VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2023-2024)

M.Tech (CSE) - Specialization in Data Science – 5 year Integrated

School of Computer Science and Engineering

M.Tech (CSE) - Specialization in Data Science - 5 Year Integrated

CURRICULUM AND SYLLABUS

(2023-2024 Admitted Students)

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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.

Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.

Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

To be a world-renowned centre of education, research and service in computing and allied domains.

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.

- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.

- To foster vibrant outreach programs for industry, research organizations, academia and society.

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School of Computer Science and Engineering

M.Tech (CSE) - Specialization in Data Science – 5 year Integrated

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduate will acquire fundamental knowledge and expertise essential for professional practice in computer engineering.
2. Graduates will use suitable principle, hypothesis, mathematics and computational technology to analyze and solve problems encountered in the applications of computer systems.
3. Graduates will own a professional attitude as an individual or a team member with contemplation for society, professional ethics, environmental factors and motivation for lifelong learning.
4. Graduates will communicate, using oral, written and computer based communication technology, as well as function effectively as an individual and a team member in professional environment.
5. Graduates will realise the local, national and global issues related to the growth and applications of computer systems and to be solicitous of the impact of these issues on different cultures.

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M. Tech Computer Science and Engineering
Specialization in Data Science 5-Year Integrated

PROGRAMME OUTCOMES (POs)

PO_1 Having an ability to apply mathematics and science in engineering applications

PO_2 Having a clear understanding of the subject related concepts and of contemporary issues

PO_3 Having an ability to design a component or a product applying all the relevant standards and with realistic constraints

PO_4 Having an ability to design and conduct experiments, as well as to analyze and interpret data

PO_5 Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

PO_6 Having problem solving ability-solving social issues and engineering problems

PO_7 Having adaptive thinking and adaptability

PO_8 Having a clear understanding of professional and ethical responsibility

PO_9 Having cross cultural competency exhibited by working in teams

PO_10 Having a good working knowledge of communicating in English

PO_11 Having a good cognitive load management [discriminate and filter the available data] skills

PO_12 Having interest in lifelong learning

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School of Computer Science and Engineering

M.Tech (CSE) - Specialization in Data Science – 5 year Integrated

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Employ mathematical models with indispensable engineering and scientific principles to unravel solutions for life problems using appropriate data structures and algorithms.

2. Design storage structures to represent huge data and apply artificial statistics and computational analysis for data to predict and represent knowledge.

3. Evaluate the use of data from acquisition through cleansing, warehousing, analytics, and visualization to the ultimate business decision.

4. Utilize the core concepts of computer science and engage in research methods to interpret, process, experiment and conclude the investigations.

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SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
5 Year integrated M.Tech CSE with Spl. in Data Science
Curriculum for 2023-2024 Batch

Sl.NO	Category	Total No. of Credits
1	University Core	61
2	Programme Core	81
3	University Elective	12
4	Programme Elective	66
	Total	220

University Core (61 Credits)

Sl.No	Course Code	Course Title	L	T	P	J	C	Pre Requisite	Category
1.	ENG1002	Effective English(bridge course)	0	0	4	0	Pass		H
2.	FLC4097	Foreign Language	2	0	0	0	2		H
3.	CHY1701	Engineering Chemistry	3	0	2	0	4		S
4.	PHY1701	Engineering Physics	3	0	2	0	4		S
5.	MAT2001	Statistics for Engineers	3	0	2	0	4		S
6.	HUM1021	Ethics and Values	2	0	0	0	2		H
7.	CSE1001	Problem Solving and Programming	0	0	6	0	3		E
8.	CSE1002	Problem Solving and Object Oriented Programming	0	0	6	0	3		E
9.	CSI4099	Capstone Project	0	0	0	0	18		E
10.	CSI4098	Comprehensive Examination	0	0	0	0	1		E
11.	STS5097	Soft Skills(8 courses)	24	0	0	0	8		H
12.	ENG1901	English	0	0	4	0	2		H
13.	MAT1011	Calculus for Engineers	3	0	2	0	4		S
14.	PHY1901	Introduction to Innovative Projects	1	0	0	0	1		S
15.	MGT1022	Lean Start-up Management	1	0	0	4	2		M
16.	CSI3999	Technical Answers for Real World Problems (TARP)	1	0	0	4	2	PHY1901	E

17.	CSI3099	Industrial Internship	0	0	0	0	1		E
18.	EXC4097	Co-Extra Curricular Basket	0	0	0	0	0		M
19.	CHY1002	Environmental Sciences	3	0	0	0	3		S
		Total	61 credits						

Programme Core (Total 81 Credits)

Sl. No	Course Code	Course Title	L	T	P	J	C	Pre-Req	**Category**
1.	CSI2003	Advanced Algorithms	2	0	2	0	3	CSE2003	E
2.	CSI2004	Advanced Database Management Systems	3	0	0	0	3	CSI1001	E
3.	MDI1001	Advances in Web Technologies	3	0	2	0	4		E
4.	CSI3002	Applied Cryptography and Network Security	2	0	2	0	3		E
5.	CSI3003	Artificial Intelligence and Expert Systems	3	0	0	0	3		E
6.	CSI3001	Cloud Computing Methodologies	3	0	2	0	4		E
7.	CSI1004	Computer Organization and Architecture	3	0	0	0	3	CSE1003	E
8.	CSI2007	Data Communication and Networks	3	0	2	0	4		E
9.	CSI2002	Data Structures and Algorithm Analysis	3	0	2	0	4		E
10.	CSI2001	Digital logic and Computer Design	3	0	2	0	4		E
11.	MAT1014	Discrete Mathematics and Graph Theory	3	2	0	0	4		S
12.	CSI1003	Formal Languages and Automata Theory	3	0	0	0	3		E
13.	EEE1024	Fundamentals of Electrical and Electronics Engineering	2	0	2	0	3		E
14.	MAT1022	Linear Algebra	3	0	0	0	3		S
15.	CSI2006	Microprocessor and Interfacing Techniques	2	0	2	0	3		E
16.	CSI1002	Operating System Principles	2	0	2	0	3		E
17.	CSI2005	Principles of Compiler Design	3	0	0	0	3		E
18.	CSI1001	Principles of Database Systems	2	0	2	0	3		E
19.	CSI2008	Programming in Java	3	0	2	0	4		E
20.	CSI1007	Software Engineering Principles	2	0	2	0	3		E
		Total	67 Credits						

Data Science Core (14 Credits)

Sl.No	Course Code	Course Title	L	T	P	J	C	Pre-Req	**Category**
1	MDI3002	Foundations of Data Science	3	0	0	0	3		E
2	CSI3004	Data Science Programming	2	0	2	0	3		E
3	MDI4001	Machine Learning for Data Science	3	0	2	0	4		E
4	CSI3005	Advanced Data Visualization Techniques	3	0	2	0	4		E
		Total	14 Credits						

Program Electives (Total 66 Credits)

CSE Electives (Min 33 Credits)

Sl. No	Course Code	Course Title	L	T	P	J	C	Pre-Req	Category
1	CSI3021	Advanced Computer Architecture	3	0	0	0	3		E
2	CSI3019	Advanced Data Compression Techniques	3	0	0	0	3		E
3	CSI3020	Advanced Graph Algorithms	3	0	0	0	3		E
4	CSI3018	Advanced Java	2	0	2	0	3	CSI2008	E
5	CSI3009	Advanced Wireless Networks	3	0	2	0	4		E
6	CSI1032	Advances in Pervasive Computing	3	0	0	0	3		E
7	CSI1027	Augmented Reality and Virtual Reality	3	0	0	4	4		E
8	MAT2002	Applications of Differential and Difference Equations	3	0	2	0	4	MAT1011	S
9	CSI3013	Block chain Technologies	3	0	0	4	4		E
10	CSI3011	Computer Graphics and Multimedia	3	0	2	0	4		E
11	CSI1021	Computer Oriented Numerical Methods	3	0	2	0	4		E
12	CSI3022	Cyber Security and Application Security	3	0	2	0	4		E
13	CSI3012	Distributed Systems	3	0	2	0	4		E
14	CSI1033	Game Theory	3	0	0	0	3		E
15	CSI1034	GPU Programming	3	0	0	0	3		E
16	CSI3008	Internet of Everything	3	0	2	0	4		E
17	CSI1017	Internetworking with TCP/IP	3	0	0	0	3		E
18	CSI1019	Logic and Combinatorics for Computer Science	3	0	0	0	3		E
19	CSI1042	Mathematical Modeling and Simulation	3	0	0	0	3		E
20	CSI1018	Natural Language Processing and Computational Linguistics	3	0	0	4	4		E
21	CSI1037	Programming Paradigms	3	0	2	0	4		E
22	CSI1035	Advanced Python Programming	2	0	4	0	4	CSE1001	E
23	CSI1029	Quantum Computing Techniques	3	0	0	0	3		E
24	CSI1041	Robotics: Machines and Controls	3	0	0	0	3		E
25	CSI1025	Soft Computing Techniques	3	0	0	4	4		E
26	CSI1040	Software Project Management	3	0	0	0	3		E
27	CSI1030	Software verification and validation	3	0	0	0	3		E
28	CSI1023	Text Mining	3	0	0	0	3		E

Data Science Electives (Min 18 Credits)

Sl.No	Course Code	Course Title	L	T	P	J	C	Pre-Req	Category
1.	CSE2010	Advanced C Programming	2	0	2	0	3	CSE1001	E
2.	MDI1013	Advanced Data Analytics	3	0	0	0	3		E
3.	CSI1043	Advanced Predictive Analytics	3	0	2	0	4		E

4.	MDI010	Advances in Data Engineering	3	0	0	4	4		E
5.	CSI1046	Advances in Database Administration and Security	3	0	0	0	3		E
6.	MDI1014	Bayesian Statistical Methods	3	0	0	4	4		E
7.	MDI1006	Business Intelligence	3	1	0	0	4		E
8.	CSI1045	Cognitive Science and Decision making	3	0	0	0	3		E
9.	CSI1044	Data warehousing and Data Mining	3	0	2	0	4		E
10	MDI1012	Image and Video Analytics	3	0	0	4	4		E
11	MDI1007	Intelligent Database Systems	3	0	0	4	4		E
12	MDI1011	Knowledge Engineering and Management	3	0	0	4	4		E
13	MDI1008	Medical Informatics	3	0	0	0	3		E
14	MDI1016	Nature Inspired Optimization Techniques	3	1	0	0	4		E
15	MDI1015	Neural Networks and Deep Learning	3	0	0	0	3		E
16	MDI1009	Statistical Inference and Modelling	3	0	2	0	4		E
17	MDI1017	Statistics and Exploratory Analytics	3	0	0	0	3		E
18	CSI1005	User Interface Design	2	0	2	0	3		E
19	CSI1047	Web mining and Social Network Analysis	3	0	0	4	4		E

CSE1001	Problem solving and programming	L	T	P	J	C
		0	0	6	0	3
Pre-requisite	NIL	Syllabus version v.1.0				

Course Objectives:

1. To develop broad understanding of computers, programming languages and their generations
2. Introduce the essential skills for a logical thinking for problem solving
3. To gain expertise in essential skills in programming for problem solving using computer

Expected Course Outcome:

1. Understand the working principle of a computer and identify the purpose of a computer programming language.
2. Learn various problem solving approaches and ability to identify an appropriate approach to solve the problem
3. Differentiate the programming Language constructs appropriately to solve any problem
4. Solve various engineering problems using different data structures
5. Able to modulate the given problem using structural approach of programming
6. Efficiently handle data using flat files to process and store data for the given problem

List of Challenging Experiments (Indicative)

1	Steps in Problem Solving Drawing flowchart using yEd tool/Raptor Tool	4 Hours
2	Introduction to Python, Demo on IDE, Keywords, Identifiers, I/O Statements	4 Hours
3	Simple Program to display Hello world in Python	4 Hours
4	Operators and Expressions in Python	4 Hours
5	Algorithmic Approach 1: Sequential	4 Hours
6	Algorithmic Approach 2: Selection (if, elif, if.. else, nested if else)	4 Hours
7	Algorithmic Approach 3: Iteration (while and for)	6 Hours
8	Strings and its Operations	6 Hours
9	Regular Expressions	6 Hours
10	List and its operations	6 Hours
11	Dictionaries: operations	6 Hours

12	Tuples and its operations	6 Hours
13	Set and its operations	6 Hours
14	Functions, Recursions	6 Hours
15	Sorting Techniques (Bubble/Selection/Insertion)	6 Hours
16	Searching Techniques : Sequential Search and Binary Search	6 Hours
17	Files and its Operations	6 Hours
	Total hours:	**90 hours**

Text Book(s)

1.	John V. Guttag., 2016. Introduction to computation and programming using python: with applications to understanding data. PHI Publisher.

Reference Books

1.	Charles Severance.2016.Python for everybody: exploring data in Python 3, Charles Severance.
2.	Charles Dierbach.2013.Introduction to computer science using python: a computational problem-solving focus. Wiley Publishers.

Mode of Evaluation: **PAT / CAT / FAT**

Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE1002	Problem solving and object orientedprogramming	L	T	P	J	C
		0	0	6	0	3
Pre-requisite	Nil	Syllabus version v.1.0				
		1.0				

Course Objectives:

1. To emphasize the benefits of object oriented concepts.

2.To enable students to solve the real time applications using object oriented programming features

3.To improve the skills of a logical thinking and to solve the problems using any processing elements

Expected Course Outcome:

1. Demonstrate the basics of procedural programming and to represent the real world entities as programming constructs.

2.Enumerate object oriented concepts and translate real-world applications into graphical representations.

3.Demonstrate the usage of classes and objects of the real world entities in applications.
4.Discriminate the reusability and multiple interfaces with same functionality based features to

solve complex computing problems.

5. Illustrate possible error-handling constructs for unanticipated states/inputs and to use generic programming constructs to accommodate different datatypes.

6. Validate the program against file inputs towards solving the problem..

List of Challenging Experiments (Indicative)		
1.	**Postman Problem** A postman needs to walk down every street in his area in order to deliver the mail. Assume that the distances between the streets along the roads are given. The postman starts at the post office and returns back to the post office after delivering all the mails. Implement an algorithm to help the post man to walk minimum distance for the purpose.	10 hours
2.	**Budget Allocation for Marketing Campaign** A mobile manufacturing company has got several marketing options such as	15 hours

	Radio advertisement campaign, TV non peak hours campaign, City top paper network, Viral marketing campaign, Web advertising. From their previous experience, they have got a statistics about paybacks for each marketing option. Given the marketing budget (rupees in crores) for the current year and details of paybacks for each option, implement an algorithm to determine the amount that shall spent on each marketing option so that the company attains the maximum profit.	
3.	**Missionaries and Cannibals** Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Implement an algorithm to find a way to get everyone to the other side of the river, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place.	10 hours
4.	**Register Allocation Problem** A register is a component of a computer processor that can hold any type of data and can be accessed faster. As registers are faster to access, it is desirable to use them to the maximum so that the code execution is faster. For each code submitted to the processor, a register interference graph (RIG) is constructed. In a RIG, a node represents a temporary variable and an edge is added between two nodes (variables) t1 and t2 if they are live simultaneously at some point in the program. During register allocation, two temporaries can be allocated to the same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution	15 hours
5.	**Selective Job Scheduling Problem** A server is a machine that waits for requests from other machines and responds to them. The purpose of a server is to share hardware and software resources among clients. All the clients submit the jobs to the server for execution and the server may get multiple requests at a time. In such a situation, the server schedule the jobs submitted to it based on some criteria and logic. Each job contains two values namely time and memory required for execution. Assume that there are two servers that schedules jobs based on time and memory. The servers are named as Time Schedule Server and memory Schedule Server respectively. Design a OOP model and implement the time Schedule Server and memory Schedule Server. The Time Schedule Server arranges jobs based on time required for execution in ascending order whereas memory Schedule Server arranges jobs based on memory required for execution in ascending order	15 hours
6.	**Fragment Assembly in DNA Sequencing** DNA, or deoxyribonucleic acid, is the hereditary material in humans and	15 hours

	almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). In DNA sequencing, each DNA is sheared into millions of small fragments (reads) which assemble to form a single genomic sequence (superstring). Each read is a small string. In such a fragment assembly, given a set of reads, the objective is to determine the shortest superstring that contains all the reads. For example, given a set of strings, 000, 001, 010, 011, 100, 101, 110, 111 the shortest superstring is 0001110100. Given a set of reads, implement an algorithm to find the shortest superstring that contains all the given reads.	
7.	**House Wiring** An electrician is wiring a house which has many rooms. Each room has many power points in different locations. Given a set of power points and the distances between them, implement an algorithm to find the minimum cable required.	10 hours
	Total Laboratory Hours	**90 hours**

Text Book(s)	
1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, C++ primer, Fifth edition, Addison-Wesley, 2012.
2	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999.
3	Brian W. Kernighan, Dennis M. Ritchie , The C programming Language, 2nd edition, Prentice Hall Inc., 1988.
Reference Books	
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Eduction, 2014.

Mode of assessment: **PAT / CAT / FAT**			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CHY1002	Environmental Sciences	L	T	P	J	C
		3	0	0	0	3
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

1. To make students understand and appreciate the unity of life in all its forms, theimplications of life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individuals contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the localenvironment.

Expected Course Outcome: Students will be able to

1. Students will **recognize** the environmental issues in a problem oriented interdisciplinaryperspectives
2. Students will **understand** the key environmental issues, the science behind those problemsand potential solutions.
3. Students will **demonstrate** the significance of biodiversity and its preservation
4. Students will **identify** various environmental hazards
5. Students will **design** various methods for the conservation of resources
6. Students will **formulate** action plans for sustainable alternatives that incorporate science,humanity, and social aspects
7. Students will have foundational **knowledge** enabling them to make sound life decisions aswell as enter a career in an environmental profession or higher education.

Module:1	Environment and Ecosystem	7 hours

Key environmental problems, their basic causes and sustainable solutions. IPAT equation. Ecosystem, earth – life support system and ecosystem components; Food chain, food web, Energy flow in ecosystem; Ecological succession- stages involved, Primary and secondary succession,
Hydrarch, mesarch, xerarch; Nutrient, water, carbon, nitrogen, cycles; Effect of human activitieson these cycles.

Module:2	Biodiversity	6 hours

Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rare species; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity andAquatic biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation
methods.

Module:3	Sustaining Natural Resources andEnvironmental Quality	7 hours

Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Waterfootprint; virtual water, blue revolution. Water quality management and its conservation. Solid andhazardous waste – types and waste management methods.

Module:4	**Energy Resources**	**6 hours**
Renewable - Non renewable energy resources- Advantages and disadvantages - oil, Natural gas, Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar-Hydrogen revolution.		
Module:5	**Environmental Impact Assessment**	**6 hours**
Introduction to environmental impact analysis. EIA guidelines, Notification of Government ofIndia (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.		
Module:6	**Human Population Change and Environment**	**6 hours**
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.		
Module:7	**Global Climatic Change and Mitigation**	**5 hours**
Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Kyoto protocol, Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.		
Module:8	**Contemporary issues**	**2 hours**
Lecture by Industry Experts		
	Total Lecture hours:	**45 hours**

Text Books

1.	G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition,Cengage learning.
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment –Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.

Reference Books

1.	David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), VisualizingEnvironmental Science, 4thEdition, John Wiley & Sons, USA.

Mode of evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
Recommended by Board of Studies	12.08.2017		
Approved by Academic Council	No. 46	Date	24.08.2017

CHY1701	Engineering Chemistry	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	Chemistry of 12th standard or equivalent	Syllabus version v.1.0				

Course Objectives:

- To impart technological aspects of applied chemistry
- To lay foundation for practical application of chemistry in engineering aspects

Expected Course Outcome:

- Students will be familiar with the water treatment, corrosion and its control, engineering applications of polymers, types of fuels and their applications, basicaspects of electrochemistry and electrochemical energy storage devices

Module: 1	Water Technology	5 hours

Characteristics of hard water - hardness, DO, TDS in water and their determination – numerical problems in hardness determination by EDTA; Modern techniques of water analysisfor industrial use - Disadvantages of hard water in industries.

Module: 2	Water Treatment	8 hours

Water softening methods: - Lime-soda, Zeolite and ion exchange processes and their applications. Specifications of water for domestic use (ICMR and WHO); Unit processes involved in water treatment for municipal supply - Sedimentation with coagulant- SandFiltration - chlorination; Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultrafiltration, UV treatment, Ozonolysis, Reverse Osmosis; Electro dialysis.

Module: 3	Corrosion	6 hours

Dry and wet corrosion - detrimental effects to buildings, machines, devices & decorative artforms, emphasizing Differential aeration, Pitting, Galvanic and Stress corrosion cracking; Factors that enhance corrosion and choice of parameters to mitigate corrosion.

Module: 4	Corrosion Control	4 hours

Corrosion protection - cathodic protection – sacrificial anodic and impressed current protection methods; Advanced protective coatings: electroplating and electroless plating, PVDand CVD. Alloying for corrosion protection – Basic concepts of Eutectic composition and Eutectic mixtures - Selected examples – Ferrous and non-ferrous alloys.

Module: 5	Electrochemical Energy Systems	6 hours

Brief introduction to conventional primary and secondary batteries; High energy electrochemical energy systems: Lithium batteries – Primary and secondary, its Chemistry, advantages and applications. Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells-working principles, advantages, applications. Solar cells – Types – Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells, dye sensitized solar cells - working principles, characteristics and applications.

Module: 6	Fuels and Combustion	8 hours

Calorific value - Definition of LCV, HCV. Measurement of calorific value using bomb calorimeter and Boy‟s calorimeter including numerical problems.
Controlled combustion of fuels - Air fuel ratio – minimum quantity of air by volume and byKnocking in IC engines - Octane and Cetane number – Anti-knocking agents.

