

- To promote the ability to critically analyze and solve data-oriented real-world decision problems.
- To utilize the theories of statistics and probabilities in business analytics.
- Familiarisethe modeling techniques and best practices in visualization.

Course Outcomes

COs	Description
CO1	Apply best practices of data visualization in different stages of the data mining process.
CO2	Analyze and explore data to get useful insights for business.
CO3	Ability to choose an appropriate data analysis methodology suitable for a given business problem.
CO4	Achieve familiarity with using data analysis tools.
CO5	Apply time series analysis to real world problems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	2	-	-	-	1	-	1	-
CO2	2	3	1	-	-	-	-	1	-	-
CO3	2	3	1	-	-	-	-	1	-	-
CO4	1	2	3	-	-	-	1	-	2	-
CO5	2	3	1	-	-	-	-	1	2	-
CAM	2	3	1	-	-	-	1	1	2	-

Syllabus

Unit 1: Introduction to Business Analytics , Descriptive Statistics - Types of Data and its Measures, Data cleansing. Data Visualization-Design Techniques, Tables, Charts, Advanced data Visualization, Dashboards, Case Studies.

Unit 2: Inferential Analysis - Statistical Inference, Descriptive Data Mining - Clustering and Association Rules. Performance Evaluation, Overview of key Classification and prediction techniques, Case studies.

Unit 3: Introduction to Forecasting, Time Series – Level, Trend, and Seasonality, Smoothing Techniques – Moving Average and Exponential Smoothing, Determining the best forecasting model to use. Case Study.

Textbooks / References:

1. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, Dennis J. Sweeney, Thomas A. Williams ’Business Analytics’,3/e, Cengage Learning,2019.
2. GalitShmueli, Kenneth C. Lichtendahl Jr., ‘Practical Time Series Forecasting with R: A Hands-On Guide’, 2/e, Axelrod Schnall Publishers, 2016.
3. Joel Grus, ‘Data Science from Scratch: First Principles with Python’, 2/e, O'Reilly Media, 2019.
4. Cole Nussbaumer Knaflic, ‘Storytelling with Data: A Data Visualization Guide for Business Professionals’, John Wiley& Sons, 2015.
5. Claus O. Wilke, “Fundamentals of Data Visualization: A primer for making informative and compelling

figures", O'Reilly, 2019.

MATHEMATICS CORES

21MAT231 MATHEMATICAL FOUNDATION FOR COMPUTER SCIENCE L-T-P-C: 3-0-1-4

Course Objectives

- The primary objective of this course is to provide mathematical background and adequate experience on various topics of basic mathematics like Set Theory, Matrix, Differential calculus etc. This course will extend student's Logical ability.

Course Outcomes

COs	Description
CO1	Study and solve problems related to connectives,predicates and quantifiers under different situations.
CO2	Develop basic knowledge of matrices and to solve equations using Cramer's rule.
CO3	Understand the concept of eigen values.
CO4	Develop the knowledge about derivatives and know various applications of differentiation.
CO5	Understand the basic concepts of Mathematical reasoning, set and functions

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	1	-	-
CO3	3	3	-	-	-	-	2	2	-
CO4	3	3	-	-	-	-	2	2	1
CO5	3	2	-	-	-	-	1	2	1
CAM	3	3	-	-	-	-	2	2	1

Syllabus

Unit 1: Basic concepts of set theory - Mathematical logic-introduction-statements-connectives-negation, conjunction, disjunction- statement formulas and truth tables- conditional and bi-conditional statements-tautology-contradiction-equivalence of formulas-duality law-Predicates and Quantifiers, Arguments.

Unit 2: Operations on sets - power set- venn diagram Cartesian product-relations -functions- types of functions -composition of functions.