Module: 7	**Polymers**	**6 hours**
Difference between thermoplastics and thermosetting plastics; Engineering application of plastics - ABS, PVC, PTFE and Bakelite; Compounding of plastics: molding of plastics for Car parts, bottle caps (Injection molding), Pipes, Hoses (Extrusion molding), Mobile Phone Cases, Battery Trays, (Compression molding), Fiber reinforced polymers, Composites (Transfer molding), PET bottles (blow molding); Conducting polymers - Polyacetylene- Mechanism of conduction – applications (polymers in sensors, self-cleaning windows)		
Module: 8	**Contemporary issues:**	**2 hours**
Lecture by Industry Experts		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1	Sashi Chawla, A Text book of Engineering Chemistry, Dhanpat Rai Publishing Co.,
2 3 4	Pvt. Ltd., Educational and Technical Publishers, New Delhi, 3rd Ed., 2015. O.G. Palanna, McGraw Hill Education (India) Pvt. Ltd., 9th Reprint, 2015. B. Sivasankar, Engineering Chemistry 1st Ed., McGraw Hill Education, 2008 "Photovoltaic Solar Energy: From Fundamentals to Applications", Angèle Reinders et
	al., Wiley publishers, 2017.
Reference Books	
1	O.V. Roussak and H.D. Gesser, ***Applied Chemistry - A Text Book for Engineers and***
2	***Technologists***, Springer Science Business Media, New York, 2nd Edition, 2013. S. S. Dara, ***A Text book of Engineering Chemistry,*** S. Chand & Co Ltd., New Delhi, 20th
	Edition, 2013.
Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT	

List of Experiments

	Experiment title	**Hours**
1.	Water Purification: Estimation of water hardness by EDTA method and its removal by ion-exchange resin	**3 hours**
	Water Quality Monitoring:	**6 hours**
2.	Assessment of total dissolved oxygen in different water samples by	
3.	Winkler‟s method Estimation of sulphate/chloride in drinking water by conductivity method	
4/5.	Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital-imaging methods	**6 hours**
6.	Arduino microcontroller based sensor for monitoring pH/temperature/conductivity in samples	**3 hours**
7.	Iron in carbon steel by potentiometry	**3 hours**
8.	Construction and working of an Zn-Cu electrochemical cell	**3 hours**
9.	Determination of viscosity-average molecular weight of different	**6 hours**

10.	Preparation/demonstration of a working model relevant to syllabus. Ex. 1. Construction and working of electrochemical energy system – students should demonstrate working of the system. 2. Model corrosion studies (buckling of Steel under applied load). 3. Demonstration of BOD/COD	Non- contact hours
	4. Construction of dye sensitized solar cell and demonstration of its working 5. Calcium in food samples 6. Air quality analysis	
	Total Laboratory Hours	**30 hours**
Mode of Evaluation: Viva-voce, Lab performance & FAT		
Recommended by Board of Studies	31-05-2019	
Approved by Academic Council	No. 55	Date 13-06-2019

HUM1021	ETHICS AND VALUES	L	T	P	J	C
		2	0	0	0	2
Pre-requisite	**Nil**	**Syllabus version v.1.0**				

Course Objectives:

1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

Expected Course Outcome:

Students will be able to:

1. Follow sound morals and ethical values scrupulously to prove as good citizens
2. Understand varioussocial problems and learn to act ethically
3. Understand the concept of addiction and how it will affect the physical and mental health
4. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
5. Identify the main typologies, characteristics, activities, actors and forms of cybercrime

Module: 1	**Being good and responsible**	**5 hours**

Gandhian values such as truth and non-violence – comparative analysis on leaders of past and present – society‟s interests versus self-interests–Personal Social Responsibility: Helping the needy,charity and serving the society.

Module: 2	**Social Issues 1**	**4 hours**

Harassment – types - Prevention of harassment, violence and terrorism

Module: 3	**Social Issues 2**	**4 hours**

Corruption: ethical values, causes, impact, laws, prevention – electoral malpractices white collar crimes – tax evasions – unfair trade practices

Module: 4	**Addiction and Health**	**3 hours**

Peer pressure - Alcoholism: ethical values, causes, impact, laws, prevention – Ill effects of smoking – Prevention of Suicides

Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases

Module: 5	**Drug Abuse**	**4 hours**

Abuse of different types of legal and illegal drugs: ethical values, causes, impact, laws and prevention

Module: 6	**Personal and Professional Ethics**	**3 hours**

Dishonesty - Stealing - Malpractices in Examinations – Plagiarism

Module: 7	**Abuse of technologies**	**4 hours**

Hacking and other cyber crimes, addiction to mobile phone usage, video games and social networking websites

Module: 8	**Invited Talk:** Contemporary Issues	**3 hours**
Total Lecture hours		**30 hours**

Reference Books

1. Dhaliwal, K.K (2016), “Gandhian Philosophy of Ethics: A Study of Relationship between hisPresupposition and Precepts, Writers Choice, New Delhi, India

2.	Vittal, N (2012), “Ending Corruption? - How to Clean up India?”, Penguin Publishers, UK		
3.	Pagliaro, L.A. and Pagliaro, A.M (2012), “Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological , Developmental and Clinical Considerations”, Wiley Publishers, U.S.A		
4.	Pandey, P. K (2012), “Sexual Harassment and Law in India”, Lambert Publishers, Germany		
Mode of Evaluation: CAT, Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	26.07.2017		
Approved by Academic Council	46th ACM	**Date**	24.08.2017

Course code	Course Title	L	T	P	J	C
CSI2002	DATA STRUCTURES AND ALGORITHM ANALYSIS	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To provide the knowledge about linear and non-linear data structures
2. To provide the knowledge about algorithm analyses
3. To focus on the design of algorithms and data structure in various domains
4. To focus on various graph algorithms like shortest path algorithm, minimum spanning tree, etc.,
5. To provide familiarity with main thrusts of work in algorithms – sufficient to give some context for formulating and seeking known solutions to an algorithmic problem

Expected Course Outcomes:

Upon completion of the course, the students will be able to

1. Solve real life computing problems by using data structures
2. Select the suitable data structures for storage and management of different types of data.
3. Apply the algorithm design techniques to analyze, solve and evaluate computing problems.
4. Analyze algorithms asymptotically and compute the performance analysis of algorithms with the same functionality.
5. Choose an appropriate design paradigm that solves the given problem efficiently along with appropriate data structures.
6. Solve complexities of problems in various domains

Module:1	INTRODUCTION TO DATA STRUCTURES	5 hours

Introduction to Data Structure, Importance of Data Structure, Types of Data Structures, Arrays, Structures, Union, Pointers, Storage Allocation: Static and Dynamic Allocation.

Module:2	ANALYSIS OF ALGORITHMS	5 hours

Mathematical Background, Asymptotic Notations, Performance of the Algorithms: Time Complexity, Space Complexity, Master‟s Theorem.

Module:3	LISTS, STACKS AND QUEUES	9 hours

List: Definition, Operations–Implementation, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists, Stack: Definition, Operations, Implementations, Applications: Recursion, Infix to Postfix and Evaluation of Postfix, Queue: Definition, Operations, Implementations, Applications: Circular Queue and Priority Queue.

Module:4	TREES	6 hours

Definition, Terminology, Binary Tree: Binary Tree Representation, Binary Search Tree, Binary Tree Traversal – Expression Tree, Finding K_{-th} element in Binary Tree, Tree to Binary tree conversion, Tree Traversal.

Module:5	HASHING AND HEAPS	6 hours

Hashing: General Idea, Hash Function, Hash Table, Collision in Hashing: Separate Chaining and Open Addressing- Rehashing. Heaps: Definition, Basic Operations, Min heap and Max heap Construction, Heap Sort.

Module:6	SORTING	5 hours

Preliminaries, Insertion Sort, Bubble Sort, Selection Sort, Shell Sort, Merge Sort, Quick Sort, Radix Sort

Module:7	GRAPH ALGORITHMS	7 hours

Types of Graphs, Graph Representation, Shortest Path Algorithm: Dijkstra‟s Algorithm, Floyd Warshal‟s Algorithms, Graph Traversal, Minimum Spanning Tree

Module:8	RECENT TRENDS	2 hours

	Total Lecture hours:	**45 hours**	

Text Book(s) and Journals	
1.	Mark Allen Weiss, “Data structures and algorithm analysis in C”, 2nd edition, Pearson education, 2013.
Reference Books	
1. 2. 3. 4.	Debasis Samanta, “Classic data structures”, PHI, 2nd edition, 2014. Seymour Lipschutz “Data Structures by Schaum Series” 2nd edition,TMH 2013. Adam Drozdek, “Data structures and algorithms in C++”, Cengage learning, 4th edition, 2015. Michael Goodrich, Roberto Tamassta, Michael H.GoldWasser “Data structures and algorithms in Java” 6th Edition, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / LAB / Seminar

List of Indicative Experiments	
1.	Arrays , Loops and Structures
2.	Stack Implementations
3.	Stack Applications: Infix to postfix conversion, evaluation of postfix notation
4.	Queue and its applications
5.	Singly and doubly linked lists.
6.	Circular Singly Linked list
7.	Represent a polynomial as a linked list and write functions for polynomial addition.
8.	Insertion, Bubble, and selection sorts
9.	Merge and quick Sort
10.	Linear and Binary Search
11.	Binary tree. pre-order, in-order, and post-order traversals.
12.	Binary search tree insertion and deletion.
13,	Graph traversal
14.	Shortest Path Algorithm
Total Laboratory Hours	30 hours

Mode of assessment: CAT / Assignment / Quiz / FAT / Seminar

Recommended by Board of Studies	13-06-2019		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI1001	Principles of Database Systems	2	0	2	0	3
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

1. To understand the basic concepts of DBMS and ER Modeling.
2. To comprehend the concepts normalization, query optimization and relational algebra.
3. To apply the concurrency control, recovery, security and indexing for the existent domain problems.

Expected Course Outcome:

1. Acquire a good understanding of the architecture and functioning of database management systems
2. Ability to construct an ER model, derive the relational schemas from the model
3. Analyze and improve a database design by normalization.
4. Ability to associate the basic database storage structure and access techniques including B Tree andB+ Tress
5. Analyze the basics of query evaluation and heuristic query optimization techniques.
6. Learn concepts of concurrency control for the desirable database problem.
7. Analyze the fundamental concepts of recovery mechanisms and learn the recent trends in database.

Module:1	DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE	4 hours

Need for Database Systems – Characteristics of Database Approach – Actors in DBMS- Database Administrator - Data Models – Relational, Hierarchical and Network models - Schemas, and Instances - Three-Schema Architecture - The Database System Environment – Overall System
Structure/Architecture – Querying- Query Languages - Relational Algebra - Relational Calculus

Module:2	DATA MODELING	4 hours

Entity Relationship Model: Types of Attributes, Relationship, Structural Constraints – Relational Model, Relational Model Constraints – Mapping ER model to a Relational Schema – IntegrityConstraints-Extended E-R model - Generalisation – Specialization - Aggregation

Module:3	DATABASE DESIGN	5 hours

Guidelines for Relational Schema - Functional Dependency; Normalization, Boyce Codd Normal Form, Multi-valued Dependency and Fourth Normal Form; Join Dependency and Fifth Normal Form

Module:4	QUERY PROCESSING AND TRANSACTIONPROCESSING	5 hours

Translating SQL Queries into Relational Algebra – Heuristic Query Optimization – Introduction to Transaction Processing – Transaction and System Concepts - Desirable Properties of Transactions – Characterizing Schedules based on Recoverability – Characterizing
Schedules based on Serializability - Test for Serializability - Need for Locking - Compatibility Matrix for Locks - Deadlocks in Transactions.

Module:5	**PHYSICAL DATABASE DESIGN**	**5 hours**
File Organization - RAID devices - Indexing: Single Level Indexing, Multi-level Indexing, Dynamic Multilevel Indexing , Indexing on Multiple Keys – B-Tree Indexing – B+ Tree Indexes - Hashing - Static and Dynamic Hashing.		
Module:6	**CONCURRENCY CONTROL**	**5 hours**
Lock based protocols - Two-Phase Locking - Graph based Protocols - Tree Protocol - Techniques for Concurrency Control - Concurrency Control based on Timestamp based protocols.		
Module:7	**RECOVERY TECHNIQUES**	**2 hours**
Recovery Concepts - Recovery based on Deferred Update - Recovery Techniques based on Immediate Update – Shadow Paging – Distributed databases - Distributed Transactions – Commit Protocols		
Module:8	**CONTEMPORARY ISSUES**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7th Edition, 2016.
2.	A. Silberschatz, H. F. Korth& S. Sudershan, Database System Concepts, McGraw Hill, 7th Edition 2019.

Reference Books

1.	Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2015.
2.	Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6thEdition,Pearson,2015
3.	C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006

Mode of Evaluation:CAT/ Digital Assignment/Quiz/FAT/ Project.

List of Experiments

1.	SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables	3 hours
2.	Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping.	3 hours
3.	Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi)	3 hours
4.	Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc.	3 hours
5.	Iterations using For Loop,While Loop and Do while	3 hours
6.	Declaring Cursor, Opening Cursor, Fetching the data, closing the curso	3 hours
7.	Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure	3 hours
8.	Practicing User Defined Exceptionand System Defined Exception	3 hours
9.	Creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger	3 hours
10.	Database Application development	3 hours
	Total Laboratory Hours	30 hours

Mode of assessment:Assessment Examination, FAT Lab Examination

Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course code	Course Title	L	T	P	J	C
CSI1002	Operating System Principles	2	0	2	0	3
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

1. To introduce Operating system concepts, designs and provide the skills required to implement theservices.
2. To understand the structure and organization of the file system.
3. To understand what a process is and how processes are synchronized and scheduled.
4. To understand different approaches of memory management, system call for managing process and filesystem.

Expected Course Outcome:

Upon completion of the course, the students will be able to
1. Gain extensive knowledge on principles and modules of operating systems
2. Interpret the evolution of OS functionality, structures, layers and different system calls to find the stagesof various process states.
3. Design a model scheduling algorithm to compute various scheduling criteria.
4. Apply and analyze communication between inter process and synchronization techniques.
5. Implement page replacement algorithms, memory management and to apply the file system techniques.
6. Representing virtualization and demonstrating the various Operating system tasks and the principlealgorithms for enumerating those tasks.

Module:1	Introduction	4 hours

Computer-System Organization, Computer-System Architecture, Operating-System Structure (monolithic, layered, modular, micro-kernel models), Operating-System Operations, Operating-System Services, User and Operating- System Interface, System Calls.

Module:2	Processes	4 hours

Process Concept, Operations on Processes, Inter-process Communication, Threads - Overview, Multithreading Models.

Module:3	CPU Scheduling	4 hours

Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Threads, Multiple-Processor Scheduling, Deadlocks- System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Module:4	Process Synchronization	4 hours

Background, The Critical-Section Problem, Peterson‟s Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Example.

Module:5	Memory Management	4 hours

Introduction, Swapping, Contiguous Memory Allocation, Segmentation, Paging, structure of the Page Table.

Module:6	**Virtual Memory**	**4 hours**
Background, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Introduction to Virtualization.		
Module:7	**Mass-Storage Structure**	**4 hours**
Overview, Disk Structure, Disk Scheduling. File -System Interface - File Concept, Access Methods, Directory and Disk Structure, Directory Implementation, Allocation Methods. Future directions in Mobile OS.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	A.Silberschatz, P. B. Galvin & G. Gagne, Operating system concepts, Ninth Edition, John Wiley, 2018.

Reference Books

1.	W. Stallings, Operating Systems-Internals and Design Principles, Seventh Edition, Prentice-Hall,2012.
2.	Andrew.S Tanenbaum & Herbert Bos, Modern Operating Systems, Fourth Edition, Prentice Hall,2015.
3.	Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces, Arpaci-Dusseau Books, Inc (2015).

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments

1.	Study of Linux commands – System Information, Files and Directories, Process, Text Processing and Scripting, Programming.	3 hours
2.	Shell scripting (I/O, decision making, looping)	3 hours
3.	Creating Child process (using fork), Zombie, Orphan. Displaying system information using C.	3 hours
4.	CPU Scheduling Algorithms (FCFS, SJF, RR, Priority)	3 hours
5.	Deadlock Avoidance Algorithm (Bankers algorithm)	3 hours
6.	IPC (Threads, Pipes)	3 hours
7.	Process synchronization (Producer Consumer / Reader Writer/Dining Philosopher using semaphores)	3 hours
8.	Dynamic Memory Allocation Algorithms (First fit, Best fit, Worst fit)	3 hours
9.	Page Replacement Algorithms. (FIFO, LRU, Optimal)	3 hours
10.	Disk Scheduling Algorithms.	3 hours
	Total Laboratory Hours	30 hours

Mode of evaluation:

Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course code	Course Title	L	T	P	J	C
CSI2001	DIGITAL LOGIC AND COMPUTER DESIGN	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

1. To acquaint students with the basic concepts of digital and binary systems.
2. To analyze and design combinational and sequential logic circuits for real world applications.
3. To apply the theoretical concepts in designing the circuits using appropriate tools and hardware.

Expected Course Outcomes:

Upon completion of the course, the students will be able to

1. Differentiate and represent the different types of number system.
2. Express and reduce the logic functions using Boolean Algebra and K-map.
3. Design minimal combinational logic circuits.
4. Analyze the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, de-multiplexer.
5. Analyze and Design the Basic Sequential Logic Circuits
6. Outline the construction of Basic Arithmetic and Logic Circuits
7. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

Module:1	INTRODUCTION TO DIGITAL LOGIC	3 hours

Number System, Base Conversion, Binary Codes, Complements, Logic gates, Universal gates, Positive and Negative Logic

Module:2	BOOLEAN ALGEBRA	6 hours

Boolean algebra, Properties of Boolean algebra, Boolean functions, Canonical and Standard forms, Karnaugh map (up to 5 variables), Dont care conditions, Tabulation Method (up to 5 variables).

Module:3	INTRODUCTION TO COMBINATIONAL CIRUITS	6 hours

Design of combinational circuits, Adder, Subtractor, Code Converter, Analyzing a Combinational Circuit.

Module:4	DESIGN AND ANALYSIS OF COMBINATIONAL CIRCUITS	9 hours

Binary Parallel Adder, Magnitude Comparator, Decoders, Encoders, Multiplexers, De-multiplexers.

Module:5	SEQUENTIAL CIRCUITS	7 hours

Flip Flops, Conversion of Flip flops, Design and Analysis of Sequential circuits

Module:6	DESIGN OF REGISTERS AND COUNTERS	6 hours

Registers, Shift Registers, Bi-directional shift registers, Counters, Ripple and Synchronous Counters, Ring and Johnson counters.

Module:7	**ARITHMETIC LOGIC UNIT**	**6 hours**
Bus Organization, ALU, Design of ALU, Status Register, Design of Shifter.		
Module:8	**RECENT TRENDS**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book

1. Morris Mano, M., 2016. Digital Logic and Computer Design. Pearson Education India. ISBN: 9789332542525.

Reference Books

1. Malvino, A.P. and Leach, D.P. and Goutam Saha. 2014. Digital Principles and Applications (SIE). Tata McGraw Hill. ISBN: 9789339203405.
2. Morris Mano, M. and Michael D.Ciletti. 2014. Digital Design: With an introduction to Verilog HDL. Pearson Education. ISBN: 978-0132774208
3. Charles H. Roth Jr. 2013, Fundamentals of Logic Design, seventh Edition, Cl-Engineering. ISBN: 978-1133628477
4. John F. Wakerly, 2008. Digital Design Principles and Practices, Fourth Edition, Pearson Education. ISBN: 978-8131713662.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Indicative Experiments

1.	Realization of Logic gates using discrete components, verification of truth table for logic gates, realization of basic gates using NAND and NOR gates
2.	Implementation of Logic Circuits by verification of Boolean laws and verification of De Morgans.
3.	Adder and Subtractor circuit realization by implementation of Half-Adder and Full-Adder, and by implementation of Half-Subtractor and Full-Subtractor.
4.	Combinational circuit design i. Design of Decoder and Encoder ii. Design of Multiplexer and De multiplexer iii. Design of Magnitude Comparator iv. Design of Code Converter
5.	Sequential circuit design i. Design of Mealy and Moore circuit ii. Implementation of Shift registers iii. Design of 4-bit Counter iv. Design of Ring Counter.
6.	Implementation of different circuits to solve real world problems: A digitally controlled locker works based on a control switch and two keys which are entered by the user. Each key has a 2-bit binary representation. If the control switch is pressed, the locking system will pass the difference of two keys into the controller unit. Otherwise, the locking system will pass the sum of the two numbers to the controller unit. Design a circuit to determine the input to the controller unit.

7.	Implementation of different circuits to solve real world problems: A bank queuing system has a capacity of 5 customers which serves on first come first served basis. A display unit is used to display the number of customers waiting in the queue. Whenever a customer leaves the queue, the count is reduced by one and the count is increased by one if a customer joins a queue. Two sensors (control signals) are used to sense customers leaving and joining the queue respectively. Design a circuit that displays the number of customers waiting in the queue in binary format using LEDs. Binary 1 is represented by LED glow and 0 otherwise.

Total Laboratory Hours	30 hours
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Recommended by Board of Studies	13-06-2019		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI1003	Formal Languages and Automata Theory	3	0	0	0	3
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

The objective of this course is to learn

1. Types of grammars and models of automata.
2. Limitation of computation: What can be and what cannot be computed.
3. Establishing connections among grammars, automata and formal languages and realize the theoretical concepts and techniques involved in the software system development

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Model, compare and analyse different computational models
2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
3. Identify limitations of some computational models and possible methods of proving them.
4. Explain the abstract concepts mathematically with notations

Module:1	Introduction to Languages and Grammars	4 hours

Recall on Proof techniques in Mathematics - Overview of a Computational Models - Languages and Grammars - Alphabets - Strings - Operations on Languages, Overview on Automata

Module:2	Finite State Automata	8 hours

Finite Automata (FA) - Deterministic Finite Automata (DFA) - Non-deterministic Finite Automata (NFA) - NFA with epsilon transitions – NFA without epsilon transition, conversion of NFA to DFA, Equivalence of NFA and DFA – minimization of DFA

Module:3	Regular Expressions and Languages	7 hours

Regular Expression - FA and Regular Expressions: FA to regular expression and regular expression to FA - Pattern matching and regular expressions - Regular grammar and FA - Pumping lemma for regular languages - Closure properties of regular languages, linear grammars and linear languages.

Module:4	Context Free Grammars	7 hours

Context-Free Grammar (CFG) – Derivations - Parse Trees - Ambiguity in CFG - CYK algorithm – Simplification of CFG – Elimination of Useless symbols, Unit productions, Null productions - Normal forms for CFG: CNF and GNF - Pumping Lemma for CFL - Closure Properties of CFL, context-sensitive grammars definition and examples

Module:5	Pushdown Automata	5 hours

Definition of the Pushdown automata - Languages of a Pushdown automata – Power of Non-Deterministic Pushdown Automata and deterministic pushdown automata

Module:6	Turing Machine	6 hours

Turing Machines as acceptor and transducer - Multi head and Multi tape Turing Machines – Universal Turing Machine - The Halting problem - Turing-Church thesis

Module:7	Recursive and Recursively Enumerable Languages	6 hours	

Recursive and Recursively Enumerable Languages, Language that is not Recursively Enumerable (RE) – computable functions – Chomsky Hierarchy – Undecidable problems - Post‟s Correspondence Problem			
Module:8	**Recent Trends**		**2 hours**
Total Lecture hours:			**45 hours**
Text Book(s)			
1.	John C. Martin, “Introduction to Languages and the Theory of Computation”, Fourth Edition, Mcgraw-hill Higher Education Publishers, 2010.		
2.	Peter Linz, “An Introduction to Formal Language and Automata”, Fourth Edition, Narosa Publishers, New Delhi, 2013.		
Reference Books			
1.	K. Krithivasan and R. Rama, “Introduction to Formal Languages, Automata and Computation”, Pearson Education, 2009.		
2.	J.E. Hopcroft, R. Motwani and J.D. Ullman, “Introduction to Automata Theory, Languages and Computations”, Third Edition, Pearson Education, 2014.		
3.	Micheal Sipser, Introduction of the Theory and Computation, Third Edition, Thomson Brokecole Cengage Learning, 2012.		
4.	Dexter C. Kozen, “Automata and Computability”, Springer Publishers, 2012.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course code	Course Title	L	T	P	J	C
CSI1004	Computer Organization and Architecture	3	0	0	0	3
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

1. To familiarize students with the fundamental components, architecture, register organization and performance metrics of a computer.
2. To make students capable for understanding and analyzing the effects of each instruction execution and the data path in those instruction execution.
3. To impart the knowledge of data representation in binary and understand implementation of arithmetic algorithms in a typical computer.
4. To make students understand the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer.

Expected Course Outcome:

1. Understand the general architecture of a computer system and the instruction based architecture.
2. Illustrate various binary data representations for fixed and floating point data. Validate efficient algorithm for arithmetic operations.
3. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Get the idea about different external storage devices.
4. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration.
5. Understand some system performance enhancement techniques such as pipeline concepts, parallel execution, etc. Introduction to some of the advanced architectures.

Module:1	Introduction to computer architecture	4 hours

Introduction to computer systems - Overview of Organization and Architecture – Components, Registers and register files, Connections – Von Neumann machine (IAS Machine) – Architecture – Communication between components

Module:2	Instruction Set Architecture	6 hours

Introduction to ISA (Instruction Set Architecture): Instruction formats - Instruction types - Addressing modes - Instruction cycle – Introduction to Assembly Language Programming.

Module:3	Data Representation And Computer Arithmetic	9 hours

Data Representation – Introduction to Fixed point representation of numbers - Floating point representation of numbers (IEEE standard representation) - Algorithms for fixed point arithmetic operations: Addition, Subtraction, Multiplication (Booth‟s Algorithm), Division - Representation of non-numeric data (character codes).

Module:4	Memory System Organization & Architecture	10 hours

Memory systems hierarchy - Main memory organization – Byte ordering - Memory interleaving - Memory characteristics - Cache memories: Introduction - Parameters of Cache memory - Address mapping – Read and write policies - Cache Coherence - Virtual memory systems - TLB - Page replacement Algorithms.

Module:5	Interfacing and Communication I/O fundamentals	7 hours

I/O fundamentals: I/O Modules, I/O mapped I/O and Memory Mapped I/O - Introduction to I/O techniques: Programmed I/O, Interrupt-driven I/O, DMA - Interrupt structures: Interrupt cycle, Subroutine call and return mechanisms - Bus System: Synchronous and asynchronous buses, Bus Arbitration.

Module:6	**Device Subsystems**	**4 hours**
External storage systems - Organization and structure of disk drives: Electronic, Magnetic and optical technologies - RAID Levels - I/O Performance		
Module:7	**Performance Enhancements**	**4 hours**
Classification of models - Flynn‟s taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD) - Introduction to data path - Introduction to Pipelining - Pipelined data path - Introduction to hazards.		
Module:8	**Recent Trends**	**1 hour**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Patterson, D.A.,Hennessy, J. L. *Computer organization and design:The Hardware/software interface RISC-V edition* Morgan Kaufmann, 2017.
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.
Reference Books	
1.	Mano, M. Morris. *Computer system architecture*. Prentice-Hall of India, 3rd Edition, 2003.
2.	Computer Architecture and Organization by William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course code	Course Title	L	T	P	J	C
EEE 1024	Fundamentals of Electrical and Electronics Engineering	2	0	2	0	4
Pre-requisite	Nil	Syllabus version v.1.0				
Anti-requisite						

Course Objectives:

[1] To teach the simple problem of DC and AC circuits.
[2] To study the important concepts of Analog and digital electronics.
[3] To measure and interpret data

Expected Course Outcome:

On the completion of this course the student will be able to:
[1] Solve simple DC circuits using mesh and nodal analysis.
[2] Describe the RLC components with sinusoidal sources.
[3] Design of combinational circuits and synthesis of logic circuits
[4] Utilize the basic concepts of semiconductor devices and circuits
[5] Interpret the architecture of microprocessor & microcontrollers
[6] measure the various signals using the sensors
[7] Discuss the overview of communication systems.
[8] Design and Conduct experiments, as well as analyze and interpret data

Module:1	Fundamentals of DC circuits:	5 Hours

Basic circuit elements and sources, Ohms law, Kirchhoff's laws, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem.

Module:2	Fundamentals of AC Circuits:	4 Hours

Introduction to AC circuits, Steady state AC analysis of a RL, RC, RLC Series circuits, AC power calculations.

Module:3	Digital Systems:	4 Hours

Number system, Boolean algebra, Logic circuit concepts, Multiplexer, Demultiplexer, Half adder, Full adder, Computer organization, Memory types, Flip Flops, Counters.

Module:4	Semiconductor devices:	3 Hours

Conduction in semiconductor materials, principle of operation, V-I characteristics of PN junction diode, Zener diode, BJT, half wave rectifier, full wave rectifier.

Module:5	Microprocessor & microcontroller:	4 Hours

Overview of ARM architecture, Different modes of ARM processor, various instructions, 8051Microcontroller architecture, Applications.

Module:6	Measuring Instruments and Sensors:	5 Hours

Measuring Instruments: Classification of instruments, Working principle of PMMC, MI, Digital & Smart Meters, Ammeter, Voltmeter & wattmeter.
Sensors: Transducers classification & selections, Resistive, Inductive and capacitive sensors, Optical and Digital sensors

Module:7	Communication systems	3 Hours

Modulation and Demodulation – Amplitude, frequency, digital modulation, wired and wireless communication – concept and types

Module:8	**Lecture by industry experts.**	**2 Hours**
	Total Lecture hours:	**30 Hours**
List of Challenging Experiments (Indicative		
Software Experiments		
1. Analysis and verification of circuit using Mesh and Nodal analysis		2
2. Verification of network theorems using Maximum power transfer		2
3. Analysis of Single AC circuit with R, RL and RC loads		2
4. Design of half adder and full adder		2
5. Single phase half wave		2
6. Full wave rectifier		2
7. Design of controlled switch using BJT		2
Hardware Experiments		
1. Verification of network theorems using Thevenin‟s		2
2. Regulated power supply using Zener diode		2
3. Design of a lamp dimmer circuit using Darlington pair		2
4. Design and verification of logic circuit by simplifying the Boolean expression		2
5. Calibration of voltmeter and Ammeter		2
6. Wiring connection for Fan		2
7. Staircase wiring layout for multi-storied building		2
8. Study on Microprocessor kit		2
	Total Laboratory Hours	**30 hours**

Text Book(s)	
1.	Allan R. Hambley, „Electrical Engineering - Principles & Applications, Pearson Education, First Impression, 6/e, 2013.
2.	John Bird, „Electrical circuit theory and technology‟, Newnes publications, 4th Edition, 2010.
3.	Mohammad Ali Mazidi, Janice Gillispie Mazidi, " The 8051 Microcontroller and Embedded Systems", Pearson education, 2nd Edition, 2014.
4	D.V.S.Murthy, “Transducers and Instrumentation”, Prentice Hall of India Learning Pvt. Ltd. 2nd edition 2012.
5	Simon Haykin; Michael Moher, “An Introduction to Analog and Digital Communications.”, Hoboken :Wiley Textbooks, 2nd Edition, 2012.
Reference Books	
1.	Charles K Alexander, Mathew N O Sadiku, „Fundamentals of Electric Circuits‟, Tata McGraw Hill, 2012.
2.	David A. Bell, „Electronic Devices and Circuit‟, Oxford press-2008.

3.	M. Morris Mano, Charles R. Kime, „Digital Design and Computer Organization", Pearson Education,December 1994.		
4.	D. Roy Choudhary, Shail B. Jain, „Linear Integrated Circuits", 4th/e, New Age International, 2010.		
5.	A.K. Sawhney, "A Course In Electrical And Electronic Measurements And Instrumentation", DhanpatRai Publications, 2012.		
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	**Date**	24-09-2020

Course Code	Course title	L	T	P	J	C
MAT1022	**Linear Algebra**	3	0	0	0	3
Pre-requisite	**MAT1011**	**Syllabus Version v.1.0**				

Course Objectives :

[1] Understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.
[2] apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
[3] solve problems in cryptography, computer graphics and wavelet transforms

Course Outcome :

At the end of this course the students are expected to learn
[1] The abstract concepts of matrices and system of linear equations using decomposition methods
[2] The basic notion of vector spaces and subspaces
[3] Apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces
[4] Applications in image processing.
[5] Applications of inner product spaces in cryptography

Module:1	**System of Linear Equations:**	**6 hours**

Rank of matrix -Gaussian elimination and Gauss Jordan methods - Elementary matrices- permutation matrix - inverse matrices - System of linear equations - LU factorizations.

Module:2	**Vector Spaces**	**6 hours**

The Euclidean space R^n and vector space- subspace –linear combination-span-linearly dependent-independent- bases - dimensions-finite dimensional vector space.

Module:3	**Subspace Properties**:	**6 hours**

Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.

Module:4	**Linear Transformations and applications**	**7 hours**

Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations.

Module:5	**Inner Product Spaces:**	**6 hours**

Dot products and inner products – the lengths and angles of vectors – matrix representations of inner products- Gram-Schmidt orthogonalisation

Module:6	**Applications of Inner Product Spaces**:	**6 hours**

QR factorization- Projection - orthogonal projections -Least Square solutions in Computer Codes.

Module:7	**Applications of Linear equations** :	**6 hours**
An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption .		
Module:8	**Contemporary Issues:**	**2 hours**
Industry Expert Lecture and R & D.		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1,3,4 &5)
2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.

Reference Books

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)
2. Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2nd Edition, Springer 2004.
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003
4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

Mode of Evaluation

Digital Assignments,Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	30.06.2021		
Approved by Academic Council	No: 62	Date	15.07.2021

MAT1011	Calculus for Engineers	L	T	P	J	C
		3	0	2	0	4
Pre-requisite		Syllabus version v.1.0				

Course Objectives :

1. To provide the requisite and relevant background necessary to understandthe other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transformtechniquefor Engineers which requires knowledge of integration

Expected Course Outcomes:

At the end of this course the students should be able to

1. apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution
3. evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
4. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. understand gradient, directional derivatives, divergence, curl and Greens‟, Stokes, Gauss theorems
6. demonstrate MATLAB code for challenging problems in engineering

Module:1	Application of Single Variable Calculus	9 hours

Differentiation- Extrema on an Interval-Rolle‟s Theorem and the Mean Value Theorem-Increasing and Decreasing functions and First derivative test-Second derivative test-Maxima and Minima-Concavity. Integration-Average function value - Area between curves - Volumes of solids of revolution - Beta and Gamma functions–interrelation

Module:2	Laplace transforms	7 hours

Definition of Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform-Convolution.

Module:3	Multivariable Calculus	4 hours

Functions of two variables-limits and continuity-partial derivatives –total differential- Jacobian and its properties.

Module:4	**Application of Multivariable Calculus**	**5 hours**
Taylor‟s expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange‟s multiplier method.		
Module:5	**Multiple integrals**	**8 hours**
Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates - Evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates- evaluation of multiple integrals using gamma and beta functions.		
Module:6	**Vector Differentiation**	**5 hours**
Scalar and vector valued functions – gradient, tangent plane–directional derivative- divergenceand curl–scalar and vector potentials–Statement of vector identities-Simple problems		
Module:7	**Vector Integration**	**5 hours**
line, surface and volume integrals - Statement of Green‟s, Stoke‟s and Gauss divergence theorems -verification and evaluation of vector integrals using them.		
Module:8	**Contemporary Issues:**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**

Text Book(s)

[1] Thomas‟ Calculus, George B.Thomas, D.Weir and J. Hass, 13th edition, Pearson, 2014.
[2] Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley India, 2015.

Reference Books

1. Higher Engineering Mathematics, B.S. Grewal, 43rd Edition ,Khanna Publishers, 2015
2. Higher Engineering Mathematics, John Bird, 6th Edition, Elsevier Limited, 2017.
3. Calculus: Early Transcendentals, James Stewart, 8th edition, Cengage Learning, 2017.
4. Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 7th Edition, Palgrave Macmillan (2013)

Mode of Evaluation

Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

List of Challenging Experiments (Indicative)		
1.	Introduction to MATLAB through matrices, and general Syntax	3 hours
2	Plotting and visualizing curves and surfaces in MATLAB –	3 hours

	Symbolic computations using MATLAB	
3.	Evaluating Extremum of a single variable function	3 hours
4.	Understanding integration as Area under the curve	3 hours
5.	Evaluation of Volume by Integrals (Solids of Revolution)	3 hours
6.	Evaluating maxima and minima of functions of several variables	3 hours
7.	Applying Lagrange multiplier optimization method	2 hours
8.	Evaluating Volume under surfaces	2 hours
9.	Evaluating triple integrals	2 hours
10.	Evaluating gradient, curl and divergence	2 hours
11.	Evaluating line integrals in vectors	2 hours
12.	Applying Green's theorem to real world problems	2 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment:			
Weekly assessment, Final Assessment Test			
Recommended by Board of Studies	12-06-2015		
Approved by Academic Council	No. 37	Date	16-06-2015

MAT2002	Applications of Differential and Difference Equations	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**MAT1011 - Calculus for Engineers**			**Syllabus version v.1.0**		

Course Objectives

The course is aimed at

[1] Presenting the elementary notions of Fourier series, which is vital in practical harmonic analysis

[2] Imparting the knowledge of eigenvalues and eigen vectors of matrices and the transform techniques to solve linear systems, that arise in sciences and engineering

[3] Enriching the skills in solving initial and boundary value problems

[4] Impart the knowledge and application of difference equations and the Z-transform in discrete systems, that are inherent in natural and physical processes

Course Outcome

At the end of the course the student should be able to

[1] Employ the tools of Fourier series to find harmonics of periodic functions from the tabulated values

[2] Apply the concepts of eigenvalues, eigen vectors and diagonalisation in linear systems

[3] Know the techniques of solving differential equations

[4] understand the series solution of differential equations and finding eigen values, eigen functions of Strum-Liouville‟s problem

[5] Know the Z-transform and its application in population dynamics and digital signal processing

[6]demonstrate MATLAB programming for engineering problems

Module:1	**Fourier series:**	**6 hours**

Fourier series - Euler‟s formulae - Dirichlet‟s conditions - Change of interval - Half range series – RMS value – Parseval‟s identity – Computation of harmonics

Module:2	**Matrices:**	**6 hours**

Eigenvalues and Eigen vectors - Properties of eigenvalues and eigen vectors – Cayley-Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature of quadratic form

Module:3	**Solution of ordinary differential equations**:	**6 hours**

Linear second order ordinary differential equation with constant coefficients – Solutions of homogenous and non-homogenous equations - Method of undetermined coefficients – method of variation of parameters – Solutions ofCauchy-Euler and Cauchy-Legendre differential equations

Module:4	**Solution of differential equations throughLaplace transform and matrix method**	**8 hours**

Solution of ODE‟s - Nonhomogeneous terms involving Heaviside function, Impulse function - Solving nonhomogeneous system using Laplace transform – Reduction of *n*th order differential equation to first order system - Solving nonhomogeneous system of first order differential equations

Module:5	**Strum Liouville's problems and powerseries Solutions:**	**6 hours**
The Strum-Liouville‟s Problem - Orthogonality of Eigen functions - Series solutions of differential equations about ordinary and regular singular points - Legendre differentialequation - Bessel‟s differential equation		
Module:6	**Z-Transform:**	**6 hours**
Z-transform -transforms of standard functions - Inverse Z-transform: by partial fractionsand convolution method		
Module:7	**Difference equations:**	**5 hours**
Difference equation - First and second order difference equations with constant coefficients - Fibonacci sequence - Solution of difference equations - Complementary function - Particular integral by the method of undetermined coefficients - Solution of simple difference equations using Z-transform		
Module:8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours: 45 Hours	

Text Book(s)

1.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley India, 2015

Reference Books

1.	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition, Khanna Publishers, India, 2015
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2nd Edition, Pearson Education, Indian edition, 2006

Mode of Evaluation

Digital Assignments (Solutions by using soft skills), ContinuousAssessment Tests, Quiz, Final Assessment Test		
1.	Solving Homogeneous differential equations arising in engineeringproblems	2 hours
2.	Solving non-homogeneous differential equations and Cauchy,Legendre equations	2 hours
3.	Applying the technique of Laplace transform to solve differentialequations	2 hours
4.	Applications of Second order differential equations to Mass spring system (damped, undamped, Forced oscillations), LCR circuits etc.	2 hours
5.	Visualizing Eigen value and Eigen vectors	2 hours
6.	Solving system of differential equations arising in engineering applications	2 hours
7.	Applying the Power series method to solve differential equationsarising in engineering applications	3 hours
8.	Applying the Frobenius method to solve differential equationsarising in engineering applications	3 hours
9.	Visualising Bessel and Legendre polynomials	3 hours
10.	Evaluating Fourier series-Harmonic series	3 hours
11.	Applying Z-Transforms to functions encountered in engineering	3 hours

12.	Solving Difference equations arising in engineering applications			3 hours
	Total Laboratory Hours			**30 hours**
Mode of Evaluation: Weekly Assessment, Final Assessment Test				
Recommended by Board ofStudies				12-06-2015
Approved by AcademicCouncil		No. 37	Date	16-06-2015

PHY1701	Engineering Physics	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	Physics of 12th standard or equivalent	Syllabus version v.1.0				

Course Objectives:

To enable the students to understand the basics of the latest advancements in Physicsviz., Quantum Mechanics, Nanotechnology, Lasers, Electro Magnetic Theory and Fiber Optics.

Expected Course Outcome: : Students will be able to

1. Comprehend the dual nature of radiation and matter.
2. Compute Schrodinger‟s equations to solve finite and infinite potential problems.
3. Analyze quantum ideas at the nanoscale.
4. Apply quantum ideas for understanding the operation and working principleof optoelectronic devices.
5. Recall the Maxwell‟s equations in differential and integral form.
6. Design the various types of optical fibers for different Engineering applications.
7. Apply the various types of optoelectronic devices for designing a typical opticalfiber communication system.
8. Demonstrate the quantum mechanical ideas

Module:1	Introduction to Modern Physics	6 hours

Planck‟s concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent).

Module:2	Applications of Quantum Physics	6 hours

Particle in a 1-D box (Eigen Value and Eigen Function), 3-D Analysis (Qualitative), Tunneling
Effect (Qualitative), Scanning Tunneling Microscope (STM).

Module:3	Nanophysics	6 hours

Introduction to Nano-materials, Moore‟s law, Properties of Nano-materials, Types of Nano-materials, Synthesis of Nano-materials (Top-down and Bottom-up approaches), Quantum confinement, Quantum well, wire & dot, Fullerenes, Carbon Nano-tubes (CNT), Applications
of nanotechnology in industry.

Module:4	Laser Principles and Engineering Application	7 hours

Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient & its significance, Population inversion, Two, three & four level systems, Pumping schemes, Threshold gain
coefficient, Components of laser, Nd-YAG, He-Ne, CO_2 and their engineering applications.

Module:5	Electromagnetic Theory and its application	6 hours

Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral, Maxwell Equations (Qualitative), Wave Equation (Derivation), EM Waves, Phase velocity, Group velocity, Group index (Qualitative), experimental evidenceof light as em wave (Hertz experiment)

Module:6	**Propagation of EM waves in Optical fibers**	**6 hours**

Light propagation through fibers, Acceptance angle, Numerical Aperture, Types of fibers -step index, graded index, single mode & multimode, Attenuation, Dispersion-intermodal and intramodal.

Module:7	**Optoelectronic Devices & Applications ofOptical fibers**	**6 hours**

Introduction to semiconductors, Direct and indirect bandgap, Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications of fiber optics in communication-
Endoscopy.

Module:8	**Contemporary issues**	**2 hours**

Lecture by Industry Experts

	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Arthur Beiser et al., Concepts of Modern Physics, 2013, Sixth Edition, Tata McGraw
2.	Hill.
3.	William Silfvast, Laser Fundamentals, 2008, Cambridge University Press.
4.	D. J. Griffith, Introduction to Electrodynamics, 2014, 4th Edition, Pearson. Djafar K. Mynbaev and Lowell L.Scheiner, Fiber Optic Communication Technology,
	2011, Pearson

Reference Books

1.	Raymond A. Serway, Clement J. Mosses, Curt A. Moyer Modern Physics, 2010, 3rd Indian Edition Cengage learning.
2.	John R. Taylor, Chris D. Zafiratos and Michael A. Dubson, Modern Physics for Scientists and Engineers, 2011, PHI Learning Private Ltd.
3.	Kenneth Krane, Modern Physics, 2010, Wiley Indian Edition.
4.	Nityanand Choudhary and Richa Verma, Laser Systems and Applications, 2011, PHI Learning Private Ltd.
5.	S. Nagabhushana and B. Sathyanarayana, Lasers and Optical Instrumentation, 2010, I.K. International Publishing House Pvt. Ltd..
6.	R. Shevgaonkar, Electromagnetic Waves, 2017, Tata McGraw Hill. Matthew N.O. Sadiku, Principles of Electromagnetics, 2010, Fourth Edition, Oxford.
7.	Ajoy Ghatak and K. Thyagarajan, Introduction to Fiber Optics, 2010, Cambridge University Press.
8.	S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, 2008, 3rd Edition, Wiley.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

	List of Experiments	
1.	Electron diffraction	2 hrs
2.	Determination of wavelength of laser source (He -Ne laser anddiode lasers of different wavelengths) using diffraction technique	2 hrs
3.	Determination of size of fine particle using laser diffraction	2 hrs
4.	Determination of the track width (periodicity) in a written CD	2 hrs
5.	Optical Fiber communication (source + optical fiber + detector)	2 hrs
6.	Analysis of crystallite size and strain in a nano -crystalline film usingX-ray diffraction	2 hrs
7.	Numerical solutions of Schrödinger equation (e.g. particle in abox problem) (can be given as an assignment)	2 hrs
8.	Laser coherence length measurement	2 hrs
9.	Proof for transverse nature of E.M. waves	2 hrs
10	Quantum confinement and Heisenberg's uncertainty principle	2 hrs
11	Determination of angle of prism and refractive index for variouscolour – Spectrometer	2 hrs
12	Determination of divergence of a laser beam	2 hrs
13	Determination of crystalline size for nanomaterial (Computer simulation)	2 hrs
14	Demonstration of phase velocity and group velocity (Computer simulation)	2 hrs
	Total Laboratory Hours	**30 hrs**
Mode of evaluation: CAT / FAT		
Recommended by Board of Studies	25.06.2020	
Approved by Academic Council	No. 59	Date 24.09.2020

STS1022	Introduction to Personal Skills	L	T	P	J	C
		3	0	0	0	1
Pre-requisite		**Syllabus version v.1.0**				

Course Objectives:

1. To Identify and develop personal skills to become a more effective teammember/leader.
2. To Examine, Clarify and apply positive values and ethical principles.
3. To Develop habits which promote good physical and mental health.

Expected Course Outcome:

- Enabling students to exhibit appropriate presentation and analytical skills

Module:1	**Presentation skills – Preparing presentation and Organizing materials and Maintaining and preparing visual aids and Dealing with questions**	**7 hours**
10 Tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test, Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation, Importance and types of visual aids, Animation to captivate your audience, Design of posters, Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions		
Module:2	**Analytical Writing – Articulate and support complex ideas**	**6 hours**
30 minute - Analyse an Issue, 30 minute - Analyse an Argument, Construct and Evaluate arguments¸Focused and Coherent discussion		
Module:3	**Speed Reading and Things to avoid during speed reading**	**6 hours**
Skimming, Meta guiding, Auditory reading, Visual reading, Eye span expansion, Pareto principle,Applications of Pareto principle, Sub-vocalization, Regression, Pen Tracing		
Module:4	**Debate**	**8 hours**
Idea generation, Research, Articulating, Style, Preparation of arguments –Rebuttal, Use of statistics,Practice rounds		
Module:5	**PEST Analysis**	**7 hours**
SLEPT, STEEPLE, 360 Feedback		
Module:6	**Lean Concepts**	**3 hours**
Product life cycle, Waste reduction, Technology change, Product support		
Module:7	**Listening**	**8 hours**
Types of Listening, Hearing, Focus, Voice, Verbal and Non-verbal messages		
	Total Lecture hours:	**45 hours**

Reference Books

1. Dale Carnegie,(1936) How to Win Friends and Influence People. New York City. Gallery Books
2. Joyce Aemstrong and Carroll(1992) Integrated Teaching of Reading, Writing, Listening, Speaking,Viewing and Thinking. Korea. Libraries Unlimited Inc.
3. Theo Theobald(2011) Develop your Presentation Skills. New Delhi. Kogan Page Limited.