Unit 3: Matrix algebra-Introduction-Types of matrices-matrix operations- transpose of a matrix -determinant of matrix - inverse of a matrix- Cramer's rule

Unit 4: Matrix: finding rank of a matrix - normal form-echelon form-Cayley Hamilton theorem-Eigen values

Unit 5: Differential calculus - Functions and limits - Simple Differentiation of Algebraic Functions — Evaluation of First and Second Order Derivatives – Maxima and Minima

Textbooks/References:

1. P.R.Vittal-Business Mathematics and Statistics,Margham Publications,Chennai.
2. B.S.Vatsa-Discrete Mathematics –New Age International Limited Publishers,New Delhi

21MAT232	DISCRETE MATHEMATICS	L-T-P-C: 3-0-1-4

Course Objectives

- To give an insight to develop logical thinking and its application to computer science by learning Boolean algebra, number theory, counting techniques and graph theory.

Course Outcomes

Cos	Description
CO1	To understand the basic concepts of Mathematical reasoning, set and functions.
CO2	To understand various counting techniques and principle of inclusion and exclusions.
CO3	Understand the concepts of various types of relations, partial ordering and equivalence relations.
CO4	Apply the concepts of generating functions to solve the recurrence relations.
CO5	Familiarise the fundamental concepts of graph theory and shortest path algorithm.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	1	2	1
CO2	1	3	2	-	-	-	1	1	-
CO3	1	3	2	-	-	-	1	1	-
CO4	3	3	-	-	-	-	1	1	-
CO5	1	1	1	-	-	-	1	2	3
CAM	1	3	2	-	-	-	1	1	2

Syllabus

Unit 1: Binary operations, group, semi group,monoid, abelian group, subgroup(simple theorems without proof) Boolean algebra-definition-principle of duality-theorems.

Unit 2: Basic Counting Principles, Generating Functions, Euler's phi-function and its Application to Cryptography.

Unit 3: Relations and their properties - relation matrix, graph of a relation - types of relations -equivalence relation - n-ary relations

Unit 4: Advanced Counting Techniques: Recurrence Relations, Solving Linear Recurrence relations, Divide and Conquer Algorithms and Recurrence relations, Generating Functions, Inclusion Exclusionprinciples and their Applications.

Unit 5: Introduction to Graph Theory: Graphs, Bipartite Graphs, Eulerian and Hamiltonian Graphs, Graph Connectivity.

Textbooks/References:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw Hill.
2. R. P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2007.
3. Thomas Koshy, "Discrete Mathematics with Applications", Academic Press, 2005.

21MAT233	STATISTICAL AND NUMERICAL METHODS	L-T-P-C: 3-1-0-4

Course Objectives

- The main objective of this course is to understand and implement various concepts of numerical analysis and statistics to solve real life problems.

Course Outcomes

Cos	Description
CO1	Study the relationship of a dependent variable on an independent variable.
CO2	Understand the various types of probability distributions and its applications
CO3	To understand the meaning and process of differentiation
CO4	Provide numerical answers to complex problems of scientific and engineering nature.
CO5	Develop an idea of numbers, its divisibility and properties

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	2	-	-
CO2	2	3	-	-	-	-	2	1	-
CO3	2	2	-	-	-	-	2	-	-
CO4	2	2	-	-	-	1	1	1	-
CO5	2	2	2	-	-	-	2	2	1
CAM	2	2	2	-	-	1	2	1	1

Syllabus

Unit 1: Statistics-Introduction -Measures of average-AM-Median-Mode, Measures of dispersion and its coefficients – Range – QD – SD-MD

Unit 2 : Correlation- Karl Pearson's and Spearman's rank correlation, Regression- regression equations, regression coefficients

Unit 3: Permutations – combinations – Probability-addition theorem, multiplication theorem, independent events,conditional probability,Baye's theorem,Probability distribution-Binomial,Poisson, Normal.

Unit 4: Interpolation- Newton's forward &backward method- Lagrange's Method,Curve fitting-fitting a straight line

Unit 5: Solutions of Numerical, Algebraic and transcendental methods- bisection method, Newton Raphson method,Simultaneous linear equations -Gauss elimination

Textbooks/References:

1. P.R.Vittal-Business Mathematics and Statistics,Margham Publications,Chennai,
2. H.S.Hall and S.R.Knight: Higher Algebra –AITBS Publishers India.
3. M.K.Venkataraman: Numerical methods in Science and Engineering-National Publishing Company,Chennai

21MAT234	ALGEBRA AND NUMBER THEORY	L-T-P-C: 3-0-1-4

Course Objectives

- This course aims to introduce students the basic concept of algebra and number theory.

Course Outcomes

Cos	Description
CO1	To understand inner products and compute the angle/length of a vector. To construct the orthonormal basis.
CO2	To understand the process of diagonalizing and identify Conic Sections using diagonalization.
CO3	Understand the axioms in the definition of a group through examples; to understand Subgroups/ Cyclic Groups / Factor Groups and identify them.
CO4	Apply division algorithm in Cryptography.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	2	1	-
CO2	1	1	2	-	-	-	-	1	1	1
CO3	1	1	-	-	-	1	1	1	1	1
CO4	1	2	-	1	-	-	1	2	1	-
CAM	1	2	2	1	-	1	1	2	1	1

Syllabus

Unit 1: Vector Spaces, Inner Products, Angle and Orthogonality in Inner Product Spaces, Length of a Vector, Schwarz Inequality, Orthogonal Vectors, Orthogonal Complement, Orthogonal Bases: Gram-Schmidt Process. (Sec. 4.4 ,T-1)

Unit 2: Problems in Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections. (Sec. 7.1 to 7.3 and 9.5 to 9.6 ,T-3)

Unit 3: Decomposition-LU-Decompositions-The Power Method- QR method- SVD- Data Compression Using Singular Value Decomposition (Sec. 6.3 and 7.3 T2 & 9.1- 9.5 T3)

Unit 4: Definition of Groups, Basic Examples - Symmetric Groups, Matrix Groups, Groups of Rigid Motions of a Plane, Finite Groups of Motions, Subgroups, Cyclic Group and Factor Groups, Lagrange's Theorem, Normal Subgroups. Quotients of Groups, Homomorphisms, Kernal of a homomorphism, Automorphisms , Cayley's Theorem (without proof)and, Permutation Groups. (Sec. 2.1 to 2.10, T1)

Definition of Rings, Examples including Polynomial Rings, Formal Power Series Rings, Matrix Rings and Group Rings. Commutative Rings, Integral Domain, Division Ring, Characteristics of an Integral domain, Fields. (Sec. 3.1 to 3.2, T1)

Unit 5: Divisibility theory and congruences: Division algorithm, Greatest Common Divisor Euclidean algorithm, Basic properties of congruences, Binary and decimal representation of integers, Linear congruences and Chinese Remainder Theorem. (Sec 2.2- 2.5,4.2-4.4 , T4)

Fermat's Theorem and its Generalization, Fermat's Little theorem, Wilson's theorem, Euler's phi function, Euler's theorem, Properties of phi function.(Sec 5.2-5.3,7.2-7.4 ,T4).

Textbooks / References:

1. I N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.
2. Gilbert Strang,' Linear Algebra and its Applications, Fourth Edition, Cengage Learning, 2014 (chapter 3)
3. Howard Anton and Chris Rorres, 'Elementary Linear Algebra', 9th Edition, Wiley, 2005. (ch 9)
4. David M. Burton,Elementary Number Theory(7th edition),McGraw Hill Education(India)
5. John B. Fraleigh, 'A First Course in Abstract Algebra', Narosa Publishing House, 2003.
6. Joseph A. Gallian, 'Contemporary Abstract Algebra', Cengage Learning, 2013.
7. M.Artin, 'Algebra', Prentice Hall inc., 1994.
8. David C. Lay, Linear Algebra and its Applications, Pearson

21MAT235	FOUNDATIONS OF APPLIED MATHEMATICS - PART I	L-T-P-C: 3-0-1-4

Course Objectives

- The objective of this course is to understand and implement various mathematical principles techniques and tools to model to solve real life problems.