Websites:			
1.	**www.chalkstreet.com**		
2.	**www.skillsyouneed.com**		
3.	**www.mindtools.com**		
4.	**www.thebalance.com**		
5.	**www.eguru.ooo**		
Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays,3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

MAT1014	Course title	L	T	P	J	C
	Discrete Mathematics and Graph Theory	3	2	0	0	4
Pre-requisite	None	Syllabus version v.1.0				

Course Objectives (CoB): 1,2,3

1. To address the challenge of the relevance of lattice theory, coding theory andalgebraic structures to computer science and engineering problems.
2. To use number theory, in particular congruence theory to cryptography and computer science problems.
3. To understand the concepts of graph theory and related algorithm concepts.

Expected Course Outcome (CO): 1,2,3,4,5

At the end of this course, students are expected to

1. form truth tables, proving results by truth tables, finding normalforms,
2. learn proof techniques and concepts of inference theory
3. understand the concepts of groups and application of group codes, use Boolean algebrafor minimizing Boolean expressions.
4. learn basic concepts of graph theory, shortest path algorithms, concepts of trees andminimum spanning tree and graph colouring, chromatic number of a graph.
5. Solve Science and Engineering problems using Graph theory.

Module:1	Mathematical Logic and Statement Calculus	6 hours

Introduction-Statements and Notation-Connectives–Tautologies–Two State Devices and Statement logic -Equivalence - Implications–Normal forms - The Theory of Inference for the Statement Calculus.

Module:2	Predicate Calculus	4 hours

The Predicate Calculus - Inference Theory of the Predicate Calculus.

Module:3	Algebraic Structures	5 hours

Semigroups and Monoids - Groups – Subgroups – Lagrange‟s Theorem Homomorphism – Properties-Group Codes.

Module:4	Lattices	5 hours

Partially Ordered Relations -Lattices as Posets – Hasse Digram – Properties of Lattices.

Module:5	Boolean algebra	5 hours

Boolean algebra - Boolean Functions-Representation and Minimization of Boolean Functions – Karnaugh map – McCluskey algorithm.

Module:6	Fundamentals of Graphs	6 hours
Basic Concepts of Graph Theory – Planar and Complete graph - Matrix representation of Graphs – Graph Isomorphism – Connectivity–Cut sets-Euler and Hamilton Paths–Shortest Path algorithms.		
Module:7	**Trees, Fundamental circuits , Cut sets, Graph colouring, covering, Partitioning**	**12 hours**
Trees – properties of trees – distance and centres in tree –Spanning trees – Spanning tree algorithms- Tree traversals- Fundamental circuits and cut-sets. Bipartite graphs - Chromatic number – Chromatic partitioning – Chromatic polynomial - matching – Covering– Four Colour problem.		
Module:8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**
Tutorial	• A minimum of 10 problems to be workedout by students in every Tutorial class. • Another 5 problems per Tutorial Class tobe given as home work. **Mode:** Individual Exercises, Team Exercises,Online Quizzes, Online, Discussion Forums	**30 hours**

Text Book(s)

1. Discrete Mathematical Structures with Applications to Computer Science, J .P. Trembley and R. Manohar, Tata McGraw Hill-35th reprint, 2017.
2. Graph theory with application to Engineering and Computer Science, Narasing Deo, Prentice Hall India 2016.

Reference Books

1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill, 2019.
2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018.
3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.
4. Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017.
5. Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw Hill, Special Indian Edition, 2017.
6. Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015.

Mode of Evaluation

Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	25-02-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course code	ADVANCED ALGORITHMS	L	T	P	J	C
CSI2003		2	0	2	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. To focus on the design of algorithms in various domains
2. To provide a foundation for designing efficient algorithms.
3. To provide familiarity with main thrusts of work in algorithms- sufficient to give some context for formulating and seeking known solutions to an algorithmic problem.

Expected Course Outcome:

1. Familiarize students with different algorithmic techniques
2. Apply advanced methods of designing and analyzing algorithms.
3. Choose appropriate algorithms and use it for a specific problem.
4. Understand different classes of problems concerning their computation difficulties.
5. Implement algorithm, compare their performance characteristics, and estimate their potential effectiveness in applications.

Module:1	Algorithm Design Techniques	5 hours

Revisit of Greedy algorithms, divide-conquer, dynamic programming. Backtracking: General method, N-queen problem, Subset sum, Graph coloring, Hamiltonian cycles. Branch and Bound: General method, applications - Traveling sales person problem, 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution.

Module:2	Network Flow	4 hours

Flow Networks, Networks with multiple sources and sinks, Floyd-Warshall algorithm, Max Flow and Min Cut, Ford-Fulkerson Method and Edmonds-Karp Algorithm, Bipartite Matching.

Module:3	Computational Complexity	5 hours

Class complexity classes: P, NP, Reductions, NP-completeness and NP hard , NP-Complete Problems, CNF-SAT and 3SAT, Vertex-Cover and Clique

Module:4	Randomized Algorithms	3 hours

Las Vegas algorithms, Randomized Quick Sort, Monte Carlo algorithm, Primality Testing

Module:5	**Approximation Algorithms**	**4 hours**
Limits to Approximability, Bin Packing (First fit, Best fit),2 – Approximation algorithm for Metric TSP, Euclidean TSP, Max-SAT and Vertex Cover		
Module:6	**Computational Geometry**	**4 hours**
Segment-intersection algorithm, Algorithms for finding convex hull: Graham‟s scan, Gift wrapping Algorithm. Finding the closest pair of points.		
Module:7	**Algorithms for AI**	**3 hours**
Uninformed search, Heuristic search (8 queen and tiling problems), A* and AO* algorithms.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, „Introduction to algorithms‟,3rd Edition, MIT Press, 2009.
2.	S. Sridhar, „Design and Analysis of Algorithms‟, Oxford University Press, 2015. (Module 4 & 5).

Reference Books

1.	M.T.Goodrich and R.Tomassia, „Algorithm Design: Foundations, Analysis and Internet examples‟ , John Wiley and sons, 2011.
2.	Sara Baase, Allen, Van, Gelder, „Computer Algorithms, Introduction to Design and Analysis‟, 3rd Edition, Pearson Education., 2003.
3.	A.Levitin, „Introduction to the Design and Analysis of Algorithms‟, Third Edition, Pearson Education, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments

1.	Implementation of algorithms for problems that can be solved by one or more of the following strategies: Divide and Conquer, Brute force, Greedy, Dynamic Programming. Branch-and-Bound algorithm for the 0-1 Knapsack problem to maximize the profit for a given problem instance.	6 hours

2.	Implementation of Graham‟s scan and Gift wrapping algorithms. In addition to that, using the implementation compare the running time of both the algorithms empirically by taking large input size range. Finally, compare empirical analysis and theoretical time complexity of both the algorithms.	4 hours
3.	Implementation of Ford-Fulkerson algorithm for computing a maximum flow in a network.	2 hours
4.	Randomized Algorithms: Las Vegas and Monte Carlo algorithms	2 hours
5.	Implementation of solution techniques for the minimum-cost flow problem.	2 hours
6	Heuristic search and A*, AO* algorithms	2 hours
7	Implementation of algorithms for Bin Packing, TSP, Vertex cover	4 hours
8	Implementation of search algorithms for graphs and trees: fundamental algorithms, Floyd Washall algorithm, Ford-Fulkerson Method and Edmonds-Karp Algorithm	6 hours
9	A simple polygon is defined as a flat shape consisting of straight non-intersecting line segments or sides that are joined pair –wise to from a closed path. Let P {p1, p2 , p3 ,....pn} be a set of points in the two dimensional plane. a. Write a program to find the simple polygon of P . b. Write a program (linear time) to convert that the simple polygon of P to a Convex Hull.	2 hours
	Total Laboratory Hours	**30 hours**
Mode of evaluation: Regular Assignments, Continuous Assessment Test / FAT (Lab)		

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	ADVANCED DATABASE MANAGEMENT SYSTEMS	L	T	P	J	C
CSI2004		3	0	0	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. To design conceptual and physical database tuning
2. To comprehend the concepts of parallel, distributed, multimedia and spatial database
3. To learn the concepts of mobile and cloud database
4. To understand the concepts of security and emerging technologies in database.

Expected Course Outcome:

1. Acquire the concept of physical database design and tuning
2. Learn the concept of parallel and distributed database
3. Obtain the knowledge of multimedia and spatial database
4. Apply the concepts of mobile and cloud database in realtime applications
5. Distinguish various emerging database technologies and Analyze various security issues in databases

Module:1	Database Design Techniques	5 hours

Review of DBMS Techniques – EER – Physical database design and tuning – Advanced transaction processing and Query processing

Module:2	Parallel Databases	6 hours

Architecture, Data partitioning strategy, Interquery and Intraquery Parallelism –Parallel query optimization

Module:3	Distributed Databases	7 hours

Structure of distributed database, Advantages, Functions, Distributed database architecture, Allocation, Fragmentation, Replication, Distributed query processing, Distributed transaction processing, Concurrency control and Recovery in distributed database systems.

Module:4	Multimedia and Spatial Databases	7 hours

Multimedia sources, issues, Multimedia database applications Multimedia database queries-LOB in SQL. Spatial databases -Type of spatial data– Indexing in spatial databases.

Module:5	**Mobile and Cloud Databases**	**8 hours**
Wireless network communication, Location and handoff management, Data processing and mobility, Transaction management in mobile database systems, Database options in the cloud, Changing role of the DBA in the cloud, Moving your databases to the cloud		
Module:6	**Emerging Database Technologies**	**5 hours**
Active database – Detective database- Object database - Temporal database - Streaming databases		
Module:7	**Database Security**	**5 hours**
Introduction to Database Security Issues –Security Models – Different Threats to databases – Counter measures to deal with these problems		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Raghu Ramakrishnan, Database Management Systems, ,4th edition, Mcgraw-Hill,2015
2.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019.

Reference Books

1.	RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
2.	Vlad Vlasceanu, Wendy A. Neu, Andy Oram, Sam Alapati, "An Introduction to Cloud Databases", O'Reilly Media, Inc. 2019
3.	S.K.Singh, Database Systems: Concepts, Design & Applications, 2nd Edition, Pearson education, 2011

Mode of Evaluation: CAT/ Digital Assignments/ Quiz/ FAT/ Project.

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI2007	SOFTWARE ENGINEERING PRINCIPLES	2	0	2	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1.To introduce the essential software engineering concepts involved in developing software products and components

2. To impart development skills during design, implementation and testing of reliable software systems across various disciplines

3. To familiarize engineering practices and standards used in developing software products and components

Expected Course Outcome:

1. Apply the principles of Software engineering methodology during software development and deployment process.

2. Document various processes like Requirement Engineering, Design and Testing.

3. Demonstrate an ability to use the techniques and tools necessary for significant application domains

4. Apply software testing and quality knowledge and engineering methods for various applications

5. Analyze the effectiveness of managing software projects through various techniques like Estimations, Scheduling and Quality Models

6. Apply benchmarking standards in process and in product.

Module:1	INTRODUCTION	5 hours

Software Engineering- Need, Importance and its characteristics - Software Process- Generic process model-Prescriptive process model-specialized, unified process-Agile development-Agile Process- Extreme Programming- Other agile Process models-Software engineering Knowledge-core Principles-Principles that guide each framework Activity.

Module:2	SOFTWARE REQUIREMENT ANALYSIS	5 hours

Requirements Engineering-Establishing the Groundwork-Eliciting Requirements- Developing use cases-Building the requirements model-Negotiating, validating Requirements-Requirements Analysis-Requirements Modeling Strategies.

Specifying Requirements: functional and non-functional requirements; specification exercise. Managing the Requirements Process: methods which provide a structure for co-operation between different stake holders. Prototyping: The role of prototyping in requirements techniques for prototyping. Requirements for Future Technologies: Computer Supported Co-operative Work (CSCW); networked multi-media systems.

Module:3	SOFTWARE DESIGN	5 hours

Design concepts and principles - Abstraction - Refinement - Modularity – Cohesion & coupling, Architectural design, Detailed Design – Transaction & Transformation, Refactoring of designs, Object-oriented Design User-Interface Design; Object Oriented Design Concepts and Diagrams - Use Case Diagrams - Class Diagrams - Interaction Diagrams - State chart Diagrams - Activity Diagrams - Package Diagrams - Component Diagrams – Deployment Diagrams

Module:4	SOFTWARE IMPLEMENTATION	4 hours

Structured coding Techniques-Coding Styles-Standards and Guidelines- Documentation Guidelines-Modern Programming Language Features: Type checking-User defined data types-Data Abstraction-Exception Handling- Concurrency Mechanism – Seven Steps of implementing software – Implementation Challenges and its resolution.

Module:5	SOFTWARE TESTING	4 hours

TESTING: Introduction; Software Testing Fundamental; Testing Principles; Testing Levels; Verification and Validation: Validation Testing, Validation Test Criteria; Test Plan: Test Documentation; Test Strategies: Top-Down Testing, Bottom-Up Testing, Thread testing, Stress testing, Back-to-back testing; Testing methods and tools: Testing through reviews, Black-box testing (Functional testing), White box testing (glass-box testing), Testing software changes; Additional requirements in testing OO Systems; Metrics Collection, Computation, and Evaluation; Test and QA plan; Managing Testing Functions.

Module:6	SOFTWARE MAINTENANCE	3 hours

Software Maintenance, Types of Maintenance, Structured versus unstructured maintenance – Maintenance costs – Typical problems with maintenance and its side-effects – Maintenance

process - Software Configuration Management – Component Reusability - Overview of RE-engineering & Reverse Engineering- Business Process Reengineering- Restructuring- Forward Engineering- Economics of Reengineering.

Module:7	**PROJECT PLANNING AND RISK MANAGEMENT**	**2 hours**

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

Module:8	**RECENT TRENDS**	**2 hours**
	Total Hours	**30 Hrs**

Lab Experiments

1. Work Break-down Structure (Process Based, Product Based, Geographic Based and Role Based) 2. Estimations – Cost & Schedule 3. Entity Relationship Diagram, Context flow diagram, DFD (Structural Modeling and Functional Modeling) 4. State Transition Diagrams (Behavioral Modeling) 5. System Requirements Specification 6. UML diagrams for OO Design 7. Tools for Version Control 8. Black-box, White-box testing Non-functional testing	**30 Hrs**

Text Book(s)

1.	Roger Pressman and Bruce Maxim, Software Engineering: A Practitioner's Approach, 9th Edition, McGraw-Hill, 2020.

Reference Books

1.	Ian Sommerville, Software Engineering, 10 th Edition, Addision-Wesley, 2015
2.	Pankaj Jalote, An Integrated Approach to Software Engineering (Texts in Computer Science),Reprint Springer, 2010
3.	William E. Lewis , “Software Testing and Continuous Quality Improvement”, Third Edition, Auerbach Publications, 2008
4.	David Gustafson , Schaum's Outline of Software Engineering,1st Edition, 2020

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar/Lab

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course Code	PRINCIPLES OF COMPILER DESIGN	L	T	P	J	C
CSI2005		3	0	0	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. To provide foundation for study of high performance compiler design.
2. To make students familiar with lexical analysis and semantic analysis.
3. To understand the principles of code optimization techniques.

Expected Course Outcome:

1. Demonstrate the functioning of a Compiler and to develop a firm and enlightened grasp of concepts such as higher level programming, assemblers, automata theory, and formal languages, language specifications.
2. Develop language specifications using context free grammars (CFG).
3. Apply the ideas, the techniques, and the knowledge acquired for the purpose of developing software systems.
4. Construct symbol tables and generating intermediate code.
5. Obtain insights on compiler optimization

Module:1	INTRODUCTION TO COMPILATION AND LEXCIAL ANALYSIS	7 hours

Introduction to programming language translators-Structure and phases of a compiler-Design issues- Patterns- lexemes-Tokens-Attributes-Specification of Tokens- Extended Regular expression, Regular expression to Deterministic Finite Automata (Direct method).

Module:2	SYNTAX ANALYSIS –TOP DOWN	5 hours

Role of parser- Parse Tree - Elimination of ambiguity - Top down parsing - Recursive Descent parsing - Non Recursive Descent parsing - Predictive Parsing - LL(1) grammars.

Module:3	SYNTAX ANALYSIS –BOTTOM UP	7 hours

Shift Reduce Parsers- Operator Precedence Parsing ,LR parsers:-Construction of SLR parser tables and parsing , CLR parsing-LALR parsing

Module:4	SEMANTICS ANALYSIS	6 hours

Syntax Directed Definition – Evaluation Order - Applications of Syntax Directed Translation -

Syntax Directed Translation Schemes - Implementation of L attributed Syntax Directed Definition.		
Module:5	**INTERMEDIATE CODE GENERATION**	**7 hours**
Variants of syntax trees - Three address code- Types – Declarations - Procedures - Assignment Statements - Translation of Expressions - Control Flow - Back Patching- Switch Case Statements.		
Module:6	**CODE OPTIMIZATION**	**6 hours**
Loop optimizations- Principal sources of optimization -Introduction to Data Flow Analysis - Basic Blocks - The DAG Representation of Basic Blocks -Loops in Flow Graphs.		
Module:7	**CODE GENERATION & OTHER TRANSLATIONS ISSUES**	**5 hours**
Issues in the design of a code generator- Target Machine- Next-Use Information - Optimization of basic blocks - Peephole Optimization - Register Allocation and Assignment.		
Module:8	Recent Trends	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, Techniques, & Tools, Second Edition, , Pearson Education, 2007
2.	K. D. Cooper and L. Torczon, Engineering a Compiler, 2nd edition. Morgan Kaufmann, , 2011

Reference Books

1.	Andrew A.Appel , Modern Compiler Implementation in Java, 2nd edition ,Cambridge University Press, 2002.
2.	Allen Holub, Compiler Design in C, Prentice Hall, 1990.
3.	Torbengidius Mogensen, “Basics of Compiler Design”, Springer, 2011.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	CLOUD COMPUTING METHODOLOGIES	L	T	P	J	C
CSI3001		3	0	2	0	4

Pre-requisite	Nil	Syllabus version v.1.0

Course Objectives:

1. To introduce the concept of Virtualization and cloud computing
2. To provide students a sound foundation of the Cloud Computing enabling them to start using and adopting Cloud Computing services and tools in their real life scenarios
3. To enable students explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

Expected Course Outcome:

1. Analyze and study the basics of cloud computing, cloud models and its applications
2. Appreciate the requirements of various service paradigms in Cloud Computing
3. Analyze, identify and select suitable type of virtualization
4. An ability to use techniques, tools, skills in a secured cloud environment
5. Design, implement and evaluate a cloud-based system, process, component, or program to meet desired needs

Module:1	Introduction	5 hours

Overview of Computing Paradigm, Cloud Computing- NIST Cloud Computing Reference

Architecture, Types of Cloud Deployment Models - Private, Public, Hybrid, Agency Clouds

Module:2	Cloud Service Models	5 hours

Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Anything as a Service(XaaS)

Module:3	Virtualization	7 hours

Need for Virtualization – Pros and cons of Virtualization, Types - Implementation Levels – CPU, Memory, I/O Devices, Virtual Clusters and Resource management

Module:4	Cloud Environments	7 hours

Cloud Environments - Case study: One cloud service provider per service model (eg. Amazon EC2,

Google App Engine, Sales Force, Microsoft Azure, Open Source tools)		
Module:5	**Cloud Application Development**	**8 hours**
Cloud application development using third party APIs, Working with EC2 API – Google App Engine API - Facebook API, Twitter API , HDFS, Map Reduce Programming Model.		
Module:6	**Security**	**7 hours**
Cloud Security Challenges and Risks – Software-as-a- Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security		
Module:7	**Advances in Cloud**	**4 hours**
MQTT in Cloud, MQTT working example – Fog Computing basics – Comparing Cloud, Fog and Mist Computing		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Rajkumar Buyya, James Broberg, Andrzej, M. Goscinski, Cloud Computing: Principles and Paradigms, 1st Edition, Wiley,2013
2.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers,2013

Reference Books

1. Sehgal, Naresh, Bhatt, Pramod Chandra P., Acken, John M, "Cloud Computing with Security Concepts and Practices", 2nd Edition , Springer International Publishing, 2020
2. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, "Mastering Cloud Computing" , 1st Edition, Tata McGraw Hill, 2017
3. Perry Lea, "IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security", 2nd Edition, Packt Publishing Limited, 2020

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Indicative Experiments		
1.	Virtual box based Webserver creation, Images/Snapshots access web page from 2nd VM on another subnetwork	2 hours
2.	EC2 AWS – S3 bucket based static webpages.	2 hours
3.	EC2 AWS – Instance Creation, Migration	2 hours
4.	EC2 AWS – Web application using Beanstalk	2 hours
5.	AWS – Local balancing and auto scaling.	3 hours
6.	IBM Blue Mix - Mobile Application development	3 hours
7.	DaaS – Deployment of a basic web app and add additional functionality(Javascripts based)	3 hours
8.	PaaS – IOT – Mobile sensor based IOT application hosted via PaaS environment	3 hours
9.	SaaS – Deployment of any SaaS application for a online Collaborative tool	3 hours
10.	Deployment of Open stack or Virtual box from the scratch	3 hours
11.	Hadoop as a Service	2 hours
12.	Cloud TM Online Collaboration Services (User Defined Applications)	2 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: CAT1/CAT2/FAT			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course Code	MICROPROCESSOR AND INTERFACING TECHNIQUES	L	T	P	J	C
CSI2006		2	0	2	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. To acquaint students with basic concepts of block diagram, architecture, pin diagram, addressing modes and instruction set of an 8086/ARM microprocessor.
2. To teach students syntax and semantics of assembly language programming and its constructs. To facilitate students to practice sample assembly programs and develop logic for other operations.
3. To explore special architectural features and various peripheral IC‟s for designing a typical computing system.
4. To understand the need for numeric co-processor. Also develop skill on open source prototyping boards for developing any smart systems for contemporary issues.

Expected Course Outcome: At the end of this course, students will be able to

1. Explain the design aspects of a typical microprocessor and illustrate its capabilities.
2. Practice and emulate assembly programs. To develop logic at assembly level for various operations.
3. Understand need for and working of Stack, Interrupt Service Routines (ISRs) and Procedures. Practice assembly programs for file handling and other operations using ISR.
4. Illustrate interfacing of basic devices viz. memory, IO, data converters and motors.
5. Illustrate interfacing of special purpose programmable devices viz. timer/counter, interrupt controller, display controller, communication and direct memory access.
6. Explain the design aspects of numeric co-processor and illustrate its capabilities with sample assembly programs.
7. Explore open source prototyping board, sample sensors and actuators and develop smart solutions for socio-economic issues.

Module:1	Intel x86/ARM Processors	5 hours

Architecture and Signal Description, Register and Memory Organization, General Bus Operations and IO Addressing Capability, Special Processor Activities, Min and Max Modes, Reduced-Instruction-Set Computing(RISC)

Module:2	Assembly Language Programming and Tools	5 hours

Addressing modes and Instruction Set, Assembler Directives and Operators, Introduction to

emu8086 emulator and MASM assembler, Assembly Language example programs.		
Module:3	**Special Architectural Features and Programming**	**3 hours**
Stack – stack structure of 8086/ARM and programming; Interrupt – interrupt cycle, non-mask-able, mask- able, Interrupt Service Routine, programming; procedure and macro– definition and passing parameters; handling larger programs; timing and delays – clock cycle, states, instruction execution time, clock count for generating delays; file management – create, open, close, read, write and delete operations;		
Module:4	**Basic Peripherals Interfacing**	**4 hours**
Memory Interfacing – Interleaving, static and dynamic RAM interfacing; IO Ports Interfacing – memory mapped I/O, I/O mapped I/O; PIO 8255 – architecture, pin, control word register, operation modes; A/D Interfacing – 0808 SAR, 7109 dual-slope, interfacing; D/A – 7523, DAC0800; Stepper Motor – 4 winding internal schematic, excitation sequence, sample programs.		
Module:5	**Special Purpose Programmable Peripheral Interfacing**	**5 hours**
Timer/Counter 8253 – architecture, pin, control word register, operation modes, programming; PIC-8259 – architecture, pin, interrupt sequence, command words, operation modes, programming; 8279 – architecture, pin, operation modes, programming; 8251 – communication methods, architecture, pin, operation modes, programming; 8257 – architecture, pin, DMA transfers and operations, programming.		
Module:6	**Numeric Co-Processor 8087**	**4 hours**
Overview, compatible processor and coprocessor, pin, architecture, block diagram - control unit, numeric execution unit, registers, status word, circuit connection of 8086-8087,data types, IEEE floating point standard, instruction set, sample programs.		
Module:7	**Case Study on Microcontroller Boards**	**2 hours**
Introduction to Microcontroller, UNO Board, IDE, Programming using GPIO for LED, LCD, Keypad, Motor, Sensor interfacing, case study on smart system design.		
Module:8	**Recent Trends**	**2 hours**

	Total Lecture hours	**30 hours**
Text Book(s)		
1.	A.K. Ray and K.M. Bhurchandi Advanced Microprocessors and Peripherals, 3rd Edition, Tata McGraw Hill, 2017.	
2.	Barry B Bray , The Intel Microprocessor 8086/8088, 80186,80286, 80386 and 80486 Architecture, programming and interfacing, 8th Edition ,PHI, , 2011	
Reference Book(s)		
1.	Douglas V. Hall, SSSP Rao" Microprocessors and Interfacing Programming and Hardware". Third edition, Tata McGraw Hill, 2017.	
2.	Mohamed Rafiquazzaman, "Microprocessor and Microcomputer based system design," Second edition, Universal Book stall, 1995	
3.	K Uday Kumar, B S Umashankar, Advanced Micro processors & IBM-PC Assembly Language Programming, Tata McGraw Hill, 2017.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	Arithmetic operations 8/16 bit using different addressing modes.	2 hours
2.	Finding the factorial of an 8 /16 bit number	1 hour
3.	(a) Solving nCr and nPr (b) Compute nCr and nPr using recursive procedure. Assume that „n" and „r" are non-negative integers.	2 hours
4.	Fibonacci series	1 hours
5.	Sorting in ascending and descending order	2 hours
6.	(a) Search a given number or a word in an array of given numbers. (b) Search a key element in a list of „n" 16-bit numbers using the Binary search algorithm.	2 hours
7.	To find the smallest and biggest numbers in a given array.	2 hours
8.	ALP for number bases conversions	2 hours
9.	String operations (String length, reverse, comparison, concatenation,	2 hours

	palindrome)	
10.	Password checking	2 hours
11.	Convert a 16-bit binary value (assumed to be an unsigned integer) to BCD and display it from left to right and right to left for specified number of times	2 hours
12.	Read the current time from the system and display it in the standard format on the screen.	2 hours
13.	Program to simulate a Decimal Up-counter to display 00-99.	2 hours
14.	Read a pair of input co-ordinates in BCD and move the cursor to the specified location on the screen.	2 hours
15.	Stepper motor interface using 8086/ Intel Galileo Board	2 hours
16.	Seven segment LED DISPLAY using 8086/Intel Arduino Board	2 hours
	Total Laboratory Hours	30 hours
Mode of evaluation: CAT/FAT/Assignment		

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course code	DATA COMMUNICATION AND NETWORKS	L	T	P	J	C
CSI2007		3	0	2	0	4
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications

2. Gain expertise in design, implement and analyze performance perspective of TCP/IP layered Architecture

3. Deal with the major issues of the layers of the model.

Expected Course Outcomes:

1. Describe the layered structure of a typical networked architecture

2. Identify and analyze the different types of network topologies, error and flow control mechanisms

3. Design sub-netting and enhance the performance of routing mechanisms.

4. Compare various congestion control mechanisms and identify suitable Transport layer protocol for real time applications

5. Identify various Application layer protocols for specific applications

6. Design and Implement various Network protocols

Module:1	Basics of Data Communication and Computer Network	5 hours

Definition and Uses of Computer Network, Criteria for a Data Communication Network, Components of Data Communication, Classification of Computer network, Network Topology, Network Models:OSI, TCP/IP- Networking Devices: Hubs, Bridges, Switches, Routers, and Gateways – Performance Metrics – Introduction to Sockets – Port numbers in Socket Programming

Module:2	Physical Layer	5 hours

Transmission Impairments, Transmission Medium,Data Encoding: Line Encoding, Types of Line Coding, Analog-to-Digital Conversion- Pulse code modulation (PCM), Delta modulation

(DM);Transmission Modes- Half and Full Duplex- Signals – Bandwidth and Data Rate – Multiplexing – Shift Keying		
Module:3	Data Link Layer	**9 hours**
Error Detection and Correction- One and two dimensional parity checks, Hamming code, Cyclic redundancy check (CRC); Flow Control: Protocols: Protocols for Noiseless Channels and Noisy Channels – Ethernet- Access Control Protocols: CSMA,CSMA/CA,CSMA/CD, Token Ring- Token Passing,TDMA,FDMA,CDMA-Virtual LAN- Wireless LAN (802.11).		
Module:4	Network Layer	**8 hours**
IP Addressing Scheme, Subnet Addressing, Subnet Masks, IPV4 Addressing, IPV6 Addressing, Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP).Unicast Routing: Routing Characteristics, Routing Algorithms: Distance Vector Routing Protocol, Link State Routing Protocol – Multicast Routing- Wireless Routing		
Module:5	Transport Layer	**6 hours**
Services of Transport Layer, Socket Programming, TCP Phases, Transport Layer Protocols: TCP, UDP, SCTP, RTP, Transport Layer Security Protocols : SSL,TLS		
Module:6	Traffic Engineering Principles	**4 hours**
Congestion Control Algorithms- Congestion prevention policies; Quality of Service- Traffic shaping, Leaky bucket algorithm, Token bucket algorithm; Integrated Services.		
Module:7	Application Layer	**6 hours**
Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP), TELNET,SNMP,DNS, Hypertext Transfer Protocol (HTTP), World Wide Web (WWW), Security in Internet, E-mail Security.		
Module:8	**Recent Trends**	**2 hours**

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	James Kurose , Keith Ross, Computer Networking: A Top-Down Approach, 7th edition Pearson, , 2016
2	Behrouz A. Forouzan, Data Communications and Networking, , 5th Ed. McGraw Hill Education,2012
Reference Books	
1	William Stallings, Data and Computer Communications, 10th Ed, Pearson Education, ,2013.
2	Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, 5th Ed**,** Elsevier, 2011.
3	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012. Andrew S Tanenbaum, "Computer Networks", 5th Edition, Pearson, 2011.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Experiments		
1.	Basic Networking **Commands** using Linux	1 hour
2.	Error detection and correction mechanisms	4 hours
3.	Flow control mechanisms	4 hours
4.	IP addressing – Classless addressing	4 hours
5.	Routing Protocol Implementation and Performance Analysis of Routing protocols	4 hours
6	Socket Programming	4 hours
7	Transport Layer Security Protocol Implementation	4 hours
8	Congestion Control Protocol	3 hours
9	Study about Network Simulation tools	2 hours
Total Laboratory Hours		30 hours
Mode of evaluation: Assignment, CAT / Assignment / Quiz / FAT		

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course Code	Applied Cryptography and Network Security	L	T	P	J	C
CSI3002		2	0	2	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. To learn the emerging concepts of cryptography and algorithms

2. To defend the security attacks on information systems using secure algorithms and Authentication process

3. To categorize and analyze the key concepts in network and wireless security

Expected Course Outcome:

1. Infer the need of security to introduced strong cryptosystems.
2. Analyze the cryptographic algorithms for information security.
3. Identify the authentication schemes for membership authorization.
4. Identify computer and network security threats, classify the threats and develop a security model for detect and mitigate the attacks.
5. Identify the requirements for secure communication and challenges related to the secure web services
6. Identify the need of ethical and professional practices, risk management using emerging security solutions.

Module:1	Introduction to Cryptography	4 hours

Security trends, Security attacks, Security mechanism, Elementary number theory, Pseudo-random bit generation. **Basic security services:** confidentiality, integrity, availability, non-repudiation, privacy.

Module:2	Symmetric Key Cryptography	4 hours

Block Ciphers: DES, Triple-DES, AES, Modes of Operation, Stream Cipher

Module:3	Asymmetric Key Cryptography	4 hours

RSA, Elgamal, Elliptic Curve Cryptography (ECC), Diffie-Hellman key exchange protocol

Module:4	Hash Functions and Authentication	**4 hours**
Message Authentication Code (MAC), MD5, Secure Hash algorithms (SHA), HMAC, Digital Signatures, Digital Signature Standard (DSS).		
Module:5	**Basic Applied Cryptography**	**3 hours**
Key management and distribution, digital certificates, identity-based encryption, Identification and authentication, zero knowledge protocols		
Module:6	**Advanced Applied cryptography**	**5 hours**
Side-channel attack, Pretty Good Privacy (PGP), S/MIME, Kerberos, Homomorphic encryption, Quantum Cryptography, DNA Cryptography, Chaos Based Cryptosystem		
Module:7	**Web and Wireless Security**	**4 hours**
IPsec: AH and ESP, IKE- SSL/TLS, Types of Firewalls, Intrusion detection and Prevention systems, Wireless Application Protocol (WAP)		
Module:8	Recent Trends	**2 hours**
Total Hours: 30 hours		

List of Experiments

1	Implement DES, Triple DES and AES Key Algorithms	**4 Hours**
2	Implement RSA, ECC and Diffie-Hellman Key Establishment.	**4 Hours**
3	Implement a Secret-Sharing algorithm and Homomorphic Encryption algorithm	**2 Hours**
4	Implement message authentication (MAC) and HASH algorithms	**3 Hours**
5	Consider and examine the Wireless network security and technology integration for compliance using the case study of Cisco.	**2 Hours**
6	Explore the Snort Intrusion Detection Systems. Study Snort IDS, a signature-based intrusion detection system used to detect network attacks. Snort can also be used as a simple packet logger. For the purpose of this lab the	**4 Hours**

	students will use snort as a packet sniffer and write their own IDS rules	
7	Explore ways to perform wireless attacks and understand potential defences. The attacks that will be covered are inspecting & modifying wireless card parameters, changing the wireless transmission channel, flooding attacks, and cracking keys of WPA2 protected networks.	**4 Hours**
8	Pretty Good Privacy – • Create a public/private key pair in PGP • Create a revocation ley • Exchange PGP keys with other students • Signing the new key • Encrypting a file using your partner‟s public key • Decrypting the file using your private key • Encrypting and signing a file • Verifying the signature • Sending secure Email with PGP • Adding a public key and sending secure email.	**4 Hours**
9	Send and receive an encrypted email message using S/MIME.	**3 Hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed. Pearson Publishers, 2017.
2.	Behrouz A. Forouzan, Cryptography and Network Security:6th Ed. McGraw-Hill, 2017.

Reference Books

1.	Kaufman, Perlman and Speciner. Network Security: Private Communication in a Public World., 2nd edition, Pearson Publishers, 2002.
2	Menezes, van Oorschot, and Vanstone, The Handbook of Applied Cryptography, 20th Edition, WILEY, 2015
3	H. Silverman, A Friendly Introduction to Number Theory, 4th Ed. Boston: Pearson, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Lab			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course code	PROGRAMMING IN JAVA	L	T	P	J	C
CSI2008		3	0	2	0	4
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. Understand Object Oriented Programming & Functional Programming in Java, Handling Exceptions and Multithreading.

2. Able to perform File Handling, Manipulating Strings, Generic Programming.

3. Use of Java for Event Handling and Web applications using Servlets.

Expected Course Outcome:

At the end of this course students should be able to:

1. Analyze the programs involving the fundamental program constructs.
2. Choose the appropriate OOP technique for solving the real world problem.
3. Demonstrate exception handling and use of threads in Java.
4. Propose the use of Generic programming and file handling for different scenarios.
5. Explore various methods for manipulating strings and several collections.
6. Choose appropriate elements to facilitate event handling and GUI programming.
7. Design and develop web applications using Servlets with JDBC.

Module:1	Introduction to Java Programming	4 hours

Overview of Java Language: Introduction, Java Virtual Machine, program structure, Java tokens, statements, variables, scope of variables and data types. Arrays: One-Dimensional arrays, Multidimensional Arrays.

Module:2	Object, Class and Packages	7 hours

Object Oriented Programming and Java –. Classes – Objects – Methods – Constructors – this keyword – Garbage collection – Overloading methods – Objects as parameters and returning objects – Nested and Inner classes – static and final keywords – Inheritance: Basics, Using super, Class hierarchy, Method overriding, Abstract classes – The Object Class – Packages and Interfaces.

Module:3	Exceptions and Threads	7 hours
Exception Handling: Fundamentals, Types, Uncaught Exceptions, Using try and catch, Multiple catch clauses, Nested try, Built-in Exceptions, Creating your own exception subclasses. Threads: Java thread model, Main thread, Creating a thread, Creating multiple threads, Thread priorities, Synchronization, Inter thread communication, Thread‟s states, Multithreading.		
Module:4	**Files and Generics**	**6 hours**
I/O streams – Console I/O – The PrintWriter class – Reading and Writing files. Generics: Basics, A Generic class, General form, Using wildcard arguments, Generic methods, Generic Interfaces, Generic Class hierarchy, Type inference.		
Module:5	**Lambda Expressions and Strings**	**6 hours**
Lambda Expressions: Introduction, Block Lambda expressions, Passing Lambda expressions as arguments, Lambda Expressions and Exceptions. String Handling: The String Constructors, Various String Operations, StringBuffer and StringBuilder Classes.		
Module:6	**Java Event Handling and GUI Programming**	**6 hours**
Event Handling mechanism, Event Delegation, Event and KeyEvent Classes, EventListener Interfaces. GUI Programming with JavaFX: UI Controls, Layout Classes, Collection Classes, Media Classes.		
Module:7	**Java Servlets and JDBC**	**7 hours**
Background - Lifecycle of a servlet – Development – The Servlet API – The javax.servlet package – Reading Servlet Parameters - Handling http requests and responses – Using Cookies – Session Tracking – JDBC-Servlets with JDBC		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)		
1.	Herbert Schildt, "Java: The Complete Reference", , 11th Edition., McGraw-Hill Publishers December 2018.	
2.	Cay S. Horstmann, "Core Java Volume I--Fundamentals", 11th Edition. , Pearson Publishers. August 2018.	
Reference Books		
1.	Ben Evans, David Flanagan, "Java in a Nutshell 7th Edition., O'Reilly Media, Inc. December 2018.	
2.	Joshua Bloch, "Effective Java".., 3rd Edition. Addison Wesley Publishers December 2018	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	Programs to demonstrate the use of arrays and various OOP concepts.	2 hours
2.	Programs to understand various exceptions and handling them.	2 hours
3.	Programs to demonstrate the concept of threads and multithreading in Java	2 hours
4.	Programs to understand Generic Programming technique and Lambda expressions.	4 hours
5.	Programs to create and manipulate file using different I/O methods.	4 hours
6.	Programs to explore various string handling methods.	3 hours
7.	Programs to idealize the use of different collection frameworks in java.util package and use of java.lang packages.	3 hours
8.	Programs to explore various swing elements to deepen the understanding of javaFX	3 hours
9.	Programs to realize the power of Java for internet programming through servlets.	3 hours
10.	Programs to realize the power of Java for internet programming through servlets with JDBC	4 hours
	Total Laboratory Hours	30 hours
Mode of evaluation: CAT / Assignment / Quiz / FAT		
Recommended by Board of Studies	11-02-2021	

Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI3003	Artificial Intelligence and Experts Systems	3	0	0	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. Ability to understand Artificial Intelligence principles and techniques
2. Introduce the facts and concepts of Expert system by computational model and their applications
3. Explore the knowledge using problem solving, search methodologies and learning algorithms.

Expected Course Outcome:

On completion of this course the students will be able to

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.

2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.

3. Analyze and illustrate how search algorithms play vital role in problem solving

4. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems

5. Understand and Illustrate the construction of expert system

6. Discuss current scope and limitations of AI and societal implications.

Module:1	Introduction to Artificial Intelligence	5 hours

Overview of Artificial Intelligence –History of AI – Agents and environment – concept of rationality - Classification of AI systems with respect to environment.

Module:2	Problem solving	6 hours

Solving problems by searching - Problem space - State space - searching for solutions - uninformed search strategies.

Module:3	Heuristic Search Strategies	6 hours

Informed search strategies – Games: mini-max algorithm, Alpha-Beta Pruning		
Module:4	**Logical Agents**	**8 hours**
Knowledge-Based Agents - Wumpus World - Propositional Logic – Constraints, Predicate Logic – First Order Logic - Inference in First Order Logic		
Module:5	**Planning Agents**	**8 hours**
Situational Calculus - Representation of Planning - Partial order Planning- Practical Planners – Conditional Planning - Replanning Agents		
Module:6	**Knowledge Reasoning**	**5 hours**
Uncertainty - Bayes Rule – Inference-Hidden Markov Model- Belief Network, Decision Network		
Module:7	**Design of Expert System**	**5 hours**
Architecture of expert systems - Stages in the development of an Expert Systems - Roles of expert systems – Expert System Tools-Difficulties in Developing Expert Systems- Knowledge Acquisition and elicitation - Meta knowledge - Typical expert systems – MYCIN		
Module:8	**Recent Trends**	**2 hours**
	Total hours:	**45 hours**

Text Book(s)

1.	Russell, S. and Norvig, P. Artificial Intelligence - A Modern Approach, 4th edition, Prentice Hall, 2020
2.	Poole, D. and Mackworth, A. Artificial Intelligence: Foundations of Computational Agents, 2nd edition Cambridge University Press, 2017

Reference Books

1.	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007
2.	Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007

3.	Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, 3rd Edition, McGraw Hill, 2008		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

MDI3002	Foundations of Data Science	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**NIL**			**Syllabus version v.1.0**		

Course Objectives:

1. To provide fundamental knowledge on data science and to understand the role of statistics and optimization to perform mathematical operation in the field of data science.
2. To understand the process of handling heterogeneous data and visualize them for better understanding.
3. To gain the fundamental knowledge on various open source data science tools and understand their process of applications to solve various industrial problems.

Expected Course Outcome:

1. Ability to obtain fundamental knowledge on data science.
2. Demonstrate proficiency in statistical analysis of data.
3. Develop mathematical knowledge and study various optimization techniques to perform data science operations.
4. Handle various types of data and visualize them using through programming for knowledge representation.
5. Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.

Module:1	**Basics of Data Science**	**5 hours**

Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems, Structured and unstructured data

Module:2	**Statistical Foundations**	**7 hours**

Descriptive statistics, Statistical Features, summarizing the data, outlier analysis, Understanding distributions and plots, Univariate statistical plots and usage, Bivariate and multivariate statistics, Dimensionality Reduction, Over and Under Sampling, Bayesian Statistics, Statistical Modeling for data analysis

Module:3	**Algorithmic Foundations**	**8 hours**

Linear algebra Matrices and their properties (determinants, traces, rank, nullity, etc.); Eigenvalues

and eigenvectors; Matrix factorizations; Inner products; Distance measures; Projections; Notion of hyperplanes; half-planes, elementary spectral graph theory. Sampling and VC-dimension - Random walks and graph sampling, MCMC algorithms, learning, linear and non-linear separators, PAC learning		
Module:4	**Optimization**	**7 hours**
Unconstrained optimization; Necessary and sufficiency conditions for optima; Gradient descent methods; Constrained optimization, KKT conditions; Introduction to non-gradient techniques; Introduction to least squares optimization		
Module:5	**Programming Foundation and Exploratory Data Analysis**	**6 hours**
Introduction to Python Programming, Types, Expressions and Variables, String Operations, selection, iteration, Data Structures- Strings, Regular Expression, List and Tuples, Dictionaries, Sets; Exploratory Data Analysis (EDA) - Definition, Motivation, Steps in data exploration, The basic datatypes, Data type Portability, Basic Tools of EDA, Data Analytics Life cycle, Discovery		
Module:6	**Data Handling and Visualization**	**6 hours**
Data Acquisition, Data Pre-processing and Preparation, Data Quality and Transformation, Handling Text Data; Introduction to data visualization, Visualization workflow: describing data visualization workflow, Visualization Periodic Table; Data Abstraction -Analysis: Four Levels for Validation- Task Abstraction - Analysis: Four Levels for Validation Data Representation: chart types: categorical, hierarchical, relational, temporal & spatial		
Module:7	**Data Science Tools and Techniques**	**4 hours**
Overview and Demonstration of Open source tools such as R, Octave, Scilab. Python libraries: SciPy and sci-kitLearn, PyBrain, Pylearn2; Weka.		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours		**45 hours**
Text Books		

1.	R. V. Hogg, J. W. McKean and A. Craig, Introduction to Mathematical Statistics, 8th Ed., Pearson Education India, 2019.
2.	Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge University Press, 2020.

Reference Books

1	Ani Adhikari and John DeNero, „Computational and Inferential Thinking: The Foundations of Data Science" , GitBook, 2019.
2	Cathy O"Neil and Rachel Schutt, „Doing Data Science: Straight Talk from the Frontline", O"Reilly Media, 2013.
3.	Hossein Pishro-Nik, "Introduction to Probability, Statistics, and Random Processes", Kappa Research, LLC, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Data Science Programming	L	T	P	J	C
CSI3004		2	0	2	0	3
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

1. To provide necessary knowledge on data manipulation and to perform analysis on the practical problems using statistical and machine learning approach
2. To generate report and visualize the results in graphical form using programming tool

Expected Course Outcome:

1. Ability to gain basic knowledge on data science
2. Gain the insights from the data through statistical inferences
3. Develop suitable models using machine learning techniques and to analyze its performance
4. Analyze on the performance of the model and the quality of the results
5. R tool for data Analysis and visualize the results
6. Demonstrate problem solving skills and provide solutions to real world problems

Module:1	Introduction	3 hours

Data Science: Basics – Digital Universe – Sources of Data – Information Commons – Data Science Project Life Cycle: OSEMN Framework

Module:2	Probabilistic Theory	4 hours

Probability Theory – Introduction – Conditional Probability – Bayes Rule – Gaussian Distribution – Inference of Gaussian

Module:3	Classification and Clustering	5 hours

Introduction to machine learning: Supervised, Unsupervised Learning – Regression: Linear Regression and Logistic Regression -- Classification Methods: K Nearest Neighbors, Naïve Bayes, Decision Trees - Clustering: k means, Hierarchical clustering

Module:4	Handling Data Using R	4 hours

R Objects, variables, datatypes, matrices, list, Control Structures, Functions, Data Frames, Reading and Writing Data File, Model Building		
Module:5	**Data Visualization in R**	**4 hours**
ggplot-univariate, bivariate, multivariate graph – time dependent graph – statistical models – histogram – box plot – heat map - scatter plot – legends – labeling		
Module:6	**Performance Evaluation**	**4 hours**
Model Evaluation Techniques: Hold out, cross validation - Prediction Errors: Type I, Type II - Loss Function and Error: Mean Squared Error, Root Mean Squared Error – Model Selection and Evaluation criteria: Accuracy, F1 score – Sensitivity – Specificity – AUC		
Module:7	**Data Analysis Using R – Case Study**	**4 hours**
Electricity consumption Data Analysis – Analysis of changes in pollution levels – Patient survival Analysis		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	HadleyWickhmen, Garrette Grolemund, R for Data Science: Import, Tidy, Transform, Visualize and Model Data, OReilly, 2017
2.	Carl Shan, Henry Wang, William Chen, Max Song. The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists. The Data Science Bookshelf. 2016.