Course Outcomes

Cos	Description
CO1	Learn mathematical principles and techniques to model and solve real life problems.
CO2	Familiarize with various computational tools to learn and apply mathematics.
CO3	Build foundations to learn advanced mathematical concepts necessary to become computational engineer/scientist, machine learning or data science practitioner.
CO4	Be able to communicate mathematical ideas orally and in writing with precision, clarity and organization.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	2	1	-
CO2	3	2	3	-	-	-	2	1	-
CO3	3	2	2	-	-	-	2	2	-
CO4	3	-	-	-	-	-	2	-	-
CAM	3	2	2	-	-	-	2	1	-

Syllabus

Unit 1: Mathematical Modelling
Roadmap of the mathematics curriculum - Problem solving -Real life applications- Mathematical modeling.

Unit 2: Description of data,Learning Computational Tools
Data observation, recording, representation and visualization (single variable and multi variable) - Introduction to Excel, Python and Jupyter - Simple data structures - Learning mathematical libraries (Matplotlib, Sympy, Numpy).

Unit 3: Algebra and Trigonometry
Order of operations - Variables and expressions - Bases and exponents - Evaluation of algebraic expressions - Linear equations and inequalities - System of linear equations - Trigonometry - Degrees and radians.

Unit 4: Functions
Definition of functions - Independent and dependent variables - Function visualization- Algebraic functions- Polynomial functions- Exponential functions- Logarithmic functions-Trigonometric functions - Inverse functions - Arithmetic operation on functions - Composition of functions - Functional transformations.

Unit 5: Probability & Statistics
Description of data with statistics - Measures of central tendency - Basics of probability - Random numbers - Probability density functions - Normal distributions - Central limit theorem

Textbooks:

1. Vadakkeppatt, Ajay. Course Notes- Foundations of Applied Mathematics
2. Bird, Basic Engineering Mathematics, 7th Edition, Newnes, India
3. Stewart 2015, CALCULUS: Early Transcendentals, 8th Edition, Cengage learning, India
4. Amit Saha 2015, Doing Math with python, 1st edition, No Starch Press
5. Morley 2020, Applying Math with Python, Packt Publishing

6. Gowers 2002, Mathematics: A Very Short Introduction, 1st edition, Oxford University press

Course Objectives

- The objective of this course is to understand and implement various mathematical principles techniques and tools to model to solve real life problems in an advanced manner.

Course Outcomes

Cos	Description
CO1	Learn mathematical principles and techniques to model and solve real life problems.
CO2	Familiarize with various computational tools to learn and apply mathematics.
CO3	Build foundations to learn advanced mathematical concepts necessary to become computational engineer/scientist, machine learning or data science practitioner.
CO4	Be able to communicate mathematical ideas orally and in writing with precision, clarity and organization

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	2	1	-
CO2	3	2	3	-	-	-	2	1	-
CO3	3	2	2	-	-	-	2	2	-
CO4	3	-	-	-	-	-	2	-	-
CAM	3	2	2	-	-	-	2	1	-

Syllabus

Unit 1: Introduction to Calculus, Limits
History of calculus – Overview of calculus – Single variable and multivariable calculus - Calculus and mathematics modeling – Limits of functions – Continuity of functions.

Unit 2: Differential Calculus
Differentiating a function – Slopes and derivatives - Algebra of derivatives - The chain rule of differentiation - Extreme values of functions – The mean value theorem - First and second derivative tests.

Unit 3: Integral Calculus
Area under the curve – Indefinite integral - Integration by substitution – Definite integral –
Fundamental theorem of calculus – Integration by parts – Numerical Integration - Applications of the definite integral in geometry, science and engineering

Unit 4: Differential Equations
Introduction to differential equations – Mathematical modeling with differential equations – Separation of variables – First Order Differential Equations – Second Order Constant Coefficient Linear Equations – Fourier transforms - Laplace transforms – First Order Systems – Convolution.

Unit 5: Elementary Linear Algebra
Systems of linear equations – Gauss elimination – Matrix operations, including inverses – Least square problem – Determinants and their properties – Eigenvalues and eigenvectors – Matrix decompositions

Textbooks / References:

1. Vadakkeppatt, Ajay. Course Notes- Foundations of Applied Mathematics, 2021
2. Stewart 2015, CALCULUS: Early Transcendentals, 8thEdition, Cengage learning, India.

3. Strang 2005, Linear Algebra and its Applications, 4th Edition, Cengage Learning (RS).