Reference Books

1.	Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann. 2011
2.	Sergios Theodoridis, Konstantinos D Koutroumbas, Pattern Recognition, 4th Edition, Academic Press, Inc, 2009.
3.	James, G., Witten, D., T., Tibshirani, R. An Introduction to statistical learning with

	applications in R. Springer. 2013	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	House rent prediction using linear regression	3 hours
2.	Medical diagnosis for disease spread pattern	3 hours
3.	Automate email classification and response	2 hours
4.	Customer segmentation in business model based on their demographic, psychographic and behavior data	3 hours
5.	Analysis of tweet and retweet data to identify the spread of fake news	2 hours
6.	Analyze crime data using suitable technique on reported incidents of crime based on time and location	2 hours
7.	Construct a recommendation system based on the customer transaction using Association rule mining	2 hours
8.	Perform analysis on power consumption data to suggest for minimizing the usage	2 hours
9.	Behavioral analysis of customers for any online purchase model	3 hours
10	Agricultural data analysis for yield prediction and crop selection on Indian terrain data set	3 hours
11.	Develop a recommender system for any real-world problem (when a user queries to find the university that offers Python, the system should display rank wise list of the university based on the review given by the customers)	3 hours
12.	Develop a business model to predict the trend in Investment and Funding	2 hours
	Total Laboratory Hours	**30 hours**
Mode of Evaluation: Project/Activity		

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
MDI4001	Machine Learning For Data Science	3	0	2	0	4
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

1. To instill the basics of Machine Learning Concepts
2. To be able to apply ML concepts in computing by making a choice of the suitable ML technique
3. To practice tuning ML Models and address data inadequacies
4. To be able to understand and enhance various classification models
5. To be able to apply simple techniques like regression for powerful applications
6. To gain an insight into parameters of supervised learning models like Clustering
7. To understand the working of Neural Networks and the components involved

Expected Course Outcome:

1. Understanding the nuances of an ML sequence
2. Derive an understanding of a Model‟s deficiency
3. Gaining knowledge of mathematical concepts involved in Gradient Descent
4. Appreciate the difference between Supervised and Unsupervised learning models
5. Learn to apply accuracy metrics for various models
6. Get an insight into Reinforced Learning approaches for Problem Solving
7. Being able to understand Deep Networks and their potential in different fields

Module:1	Introduction to Machine Learning	6 hours

Machine Learning – Types; Data – Getting the data, visualizing the data, preparing the data; Selecting and Training a Model – Fine tuning a Model: Grid Search – Randomized Search - Main Challenges: Data Inadequacy – Non-representativeness – Irrelevant features – Overfitting the Model – Underfitting the Model;

Module:2	SUPERVISED LEARNING TECHNIQUES	8 hours

Binary Classifier – Performance Measures : Cross –Validation – Confusion Matrix –Precision and Recall – Multiclass classification – Mutli-label classification; Linear Regression – Gradient Descent: Batch Gradient – Stochastic Gradient Descent – Mini-batch Gradient Descent; Polynomial Regression –Logistic Regression –Estimating Probabilities, Decision Boundaries, Softmax Regression

Module:3	SUPPORT VECTOR MACHINES	7 hours

Linear SVM with Soft Margin Classification – Non-linear SVM Classification: Polynomial features –Similarity features –Gaussian Kernel; SVM Regression		
Module:4	**NEURAL NETWORKS**	**6 hours**
Introduction to a Simple Neural Network – Computations – Output Layer of a Binary and a Multiclass problem, Choosing the right configuration, Loss Functions, Back Propagation		
Module:5	**DECISION TREES AND RANDOM FORESTS**	**7 hours**
Training and Visualizing a Decision Tree –CART Algorithm – Gini Impurity; Bagging – Pasting – Random Forests – Boosting: Adaboost and Gradient Boosting –Stacking		
Module:6	**DIMENSIONALITY REDUCTION**	**4 hours**
Main approaches – Projection and Manifold Learning – PCA (Principal Component Analysis): Preserving the Variance – Principal Components – Projecting down to d Dimensions – Randomized PCA – Kernel PCA		
Module:7	**UNSUPERVISED LEARNING TECHNIQUES**	**5 hours**
Clustering –Kmeans – Limitations –Clustering for Image Segmentation, Preprocessing , Semi-supervised learning – DBSCAN – Hierarchical – Paritional - Gaussian Mixtures		
Module:8	**RECENT TRENDS**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Aurelion Geron, Hands-On Machine Learning with Scikit – Learn, Keras and Tensorflow, 2nd Edition, O.Reilly, 2019

Reference Books

1.	U Dinesh Kumar, Manaranjan Pradhan: Machine Learning Using Python, Wiley, 2019
2.	Robert (Monroe) Monarch, Human-in-the-loop Machine Learning, Publications, 2021
3.	Francois Chollet, Deep Learning with Python, Second edition, Manning Publications, 2021

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments		
1.	Simple Python Primer	3 hours
2.	Predicting real estate prices/loan processing data using simple Neurons	3 hours
3.	Classification of tabular data	2 hours
4.	Analysis of Decision Trees	3 hours
5.	Determining future EMI defaulters using Prediction Technique	3 hours
6.	Classification of images using Neural Networks	3 hours
7.	SVM based data analysis	2 hours
8.	Clustering UCI data for accuracy and outlier analysis	4 hours
9.	Ensemble methods practice	3 hours
10	Finance data analysis using Regression Techniques	4 hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Project/Activity			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Advanced Data Visualization Techniques	L	T	P	J	C
CSI3005		3	0	2	0	4
Pre-requisite	**Nil**	**Syllabus version v.1.0**				

Course Objectives:

1. To understand the various types of data, apply and evaluate the principles of data visualization
2. Acquire skills to apply visualization techniques to a problem and its associated dataset
3. To apply structured approach to create effective visualizations
4. To learn how to bring valuable insight from the massive dataset using visualization
5. To learn how to build visualization dashboard to support decision making
6. To create interactive visualization for better insight using various visualization tools

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Identify the different data types, visualization types to bring out the insight.
2. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on large dataset.
3. Design visualization dashboard to support the decision making on large scale data.
4. Demonstrate the analysis of large dataset using various visualization techniques and tools.

Module:1	Introduction to Data Visualization and Visualization techniques	6 hours

Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation. Visualization Techniques -Scalar and point techniques – colour maps – Contouring – Height Plots - Vector visualization techniques – Vector properties – Vector Glyphs – Vector Color Coding

Module:2	Visual Analytics	5 hours

Visual Variables- Networks and Trees –Tables - Map Color and Other Channels- Manipulate View

Module:3	Visualization Tools	6 hours

Fundamentals of R- Visualization using R library -Introduction to various data visualization tools- tableau

Module:4	Geo spatial visualization	6 hours

Geo spatial data and visualization techniques : Chloropleth map, Hexagonal Binning, Dot map, Cluster map, cartogram map

Module:5	Diverse Types Of Visual Analysis	6 hours

Time- Series data visualization – Text data visualization – Matrix visualization techniques - Heat Map- Multivariate data visualization and case studies

Module:6	Visualization of Streaming Data	7 hours

Introduction to Data Streaming, processing and presenting of streaming data, streaming visualization techniques, streaming analysis.		
Module:7	**Visualization Dashboard Creations**	**7 hours**
Dashboard creation using visualization tools for the use cases: Finance-marketing-insurance-healthcare etc.,		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours	**45 hours**

Text Books

1. Tamara Munzer, Visualization Analysis and Design, CRC Press 2014.
2. Aragues, Anthony. Visualizing Streaming Data: Interactive Analysis Beyond Static Limits. O"Reilly Media, Inc., 2018

Reference Books

1. Chun-hauh Chen, W.K.Hardle, A.Unwin, Hand book of Data Visualization, Springer publication, 2016.
2. Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020
3. Alexandru C. Telea, Data Visualization: Principles and Practice, AK Peters, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Seminar

List of Experiments:

1.	Acquiring and plotting data.	2 hours
2.	Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance	4 hours
3.	Financial analysis using Clustering, Histogram and HeatMap	4 hours
4.	Time-series analysis – stock market	4 hours
5.	Visualization of various massive dataset - Finance – Healthcare - Census - Geospatial	4 hours
6.	Visualization on Streaming dataset (Stock market dataset, weather forecasting)	4 hours
7.	Market-Basket Data analysis-visualization	4 hours
8.	Text visualization using web analytics	4 hours
Total Lecture hours		**30 hours**

Mode of evaluation: Project/Activity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI1005	User Interface Design	2	0	2	0	3
Pre-requisite		Syllabus version v.1.1				

Course Objectives:

1. To understand the basics of User Interface Design.
2. To design the user interface, menu creation and windows creation
3. To understand the concept of menus, windows, interfaces, business functions, various problems in windows design with colour, text, Non-anthropomorphic Design.
4. To study the design process and evaluations

Expected Course Outcome:

1. Knowledge on development methodologies, evaluation techniques and user interface building tools
2. Explore a representative range of design guidelines and gain experience in applying design guidelines to user interface design tasks.
3. Ability to design their own Human Computer
4. be able to perform task analysis for user interface design and usability analysis including heuristic analysis
5. understand the innovative features of interactive system and be able to improve existing interfaces by considering these features

Module:1	INTERACTIVE SOFTWARE AND INTERACTION DEVICE	4 hours

Human – Computer Interface – Characteristics Of Graphics Interface – Direct Manipulation Graphical System – Web User Interface – Popularity – Characteristic & Principles.

Module:2	HUMAN COMPUTER INTERACTION	4 hours

User Interface Design Process – Obstacles – Usability – Human Characteristics In Design – Human Interaction Speed – Business Functions – Requirement Analysis – Direct – Indirect Methods — Conceptual Model Design.

Module:3	USER INTERFACE DESIGN PRINCIPLES AND MODELS	4hours

Shneideman's eight golden rules, Norman's Sever principles, Norman's model of interaction, Nielsen's ten heuristics, Heuristic evaluation, contextual evaluation, Cognitive walk-through Keyboard Level Model-Application of the Keyboard Level Model, GOMS.

Module:4	HUMAN FACTORS IN UI DESIGN	4hours

Characteristics – Components – Presentation Styles – Types – Managements – Organizations – Operations – Web Systems – System Timings – Device – Based Controls Characteristics – Screen – Based Controls — Human Consideration In Screen Design – Structures Of Menus Operate Control – Text Boxes – Selection Control – Combination Control – Custom Control – Presentation Control.

Module:5	UI DESIGN PROCESS AND EVALUATION	4 hours

User Interface Design Process - Usability Testing - Usability Requirements and Specification procedures and techniques - User Interface Design Evaluation.

Module:6	MULTIMEDIA & MOBILE USER EXPERIENCE DESIGN	4 hours

Text For Web Pages – Effective Feedback – Guidance & Assistance – Internationalization – Accessibility – Icons – Image – Multimedia – Coloring.

Mobile Ecosystem: Platforms, Application frameworks- User Experience Design for Mobile – Elements of Mobile User Interface and Experience – UI Style guidelines for Mobile – UI Mobile Components and Patterns		
Module:7	**USER AND TASK MODELS**	**4 hours**
Cognitive Models - Groupware - Ubiquitous Computing - Virtual and Augmented Reality – Multi-model Interface Characteristics — Multi-model interface Types (Voice & Gesture Recognition) -– Communication and Collaboration models		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours		**30 hours**

Text Books

1. Alan Cooper, "The Essential of User Interface Design", John Wiley & Sons, 2007.
2. Sharp, Rogers, Preece, „Interaction Design", Wiley India Edition, 2007
3. B. Shneiderman, Designining the User Interface: Strategies for Effective Human-Computer Interaction, 3rd Ed., Addison Wesley, 2000.

Reference Books

1. Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.
2. Nava Shaked and Ute Winter, "Design of Multimodal Mobile Interfaces" De Gruyter Publisher,ISBN: 978-1-5015-1084-7, 2016
3. Pablo Perea Pau Giner, "UX Design for Mobile" Packt Publishing, UK, 2017

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

List of Challenging Experiments (Indicative)	Hours
1. Interaction Design, Task Analysis - Design prototypes at varying levels of fidelity, from paper prototypes to functional, interactive prototypes	6 hours
2. Handling errors & help & UI Software	6 hours
3. Usability Evaluation - Use different data analysis tool to analyze gathered data	4 hours
4. Usability Measurement Tool for E-Learning	4 hours
5. Prototyping of Control Panel of Domestic Appliances	6 hours
6. Tool Analysis - Voice & Guesture Recognition	4 hours
Total Hours	30 hours

Mode of assessment: Project/Activity

Recommended by Board of Studies		13-06-2019	
Approved by Academic Council	No.61	Date	18-02-2021

Course Code	Course Title	L	T	P	J	C
CSI3007	ADVANCED PYTHON PROGRAMMING	2	0	4	0	4
Pre-requisite	CSE1001	Syllabus version v.1.0				

Course Objectives:

1. To be able to apply advanced python programming concepts for industry standard problems.
2. To perform advanced Data Preprocessing tasks like Data Merging and Mugging
3. To be able to develop powerful Web-Apps using Python

Expected Course Outcome:

1. Understand the nuances of Data Structures
2. Derive an understanding of a classes and objects and their potential
3. Gain knowledge of multithreading concepts and implementing the same
4. Appreciate the difference between different data processing techniques
5. Learn to apply Python features for Data Science
6. Get an insight into Metrics Analysis
7. Develop web-apps and build models for IoT

Module:1	DATA STRUCTURES	4 Hours

Problem solving using Python Data Structures : LIST, DICT, TUPLES and SET- Functions and Exceptions – Lamda Functions and Parallel processing – MAPS – Filtering - Itertools – Generators

Module:2	CLASSES AND OBJECTS	4 Hours

Classes as User Defined Data Type ,Objects as Instances of Classes, Creating Class and Objects, Creating Objects By Passing Values, Variables & Methods in a Class Data Abstraction, Data Hiding, Encapsulation, Modularity, Inheritance, Polymorphism

Module:3	MULTITHREADING IN PYTHON	4 Hours

Python Multithreading and Multiprocessing Multithreading and multiprocessing Basics – Threading module and example – Python multithreading - Multithreaded Priority Queue

Module:4	DATA PROCESSING	5 Hours

Handling CSV, Excel and JSON data - Creating NumPy arrays, Indexing and slicing in NumPy, Downloading and parsing data, Creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing, Creating array views copies, Manipulating array shapes I/O – MATPLOT LIB

Module:5	DATA SCIENCE PERSPECTIVES	4 Hours

Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge DataFrames, Generate summary tables, Group data into logical pieces, Manipulate dates, Creating metrics for analysis

Module:6	DATA HANDLING TECHNIQUES	3 Hours

Data wrangling ,Merging and joining,- Loan Prediction Problem, Data Mugging using Pandas		
Module:7	**WEB APPLICATIONS**	**4 Hours**
Web Applications With Python – Django / Flask / Web2Py – Database Programming – NoSQL databases - Embedded Application using IOT Devices - Building a Predictive Model for IOT and Web programming		
Module: 8	**RECENT TRENDS**	**2 Hours**
	Total Hours	**30 Hours**

Text Book(s)

1	Doug Farrell, The Well Grounded Python Developer; Manning Publications, 2021
2	Paul Barry, Head-First Python, O-Reilly Media, 2016

Reference Book(s)

1	Zed A Shaw, Learn Python the Hard Way - A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Addison Wesley Press, 2013
2	Eric Mathews, Python Crash Course, Second Edition, No Starch Press, 2019
	Michael Kennedy, Talk Python: Building Data-Driven Web Apps with Flask and SQLAlchemy, Manning Publications, 2020

List of Experiments

1. Working with very large integers/different Data Formats	1 Hour
2. Rewriting an immutable string/String Manipulation	1 Hour
3. Using the Unicode characters that aren‟t in the keyboard	1 Hour
4. Encoding strings- ASCII and UTF 8	1 Hour
5. Writing list related type hints	2 Hours
6. Building sets with literals, adding, comprehensions and operators	2 Hours
7. Extending a built-in collection – a list that does statistics	2 Hours
8. Using properties for lazy attributes	2 Hours
9. Creating a breadboard prototype Circuit for IoT Program	3 Hours
10. Creating complex structures – maps of lists	3 Hours
11. Using Flask framework for RESTful APIs	3 Hours
12. Implementing authentication for Web Services	3 Hours
13. Application Integration	3 Hours

14. Combining many applications using Command Design Pattern			3 Hours
		Total Hours	**30 Hours**
Mode of Evaluation: Project/Activity			
Recommended by Board of Studies		11-02-2021	
Approved by Academic Council	No.61	Date	18-02-2021

Course Code	ADVANCED WIRELESS NETWORKS	L	T	P	J	C
CSI3009		3	0	2	0	4
Pre-requisite		Syllabus version v.1.0				

Course Objectives:

1.To study about advanced wireless network, LTE, 4G and Evolutions from LTE to LTEA.
2.To study about wireless IP architecture, Packet Data Protocol and LTE network architecture.
3.To study about wireless protocols, Mobility Management and Wireless Security.

Expected Course Outcome:

1. Learn the latest 4G networks and LTE
2. Understand about the wireless standards and design.
3. Understand about the wireless network architecture and its concepts.
4. Learn wireless Technologies and protocols
5. Understand about the mobility management and cellular network.
6. Learn the security concepts of wireless networks and also the recent trends.

Module:1	Introduction	7 hours

Introduction to 1G/2G/3G/4G Terminology. Evolution of Public Mobile Services -Motivation for IP Based Wireless Networks -Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE- 4G Advanced Features and Roadmap Evolutions from LTE to LTEA

Module:2	Standards and Design	5 hours

Wireless systems and standards. Wireless LANs: Wireless LAN technology. Wireless standard (IEEE 802.11 etc.) and Other IEEE 802.11 Standards

Module:3	Wireless Architectures	7 hours

3GPP Packet Data Networks - Network Architecture - Packet Data Protocol (PDP) Context - Configuring PDP Addresses on Mobile Stations - Accessing IP Networks through PS Domain – LTE network Architecture - Roaming Architecture- Protocol Architecture

Module:4	Wireless technologies	7 hours

Cellular wireless networks and systems principles. Antennas and radio propagation. Signal encoding and modulation techniques., advanced modulation and coding, medium access

techniques, cognitive radio and dynamic spectrum access networks, Static and dynamic channel allocation techniques		
Module:5	**Wireless Protocols**	**6 hours**
MAC Protocols, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Challenges and Issues in Transport layer protocol. Routing protocols- data centric routing protocols, hierarchical routing protocols, location based routing, energy efficient routing.		
Module:6	**Mobility Management**	**5 hours**
Cellular Networks-Cellular Systems with Prioritized Handoff-Cell Residing Time Distribution Mobility Prediction in Pico- and Micro-Cellular Networks		
Module:7	**Wireless Network Security**	**6 hours**
Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Ayman ElNashar, Mohamed El-saidny, Mahmoud Sherif, "Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014.
2.	W. Stallings, "Wireless Communications and Networks", 2nd edition, Pearson Education, 2013.

Reference Books

1.	Dharma Prakash Agrawal and Qing-An Zeng, "Introduction to Wireless and Mobile Systems", 3rd edition ,Tomson, , 2011.
2.	Theodore S. Rappaport, "Wireless Communications -Principles Practice",2nd edition, Prentice Hall of India, New Delhi, 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Experiments (Indicative)				
1.	Connecting WIFI TO BUS(CSMA) Architecture			4 hours
2.	Creating WIFI SIMPLE INFRASTUCTURE MODE			4 hours
3.	Creating WIFI SIMPLE ADHOC MODE			4 hours
4.	Connecting WIFI TO WIRED BRIDGING			4 hours
5.	Creating WIFI TO LTE(4G) CONNECTION			6 hours
6	Creating A SIMPLE WIFI ADHOC GRID			4 hours
7	Learning GSM architecture.			4 hours
			Total Laboratory Hours	30 hours
Mode of evaluation:				
Recommended by Board of Studies	11-02-2021			
Approved by Academic Council	No. 61	Date	18-02-2021	

Course Code	DATA WAREHOUSING AND DATA MINING	L	T	P	J	C
CSI3010		3	0	2	0	4
Pre-requisite	**Nil**	**Syllabus Revision v.1.0**				

Course Objectives:

1. To introduce the concept of Data Warehousing and Data Mining
2. To develop the knowledge for application of the mining algorithms for association, clustering
3. To explain the algorithms for mining data streams and the features of recommendation systems.

Expected Course Outcomes:

1. Interpret the contribution of data warehousing and data mining to the decision-support systems
2. Apply the link analysis and frequent item-set algorithms to identify the entities on the real world data
3. Apply the various classifications techniques to find the similarity between data items
4. Analyse the various data mining tasks and the principle algorithms for addressing the tasks
5. Evaluate and report the results of the recommended systems
6. Design the model to sample, filter and mine the Streaming data
7. Analyse the various data mining tasks for multimedia and complex data.

Module 1	**DATA WAREHOUSE**	4 Hours

Introduction: Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

Module 2	**DATA PREPROCESSING**	4 Hours

Data, Types of Data, Attributes and Measurement, Types of Data Sets, Data Quality, Measurement and Data Collection Issues, Issues Related to Applications, Data pre-processing, Aggregation, Sampling, Dimensionality Reduction, Feature Subset Selection, Feature Creation, Discretization and Binarization, Variable Transformation, Similarity and Dissimilarity between Simple Attributes, Dissimilarities between Data Objects, Similarities between Data Objects.

Module 3	**ASSOCIATION ANALYSIS: CONCEPTS AND ALGORITHMS**	7 Hours

Frequent Itemset Generation, The Apriori Principle, Apriori Algorithm- Rule Generation- Candidate Generation and Pruning, Support Counting, Computational Complexity, Confidence-Based Pruning, Compact Representation of Frequent Itemsets, Maximal and Closed Frequent Itemsets, Alternative Methods for Generating Frequent Itemsets, FP-Growth Algorithm, FP-Tree Representation, Evaluation of Association Patterns, Handling Categorical Attributes, Handling Continuous Attributes, Discretization-Based Methods, Statistics-Based Methods, Non-discretization Methods, Sequential Pattern Discovery.

Module 4	**CLASSIFICATION AND PREDICTION**	7 Hours

Classification - issues regarding classification and prediction -Decision Tree Induction-Bayesian

classification – Support Vector Machines, Rule-Based Classification- Associative Classification Prediction, Rationale for Ensemble Method, Methods for Constructing an Ensemble Classifier, Bias-Variance Decomposition, Bagging, Boosting, Random Forests, Empirical Comparison among Ensemble Methods

Module 5	**CLUSTER ANALYSIS AND OUTLIER ANALYSIS**	7 Hours

Types of Data in cluster analysis, - Major clustering methods- The k-Means Method, Agglomerative Hierarchical Clustering, Cluster Evaluation, Outlier Analysis- Distance-Based Outlier Detection- Density-Based Local Outlier Detection

Module 6	**MINING OF STREAM DATA**	7 Hours

Mining Streams, Time Series and Sequence Data: Mining Data Streams, Mining Time-Series Data, Mining Sequence Patterns in Transactional Databases, Mining Sequence Patterns in Biological Data, Graph Mining, Social Network Analysis and Multirelational Data Mining

Module 7	**MULTIMEDIA AND COMPLEX DATA MINING**	7 Hours

Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web.

Module 8	**RECENT TRENDS**	**2 Hours**
	Total Hours:	**45 Hours**

TEXT BOOKS:

1. Bhatia, Parteek, "Data mining and data warehousing: principles and practical techniques". Cambridge University Press, Ist Edition, 2019.
2. Karaa, Wahiba Ben Abdessalem, and Nilanjan Dey. *Mining multimedia documents*. CRC Press, 2017.

REFERENCE BOOKS:

1. Igual, Laura, and Santi Seguí. "Introduction to Data Science." In Introduction to Data Science, Springer, Cham, 2017.
2. Gupta, Gopal K. Introduction to data mining with case studies. PHI Learning Pvt. Ltd., 2014.
3. M. Kantardzic, "Data Mining: Concepts, Models, Methods, and Algorithms", 2nd edition, Wiley-IEEE Press, 2011.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments

1.	Build Data Warehouse and Explore WEKA	3 hours
2.	Introduction to exploratory data analysis using R	3 hours
3.	Demonstrate the Descriptive Statistics for a sample data like mean, median, variance and correlation etc.,	3 hours
4.	Demonstrate Missing value analysis and different plots using sample data.	3 hours
5.	Demonstration of apriori algorithm on various data sets with varying confidence (%) and support (%).	3 hours

6.	Demo on Classification Techniques using sample data Decision Tree, ID3 or CART.	3 hours
7.	Demonstration of Clustering Techniques K-Mean and Hierarchical.	3 hours
8.	Demo on Classification Technique using KNN.	3 hours
9.	Demonstration on Document Similarity Techniques and measurements.	3 hours
10.	Demo on Classification Technique for multimedia data	3 hours

Mode of evaluation: Project/Activity			
Recommended by Board of Studies		Date: 11-02-2021	
Approved by Academic Council	No.61	Date:	18-02-2021

Course code	INTERNET OF EVERYTHING	L	T	P	J	C
CSI3008		3	0	2	0	4
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. Understand the definition and significance of the Internet of Things.
2. Discuss the architecture, operation, communication protocols, and business benefits of an IoT solution.
3. Hands on experience with microcontroller IDE with Wi-Fi module to connect with a variety of sensors to collect the data.

Expected Course Outcome:

1. Identify the IoT networking components with respect to OSI layer.
2. Design and develop IoT based applications.
3. Select the suitable communication protocol and software for the application.
4. Develop an application using microcontroller IDE with Wi-Fi module in order to communicate with various cloud services.
5. Analyze the data collected from sensors using machine learning approaches with the support of python programming.

Module:1	Introduction to Internet of Things	5 Hours

Introduction to IoT - Sensing, Actuation, Networking basics, Communication protocols, Sensor networks, M2M Communications, IoT characteristics. IoT Architecture - IoT functional blocks, Physical design of IoT, Logical design of IoT and Communication models.

Module:2	An IoT Architectural Overview	6 Hours

An Architectural Overview - An IoT architecture outline, Main design principles and needed capabilities, standards considerations. IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
M2M and IoT technology fundamentals - Devices and gateways, Local and wide area networking, Data management, Business process in IoT, Everything as a service (XaaS), M2M and IoT analytics, knowledge management.

Module:3	IoT Protocols and Point-to-Point Communication	7 hours

IoT protocols and softwares - MQTT, UDP, MQTT brokers, Publish-subscribe modes, HTTP, CoAP, XMPP, and Gateway protocols. IoT point-to-point communication technologies - Communication pattern, and IoT protocol architecture. Selection of wireless technologies -

LoWPAN, Zigbee, WiFi, BLE, SIG, NFC, LoRa, LiFi, and WiDi.		
Module:4	**Programming with Microcontrollers**	**6 hours**
Architecture of Microcontroller IDE, Setup the Microcontroller IDE, Developing a Microcontroller program, libraries, Basics of embedded C programming for Microcontroller, Interfacing with sensors & actuators - LED, push button, ultrasonic, and buzzer, Arduino interfacing with LCD, Working with digital and analog sensors - Temperature, Gas, Humidity, Motion, and Light sensors.		
Module:5	**Advanced Programming with Microcontrollers**	**7 hours**
Microcontroller interfacing with Relay Switch and Servo Motor, Basic networking with ESP8266 WiFi module, Microcontroller interfacing with Wi-Fi module, TinkerCAD simulation, Thing speak cloud synchronization with Wi-Fi module, Posting data to Thinkspeak cloud, Receiving data from Thing speak, Various other cloud services available in the market.		
Module:6	**Developing IoT Solutions**	**8 hours**
Comparison of various Rpi Models, Understand SoC architecture, Raspberry Pi Pin description, Raspberry Pi on-board components, Rpi operating system and Linux commands, First boot and basic configuration, Introduction to python - keywords, operators, data structures, flow control, and python libraries, Sensor interfacing - Temperature and humidity sensor (DHT11), and Ultrasonic sensor.		
Module:7	**Case Studies**	**4 hours**
Smart city, Smart health monitoring system, Smart irrigation system for farmers, Smart security for home, and Smart electrical appliances at Home.		
Module:8	**Recent Trends**	**2 hours**
	Total hours:	**45 hours**

Text Book(s)

1.	Cirani, S., Ferrari, G., Picone, M., & Veltri, L.. Internet of things: architectures, protocols and standards. John Wiley & Sons, 2018.
2.	Serpanos, D., & Wolf, M.. Internet-of-things (IoT) systems: architectures, algorithms,

	methodologies. Springer, 2017.
Reference Books	
1.	Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., & Henry, J.. IoT fundamentals: Networking technologies, protocols, and use cases for the internet of things. Cisco Press. (2017)
2.	Blum, Jeremy. Exploring Arduino: tools and techniques for engineering wizardry. John Wiley & Sons, 2019.
3.	Dennis, Andrew K. Raspberry Pi home automation with Arduino. Packt Publishing Ltd, 2013.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Experiments		
1.	The process of setting up a platform for Microcontroller programming.	3 hours
2.	Write a program in to display binary pattern on three LEDs	2 hours
3.	Design an experiment to identify the room temperature and humidity and turn on/off the LED based on the threshold considered.	2 hours
4.	Write a program to interface with Bluetooth sensor that switches ON/OFF the LED based on the input 0/1.	3 hours
5.	Write a program to interface with temperature and humidity sensors and store the information in Thingspeak cloud.	3 hours
6.	Write a program to rotate the servo motor in clockwise or anti-clockwise direction based on the value received from Thinkspeak cloud. If input is 0, then clockwise. Else, anti-clockwise.	3 hours
7.	Write a program to display the level of garbage bin in the smartphone, and Thingspeak based on the information received from the bin using an ultrasonic sensor.	3 hours
8.	Write a program to collect the temperature or humidity information.	2 hours
9.	Write a program to turn on/off the LED based on the pushbutton input.	2 hours
10.	Write a program to collect the information from temperature sensor and send it to MQTT broker.	3hours
11.	Implement a Theft detection application.	4 hours
	Total Laboratory Hours	30 hours
Mode of evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	SOFT COMPUTING TECHNIQUES	L	T	P	J	C
CSI3006		**3**	**0**	**0**	**4**	**4**
Pre-requisite	**Nil**			**Syllabus version v.1.0**		

Course Objectives:

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for real-world problems.
2. To provide adequate knowledge of non-traditional technologies and fundamentals of artificial neural networks, backpropagation networks, fuzzy sets, fuzzy logic, genetic algorithms in solving social and engineering problems.
3. To provide comprehensive knowledge of swarm intelligence and rough set concepts

Expected Course Outcome:

The student will be able to

1. Apply neural networks, advanced AI techniques of swarm intelligence and rough set concepts for solving different engineering problems
2. Identify and describe soft computing techniques and build supervised learning and unsupervised learning networks.
3. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
4. Apply genetic algorithms to combinatorial optimization problems.
5. Evaluate and compare solutions by various soft computing approaches for a given problem.
6. Effectively use existing software tools to solve real problems using a soft computing approach

Module:1	**Introduction to Soft Computing**	**7 hours**

Overview of Soft Computing, Soft Vs Hard computing, Components of soft computing, Introduction to neural networks, Fuzzy logic, Genetic algorithms. Artificial neural networks Vs Biological neural networks, Neural network architectures, Characteristics of neural network, Early neural network architectures (MADALINE network), and Application domains.

Module:2	**Back Propagation networks**	**5 hours**

Architecture of a back propagation network, Backprogragation learning, Effect of tuning parameters,

Selection of parameters in back propagation network, Application domains.

Module:3	**Unsupervised learning networks**	**6 hours**
Neural Nets based on competition, Max net, Mexican Hat, Hamming net, Kohonen Self organizing Feature Map, Counter propagation, Learning Vector Quantization , Adaptive Resonance Theory		
Module:4	**Fuzzy Sets and Fuzzy Relations**	**6 hours**
Introduction, Classical sets and fuzzy sets, Crisp Sets, Classical relations and fuzzy relations, membership functions , Fuzzy set operations, Properties of Fuzzy sets, Fuzzy to crisp conversion		
Module 5	**Advanced AI Techniques and Rough set concepts**	**7 hours**
Swarm Intelligence (SI), Particle swarm optimization (PSO), Ant Colony Optimization, Petrinets, Coloured Petrinets, Entropy, Rough sets, Rough set theory, Set approximation, Rough membership, Attributes, Dependency of attributes, Rough equivalence, Reducts, Rough Reducts based on SVM		
Module:6	**Fuzzy Logic and Inference**	**6 hours**
Fuzzy Logic, Predicate Logic, Fuzzy Quantifiers, Fuzzy Inference , Fuzzy knowledge and rule based system, Fuzzy decision making, Defuzzification, Applications of fuzzy logic, Neuro Fuzzy modelling		
Module:7	**Genetic Algorithms**	**6 hours**
Basic concepts, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	S.N. Sivanandam& S.N. Deepa, “Principles of Soft Computing”, 3rd ed, Wiley Publications, 2018.
2.	Jang, Jyh-Shing Roger, Chuen-Tsai Sun, and EijiMizutani. "Neuro-fuzzy and soft computing-

	a computational approach to learning and machine intelligence" Pearson, 1997.

Reference Books

1.	D. K. Pratihar, Soft Computing : Fundamentals and Applications (2nd Ed.) (Narosa, 2013)
2.	Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd ed, John Wiley and Sons, 2011.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Project

60 [Non-Contact hours]

Generally a team project [3 to 5 members]
Concepts studied in Soft computing techniques course should have been used
Down to earth application and innovative idea should have been attempted
Report in Digital format with all drawings using software package to be submitted.
Assessment on a continuous basis with a minimum of 3 reviews.

Projects may be given as group projects. The following is the sample projects that can be given to students to be implemented in any programming languages.

- Develop Fuzzy Decision-Making for Job Assignment Problem
- Implement TSP using Optimization Techniques
- Develop a suitable method for Health Care Application using Neuro-Fuzzy systems
- Develop a suitable method for Face Recognition System
- Layout Optimization using Genetic Algorithms
- Fault Diagnosis using rough set theory
- Software safety analysis using rough sets
- A Neuro-fuzzy Approach to Bad Debt Recovery in Healthcare

Mode of assessment: Review 1, Review 2 , Review 3

Recommended by Board of Studies	11.02.2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course code	Course title	L	T	P	J	C
CSI3014	**Software verification and validation**	3	0	0	0	3
Pre-requisite	Nil	**Syllabus version v.1.0**				

Course Objectives:

1. To introduce the essential software engineering concepts involved
2. To impart skills in the design and implementation of efficient software systems across disciplines
3. To familiarize engineering practices and standards used in developing software products and components

Expected Course Outcome:

1. Apply the principles of the engineering processes in software development.
2. Demonstrate software project management activities such as planning, scheduling and Estimation.
3. Model the requirements for the software projects.
4. Design and Test the requirements of the software projects.
5. Implement the software development processes activities from requirements to validation and verification.
6. Apply and evaluate the standards in process and in product.

Module:1	Overview of Software Engineering	5 hours

Introduction to Software Engineering - Software Development Life Cycle-Process Models in Software Testing

Module:2	Testing Tools & Measurement	4 hours

Introduction to Requirements Engineering Process - System Modeling - Requirement Validation- Introduction to Software Testing- Failure, Error, Fault, Defect, Bug Terminology- Skills for Software Tester- Limitations of Manual Testing and Need for Automated Testing Tools-Features of Test Tool: Guideline for Static and Dynamic Testing Tool- Advantages and Disadvantages of Using Tools- Selecting a Testing Tool- When to Use Automated Test Tools, Testing Using Automated Tools-What are Metrics and Measurement: Types of Metrics, Project Metrics, Progress and Productivity Metrics.

Module:3	Software Design & Defect Management	6 hours

Design Concepts- Formal Specifications- Verifying the implementation against the specification-

Introduction, Defect Classification-Defect Management Process-Defect Life Cycle, Defect Template- Estimate Expected Impact of a Defect, Techniques for Finding Defects, Reporting a Defect-Test Coverage-Traceability Matrix.		
Module:4	**Software Verification & Validation**	**6 hours**
Introduction to Verification and Validation-Software Inspection-Automatic Static Analysis		
Module:5	**Software Testing & Levels of Testing**	**6 hours**
Testing-Types of Testing - Test Plan- Test Design- Test Review- Software Testing Fundamentals. General characteristics of testing, seven principles of testing.		
Module:6	**Test Selection & Minimization for Regression Testing**	**8 hours**
Regression testing- Regression test process-Initial Smoke or Sanity test- Selection of regression tests- Execution Trace- Dynamic Slicing- Test Minimization- Tools for regression testing- Ad hoc Testing: Pair testing- Exploratory testing- Iterative testing- Defect seeding.		
Module:7	**Software Quality & Reliability**	**8 hours**
Software Quality and Reliability-Software defects tracking- Test Planning, Management, Execution and Reporting- Software Test Automation: Scope of automation- Design & Architecture for automation- Generic requirements for test tool framework- Test tool selection, Testing in Object Oriented Systems-Software Metrics.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Roger Pressman, Software Engineering: A Practitioner‟s Approach, 8th Edition, McGraw-Hill, 2019.

Reference Books

1.	Ian Sommerville, Software Engineering, 9th Edition, Addision-Wesley, 2016

2	William E. Lewis , Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2017
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	
Recommended by Board of Studies:11-02-2021	
Approved by Academic Council No.61 Date: 18-02-2021	

Course code	Course title	L	T	P	J	C
CSI3012	**Distributed systems**	3	0	2	0	4
Pre-requisite	Nil	**Syllabus version v.1.0**				

Course Objectives:

1. To provide students with contemporary knowledge in distributed systems
2. To equip students with skills to analyze and design distributed applications.
3. To provide master skills to measure the performance of distributed synchronization algorithms

Expected Course Outcome:

1. Elucidate the foundations and issues of distributed systems
2. Understand the various synchronization issues and global state for distributed systems.
3. Implement the Mutual Exclusion and Deadlock detection algorithms in distributed systems
4. Explore the agreement protocols and fault tolerance mechanisms in distributed systems.
5. Describe the features of peer-to-peer and distributed shared memory systems
6. Demonstrate the concepts of Resource and Process management and synchronization algorithm

Module:1	Introduction	6 hours

Introduction to Distributed Systems - Examples –Trends in Distributed Systems – Focus on resource sharing – System Models – Networking and Internetworking – Inter process Communications.

Module:2	Distributed objects and Remote invocation	6 hours

Publish-subscribe system – message queues – shared memory approach. Remote procedure call – distributed objects-communication between distributed objects – RMI – JSON-RMI

Module:3	Message Ordering and Snapshots	7 hours

Message ordering and group communication: Message ordering paradigms -Asynchronous execution with synchronous communication -Synchronous program order on an asynchronous

system -Group communication – Causal order (CO) – Total order. Global state and snapshot recording algorithms: Introduction -System model and definitions -Snapshot algorithms for FIFO channels		
Module:4	**Distributed Mutex and Deadlock**	**6 hours**
Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamports algorithm - Ricart-Agrawala algorithm Deadlock detection in distributed systems: Introduction – System model – Preliminaries -Models of deadlocks – Knapps classification – Algorithms for the single resource model		
Module:5	**Concurrency control**	**6 hours**
Distributed deadlock – Resource allocation model - requirements and performance metrics - classification of distributed deadlock detection algorithm		
Module:6	**Peer To Peer and Distributed Shared Memory**	**6 hours**
Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. Distributed shared memory: Abstraction and advantages – Memory consistency models -Shared memory Mutual Exclusion.		
Module:7	**Process and Resource Management**	**6 hours**
Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction- Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Third Edition,Pearson Education, 2017.

2	George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, Fifth Edition, Pearson Education, 2012.

Reference Books

1.	Randy Chow an d Theodore Johnson , “Distributed Operating Systems and Algorithms”, Addison - Wesley, - Fourth Impression - 2012
2	Mukesh Singhal and N. G. Shivaratri, Advanced Concepts in Operating Systems, Distributed, Database, and Multiprocessor Operating Systems, McGraw Hill, 2008.
3	Pradeep K. Sinha, "Distributed Operating Systems: Concepts & Design", PHI, 2008

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Implementation of Chat application using socket programming Implementation of Remote Method Invocation	4 hours
2.	Implementation of Client-Server architecture using Socket Programming Implement Concurrent Echo Client Server Application	5 hours
3.	Write the Programs for Remote Procedure call. Implementation of Mutual Exclusion algorithms	5 hours
4.	Illustrate the message passing Interface for remote computation in distributed applications.	5hours
5.	Idealize the working concepts behind distributed mutual exclusion algorithms through simulations.	6 hours
6	Illustrate the message passing Interface for remote computation in distributed applications.	5 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation:

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course title	L	T	P	J	C
CSI3011	Computer graphics and multimedia	3	0	2	0	4
Pre-requisite	Nill	Syllabus version v.1.0				

Course Objectives:

1. To understand the fundamental concepts of graphics and multimedia.
2. To acquire and implement the learning relate to 2D and 3D concepts in graphics programming.
3. To comprehend the elementary 3D modeling and rendering techniques.
4. To analyze the fundamentals of multimedia towards its representations, perceptions, communication and applications.

Expected Course Outcome:

1. Interpret the basic components of the graphics system and the color models.
2. Design and demonstrate the basic graphical output primitives.
3. Perform two and three dimensional transformations and viewing
4. Describe and apply methods to model and render 3D objects.
5. Identify and describe the function of the general skill sets in the multimedia systems..
6. Expand the knowledge about the multimedia and its communication standards.

Module:1	Graphical Concepts and Display Systems	6 hours

Graphics Systems: Video Display Devices – Types – Raster-Scan Systems and Random-Scan Systems – Input Devices – Hard-Copy Devices – Graphics Software; color models.

Module:2	Output Primitives	6 hours

Output Primitives: Points and lines − Line Drawing Algorithm: DDA and Bresenham‟s Algorithm − Midpoint Circle Generating Algorithm − Line Attributes − Color and Grayscale Levels.

Module:3	2-D Geometrical Transformations and Viewing	7 hours

Basic Transformations – Matrix Representations and Homogeneous Coordinates – Composite Transformations; Viewing: pipeline – Window-to- Viewport Coordinate Transformation; Clipping: point, line and polygon clipping algorithms

Module:4	3-D Geometrical Transformations and Viewing	6 hours

Three dimensional concepts; 3-D transformations: Basic, Other and Composite Transformations; Viewing: Parallel and Perspective Projections

Module:5	**Modeling and Rendering Techniques**	**6 hours**
Visible surface determination - Z-Buffer method, Scan line method, Depth sorting Method, raytracing, Shading Model - Gouraud and Phong Shading.		
Module:6	**Multimedia System Design**	**6 hours**
Multimedia basics − Components of Multimedia − Multimedia applications – Multimedia Authoring − Hypermedia.		
Module:7	**Multimedia and Communication Standards**	**6 hours**
Digitization of Sound − Quantization of Audio − Transmission of Audio − Multimedia communication standards − JPEG, MPEG**.**		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Hearn, Donald, M. Pauline Baker, and Warren R. Carithers. Computer graphics with OpenGL. Upper Saddle River, NJ: Pearson Prentice Hall, 2014. [Module 1 - Module 5]
2.	Steinmetz, Ralf, and Klara Nahrstedt. Multimedia systems. Springer Science & Business Media, 2013.

Reference Books

1	F.S.Hill,Computer Graphics using OPENGL, Second edition, Pearson Education, 2009
2	John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley, Computer Graphics: Principles and Practice, 3rd Edition, AddisonWesley Professional, 2013.
3	Kamisetty Rao, Zoran Bojkovic, Dragorad Milovanovic, Introduction to Multimedia Communications: Applications, Middleware, Networking, Wiley, ISBN: 978-0-471-46742-7
4	Pakhira, Malay K. Computer graphics, multimedia and animation. PHI Learning Pvt. Ltd., 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments		
1.	Learning of Graphics Programming Environment and usage of Graphics APIs.	2 hours
2.	Implementation of Line Drawing algorithms	4 hours
3.	Implementation of Circle Drawing algorithm	2 hours
4.	Implementation of Line clipping algorithms against the given rectangular window.	4 hours
5.	Implement the 2-D transformations functions on 2-D graphic objects.	4 hours
6	Implement the function for the following 3-D transformation of a 3-D object	2 hours
7	Modelling and visualization of real-world /artificial scene using 2D graphics primitives	4 hours
8	Create a 2D animation using 2D modelling software.	8 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: CAT / Assignment / Quiz / FAT / Project			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI3013	BLOCKCHAIN TECHNOLOGIES	3	0	0	4	4

Pre-requisite	Nil	Syllabus version v.1.0

Course Objectives:

1. To provide a conceptual understanding on the function of Blockchain.
2. To discuss the functional elements of the bitcoin and its mining process.
3. To introduce the Ethereum and solidity platform
4. To understand how blockchain is applied to different aspects of the business.
5. To describe current Hyperledger projects and cross-industry use cases

Expected Course Outcome:

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

1. Understand the basics of cryptographic hash functions and blockchain
2. Demonstrate the functional blocks of the bitcoin and cryptocurrencies
3. Describe the consensus algorithms and its challenges
4. Design the distributed application using Ethereum platform
5. Construct the solution by design and development of the smart contract using solidity
6. Identify and select suitable blockchain based applications
7. Analyze the challenges and issues in blockchain applications

Module:1	BLOCKCHAIN FOUNDATIONS	7 hours

Blockchain & Distributed Ledger Technology (DLT) - Elements of Distributed Computing: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table - Elements of Cryptography: Hash function, Properties of a hash function, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof, Hash pointer and Merkle tree.

Module:2	BITCOIN AND CRYPTOCURRENCY	7 hours

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin - Wallet - Blocks - Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

Module:3	DISTRIBUTED CONSENSUS	7 hours

Consensus introduction -Consensus in a Bitcoin network - Distributed Consensus, Merkle Patricia

Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain - Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.		
Module:4	**HYPER LEDGER FABRIC & ETHERUM**	**7 hours**
Architecture of Hyperledger fabric v1.1-Introduction to hyperledger fabric v1.1, chain code-Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity, Smart contracts, TruffleDesign and issue Crypto currency, Mining, DApps, DAO		
Module:5	**SMART CONTRACTS**	**7 hours**
Smart Contract Basics - Processing Smart Contracts - Deploying Smart Contracts - Solidity: Structure, Basic Data Types & Statements, Access Modifiers & Applications - Best Practices: Evaluating Smart Contracts		
Module:6	**BLOCKCHAIN APPLICATIONS**	**5 hours**
Blockchain and Enterprise - Use Case: Blockchains for Trade Finance, Blockchains for Supply Chain Financing, Cross Border Connectivity - Trusted Data Transfer, Capital Markets, Government Services & Sustainable Livelihood, Ownership and property rights, Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain - Blockchain Tradeoffs across Multichain, Ripple, Corda, EOS & Cosmos Facebook Libra & Corporate Currencies - CBDC & its paradoxes		
Module:7	**BLOCKCHAIN CHALLENGES AND CONSTRAINTS**	**3 hours**
Blockchain risks - Technological challenges - Standards - Scalability issues - Security and privacy - Legal and regulatory problems - Social and cultural constraints - The future of blockchain technology, AI, and digital privacy		
Module:8	**Recent Trends**	**2 hours**
	Total hours:	**45 hours**

Text Book(s)	
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
Reference Books	
1	Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Bashir, Imran,2017.
2	Antonopoulos, A. M. (2014). Mastering Bitcoin: unlocking digital cryptocurrencies. "O"Reilly Media, Inc.".
3	Franco, P. (2014). Understanding Bitcoin: Cryptography, engineering and economics. John Wiley & Sons.
4	Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015.

Mode of Evaluation:CAT/ Digital Assignments/Quiz/FAT/ Project.			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Software Project Management	L	T	P	J	C
CSI3015		3	0	0	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. To understand the importance of software project management and identify main stages and stakeholders of a software project
2. To explain the purpose of a project‟s planning documents and construct the scope statement and the work breakdown structure
3. To portray how the software can assist in project management and articulate what is involved in quality assurance, planning and control on projects
4. To demonstrate RUP, Microsoft project 2010 & open source software project management tools

Expected Course Outcome:

At the end of course student should be able to

1. Actively participate or successfully manage a software development project by applying project management concepts
2. Demonstrate knowledge of project management terms and techniques
3. Analyze the Steps involved in analyzing the Software projects and concepts to meet the estimation of the software Projects.
4. Work on Microsoft project, IBM RUP & open source software project management tools.
5. Estimate the organizing team based on industry exposure.

Module:1	Introduction to Project Management	7 hours

Importance of software project management - Stages of Project - The Stakeholder of Project - Project Management Framework - Software Tools for Project Management – Microsoft Project 2010 – Software projects versus other types of project – Contract management and technical project management

Module:2	Project Planning	6 hours

Integration Management: Project Plan Development - Plan Execution Scope Management: Methods for Selecting Projects - Project Charter - Scope Statement - WBS. Stepwise Project Planning: Main Steps in Project Planning Use of Software to Assist in Project Planning Activities

Module:3	Project Scheduling	7 hours

Time Management: Importance of Project Schedules - Schedules and Activities - Sequencing and Scheduling Activity Project Network Diagrams: Network Planning Models - Duration Estimating and Schedule Development - Critical Path Analysis - Program Evaluation and Review Technique (PERT) Use

of Software to Assist in Project Scheduling Activities - Software Metrics for Project Management: Metrics Sets for Project Management		
Module:4	**Software Risk Management**	**7 hours**
Perspectives of Risk Management - Risk Definition – Risk Categories – Risk Assessment: Approaches, techniques and good practices – Risk Identification / Analysis / Prioritization – Risk Control (Planning / Resolution / Monitoring) – Risk Retention – Risk Transfer - Failure Mode and Effects Analysis (FMEA) – Operational Risks – Supply Chain Risk Management.		
Module:5	**Project Cost Management**	**5 hours**
Project Cost Management: Importance and Principles of Project Cost Management - Resource Planning - Cost Estimating - Cost Budgeting - Cost Control - Use of Software to assist in Cost Management		
Module:6	**Software Quality Management**	**5 hours**
Project Quality: Stages of Software Quality Management - Quality Planning - Quality Assurance - Quality Control – Quality Standards – Tools for Quality control		
Module:7	**People Management**	**6 hours**
Leadership styles – Developing Leadership skills – Leadership assessment – Motivating People – Organizational strategy – Management – Team building – Delegation – Art of Interviewing People - Team Management – Rewarding - Client Relationship Management - Organizational behavior: a background, Selecting the right person for the job –Instruction in the best methods– The Oldham-Hackman job characteristics model		
Module:8	**Recent Trends**	**2 hours**
	Total hours	**45 hours**

Text Book(s)

1.	Information Technology Project Management, Kathy Schwalbe, Seven Edition 2013
2.	Software Project Management in Practice, Pankaj Jalote, Pearson, 2015.

Reference Books

1	Murali Chemuturi, Thomas M. Cagley, ―Mastering Software Project Management: Best

	Practices, Tools and Techniques, J. Ross Publishing, 2010		
2.	Bole Hughes and Mike Cotterell, “Software Project Management”, Tata McGraw Hill, Third Edition, 2002		
3.	Microsoft Project 2010 Bible,Elaine Marmel		
Mode of Evaluation:CAT/ Digital Assignments/Quiz/FAT/ Project.			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course title	L	T	P	J	C
CSI3016	**Robotics: Machines and Controls**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**				**Syllabus version v.1.0**	

Course Objectives:

1. To introduce the parts of robots, basic working concepts and types of robots
2. To make the students familiar with machine operations using robots
3. To discuss the applications and implementation of robot control systems

Expected Course Outcome:

1. Explain the working principle of robots
2. Analyze the purpose of various sensor in robot for automation
3. Design and develop the robotic arm to handle the materials and machines
4. Understand the robot programming for control engineering
5. Conduct and design the experiments for various robot control operations

Module:1	**Introduction**	**3 hours**

History of robots, robotics and programmable automation, laws of robotics, anatomy of robots, specifications of robots, Applications of robots, machine intelligence and flexible automation safety measures in robotics, AI in Robotics.

Module:2	**Robot Kinematics**	**7 hours**

Introduction, forward and reverse kinematics, robot arm and degrees of freedom, homogeneous transformation and DH parameters, dynamics of robot arm, kinematics of mobile robot

Module:3	**Actuators and Control**	**6 hours**

Robot drive system, functions of drive systems, pneumatic systems, electrical drives, DC motor, stepper motor, servo motor, need of sensing systems, types of sensors, robot vision system, robot

end effectors, drive system for grippers, types of grippers, gripper design for machine control operations		
Module:4	**Introduction to Mechatronics**	**6 hours**
Manufacturing industry, the changing environment, automation and mechatronics applications, flexible automation, CAD/CAM and CNC machine tools, Flexible manufacturing systems(FMS), robots in FMS		
Module:5	**Programmable Logic Controllers**	**6 hours**
Introduction, basic structure of PLC, PLC classification, PLC operation, loading and unloading parts by robot, PC based controller introduction		
Module:6	**Servo control in a Robot**	**6 hours**
Control loops, principles of servo control in a robot, PID control aspects, processor controlled digital servo system, introduction to transfer functions		
Module:7	**Applications of Robots**	**9 hours**
Industrial control systems, introduction to automation, basic elements of automation, levels of automation, material handling and identification, production planning and control systems, introduction to quality control and inspection technologies,		
Module:8	**Recent trends**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book(s)		

1.	S.R. Deb, “Robotics technology and flexible automation”, THH-2009
2.	Mikell.P.Groover, “Automation, Production Systems, and Computer Integrated Manufacturing” 4th edition Pearson 2016
Reference Books	
1.	Saeed B.Nikku, Introduction to robotics, analysis, control and applications, Wiley-India, 2nd edition 2011
2.	Richared D.Klafter. Thomas Achmielewski and Mickael Negin, Robotic Engineering and Integrated Approach, Prentice Hall India-New Delhi-2001
3.	John Craig, “ Introduction to Robotics, Mechanics and Control” February 2017, Pearson

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	**ADVANCES IN WEB TECHNOLOGIES**	**L**	**T**	**P**	**J**	**C**
MDI1001		**3**	**0**	**2**	**0**	**4**
Pre-requisite		**Syllabus version v.1.0**				

Course Objectives:

1. To understand the web architecture and web languages.
2. To program for web client and web server objects.
3. To understand web development environment and methodology.

Expected Course Outcome:

At the end of this course students should be able to:

1. Differentiate web protocols and web architecture.
2. Develop client side web application.
3. Implement client side script using JavaScript.
4. Develop a sophisticated web application that appropriately employs the MVC architecture
5. Demonstrate a client server application using HTTP protocol and access web services for dynamic content using AJAX.
6. Exhibit the working of server-side scripts.
7. Understand the fundamental working of data using open source databases.

Module1	**Web Essentials**	**3 hours**

Evolution of Web, Internet Overview- Networks - Web Protocols — Web Organization and Addressing - Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture – URL - Domain Name – Client-side and server-side scripting.

Module2	**Web Designing**	**8 hours**

HTML5 – Form elements, Input types and Media elements, Image map, HTML frames and semantics, HTML events, HTML form validation using pattern attribute, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface

Module3	**Client-Side Scripting**	**8 hours**

JavaScript Basics –Arrays- Functions - JavaScript objects – HTML DOM - DOM methods –

Events- Regular Expressions – Form Validation-XML, XML DTD, XML Schema, JSON, Jquery		
Module4	**Web Applications**	**6 hours**
Web applications- Web Application Frameworks-MVC framework- Single Page Applications-Responsive Web Design		
Module5	**Client/Server Communication**	**6 hours**
HTTP- Request/Response Model- HTTP Methods- RESTful APIs-AJAX-AJAX with JSON		
Module6	**Web Servers**	**6 hours**
JSP - Node.js-NPM- Call-backs -Events- Express framework-Cookies-Sessions-Scaling		
Module7	**Storage**	**6 hours**
JDBC - MongoDB-Manipulating and Accessing MongoDB Documents from Node		
Module8	**Contemporary Issues**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5th edition, Pearson Education, 2018.

2.Brad Dayley, Node.js, MongoDB, and AngularJS Web Development, Addison Wesley, November 2017.

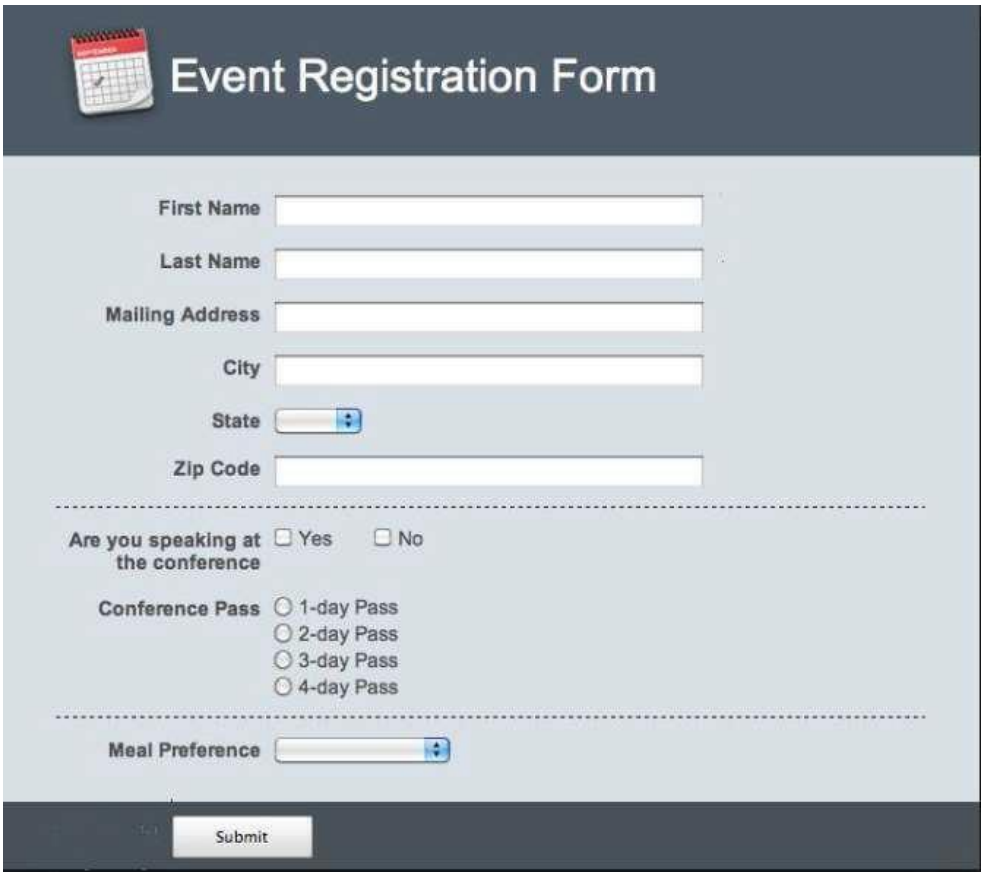
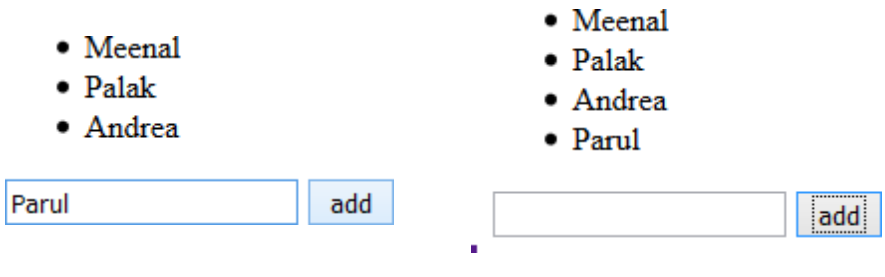
Reference Books

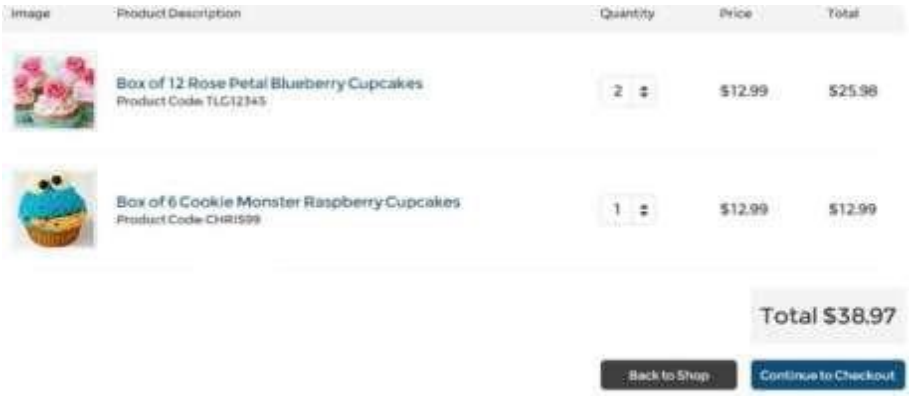
1. Lindsay Bassett, Introduction to JavaScript Object Notation, 1st Edition, O‟Reilly Media, 2015

2. Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3rd Edition, Mc-Graw Hill, 2017

3. Barry Burd, “Java for Dummies”.. 6th Edition, John Wiley & Sons Publishers 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments :		
1.	Create a user registration webpage using HTML Form elements (Input types) for a hackathon event registration. The webpage must contain the following input types to get the details of the students Input Types:- Textfields, Textarea, checkbox, radio button, submit button, reset button, drop down box, images (if required). Apply styles, Formatting tags of HTML for good design. Use HTML 5 new input types to display additional contents	2 hours
2	CSS – internal, external and inline a. Apply CSS to a shopping site having two branches with different localized content, the website being hosted on a local web server. Add an unordered list and an image to your web page, Create a html file that contains a heading and a couple of paragraphs, modify a button with which it is possible to change the text that is shown on the screen, add buttons to enlarge or shrink featured images, Modify the CSS style definition so that the initial width of a rectangle border is 6 pixels, Improve the Guess-A-Word game, Object Oriented Programming with JavaScript, Add CSS definitions so that <td> elements that represent days of the previous month will have a different color, improve webpage so that you draw a brick-wall behind the picture shown, draw_on_canvas () function	3 hours
3.	Design the following using JavaScript and DOM a) Given an array of words, write a javascript code to count the number of vowels and number of consonants in each word. Use Regular Expressions. b) Include Image Slide Show Digital clock, Survey Poll to make your webpage i) Dynamic. Develop a web application to implement online quiz system. The application includes only client side script	2 hours
4.	Create a popup Login form using jQuery which appears at the center of screen on loading the page after a specified time interval. Include Captcha text in the login page.	2 hours
5.	a) Validate the Event Registration Form given below using Jquery for the following conditions.	4 hours

	All fields are mandatory Zip code should be exactly five digits Email validation b) Create a JSON file for a list of cities. Provide autocomplete option for city field using the JSON file as source. 	
6.	Using Angular JS, add names that are entered in textbox to the list and clear the textbox once the name is added to list. 	4 hours

7.	Design a shopping cart application using AngularJS. Your shopping webpage should have the provisions for selecting the list of items from different category, Once the items are selected on clicking the submit button the items in the cart with its price should be displayed. Sample design is given below.  	3 hours
8.	Create a MongoDB collection of "books" with the following details: ***Title, ISBN(unique id), Authors, Publication ,Year of Publication and Price.*** Write commands for the following: a) Insert a new document with multiple authors. b) Update a document with change in price c) Remove documents with year of publication lesser than 1990.	3 hours
9.	A MongoDB collection of words has the document structure as: *{* *word:<word>,* *first:<first_letter>,* *last:<last_letter>,* *size: <character_count>* *}* Perform the following operations on those documents using Nodejs. Find the set of words which starts with letters „a",„b" or „c". Find the set of words which exactly has 12 letters.	2 hours

	Count the number of words that starts and ends with a vowel. Find the first ten words that end with the letter „e" and display it in descending order.	
10.	Write a NodeJs program to perform debit operation for a bank account. The HTML form should get input for the account no and the amount to be debited. The entered amount has to be reduced from their balance. In the database maintain account number and balance	2 hours
11.	a. Develop a thesaurus tool by creating a schema for thesaurus. When a word is entered the synonyms or antonyms must be displayed based on the user request. b. XSL – Create an employee information system using XML and display the employee number and name of employees with salary greater than Rs. 100000 p/m. with XSL. c. Develop a thesaurus tool by creating a schema for thesaurus. When a word is entered the synonyms or antonyms must be displayed based on the user request.	3 hours
Total Laboratory Hours		30 hours
Mode of evaluation: Project/Activity		

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Business Intelligence	L	T	P	J	C
CSI3017		3	1	0	0	4
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. Understand and Acquire the skills of BI lifecycle & its architecture to plan and implement the ETL processes.

2. Acquire the skills to understand the Decision Support System (DSS) technologies and organizational issues related to Business Intelligence (BI) required to implement a BI strategy for an organization.

3. Apply Business Performance Management and IT/strategic frameworks that are enabled by Business Intelligence tools and practices

Expected Course Outcome:

1. Take initiatives to use BI for Organizational Decision making.
2. Plan and execute a BI industrial Project.
3. Perform Meta Data Repository Analysis.
4. Articulate examples of how businesses are using Business Intelligence tools to enhance competitiveness and profitability.
5. Adopt Business Intelligence tools and practices that align with business strategies based on a case analysis.

Module:1	BI Fundamentals	4 hours

Business Intelligence and its impacts: Factors driving BI - BI and related techniques - obstacles to BI - BI in Contemporary organizations and BI capabilities.

Module:2	BI Life Cycle	6 hours

Introduction, Business Intelligence Lifecycle, Enterprise Performance Life Cycle (EPLC) Framework Elements, Life Cycle Phases, Human Factors in BI Implementation, BI Strategy, Objectives and Deliverables, Transformation Roadmap, Building a transformation roadmap, BI Development Stages and Steps, Parallel Development Tracks, BI Framework

Module:3	BI Technical Architecture	6 hours

Introducing the Technical Architecture: Technical Architecture overview, Back room Architecture, Presentation Server Architecture, Front room Architecture

Module:4	BI Modeling Process	7 hours

Modeling process overview - Getting organized - Four step modeling process - Design the dimensional model –Embrace data stewardship - Extract, Transform and Load overview - Extract, Transform and Load requirements and steps - Data extraction - Data transformation - Data loading.		
Module:5	**Analytics in BI**	**7 hours**
Types of Analytics - Predictive analytics - classification – Regression Analysis - Decision tree – Case studies: social media analytics, Prescriptive analytics.		
Module:6	**Implementing BI**	**7 hours**
Introduction, Business Intelligence Platform, Business Intelligence Platform Capability Matrix, BI Target Databases, Data Mart, BI Products and Vendor, The Big Four Business Intelligence vendors.		
Module:7	**Future of BI**	**6 hours**
Future of business intelligence – Emerging Technologies, Predicting the Future, – Advanced Visualization – Rich Report, Future beyond Technology		
Module:8	**Contemporary issues**	**2 hours**
Total Lecture hours		**45 hours**

Text Book(s)

1.	Ramesh Sharda, Dursun Delen, Efraim Turban and David King , "Business Intelligence, Analytics, and Data Science: A Managerial Perspective" , 4th Edition, Pearson Education, 2019.
2.	Grossmann W, Rinderle-Ma , " Fundamental of Business Intelligence", 1st edition, Springer, 2015.

Reference Books

1.	Gordon Linoff and Michael Berry , " Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management" , 3rd edition , Wiley 2011.
2	Joseph H. Silverman , " Introduction to Number Theory, 4th Ed. Boston", Pearson, 2012
3	Ramesh Sharda, Dursun Delen, and Efraim Turban., "Business Intelligence and Analytics: Systems for Decision Support" , 10th edition, Pearson Education, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Lab

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI3019	**Advanced Data Compression Techniques**	**3**	**0**	**0**	**0**	**3**
Pre-requisite	**Nil**	**Syllabus version v.1.0**				

Course Objectives:

1. Learn the fundamental of advanced data compression techniques
2. To introduce students to basic applications, concepts, and techniques of Data Compression.
3. To develop skills for using recent data compression software to solve practical problems in a variety of disciplines.
4. To gain experience doing independent study and research.

Expected Course Outcome:

1. Understand the importance of Data compression
2. Comprehend the idea of lossless and lossy compression
3. Understand the most common file formats for image, sound and video
4. Develop a reasonably sophisticated data compression application.
5. Select methods and techniques appropriate for the task
6. Develop the methods and tools for the given task

Module:1	**Introduction**	**4 hours**

Introduction to Compression techniques – Modeling and coding – Mathematical preliminaries for Lossless compression – Entropy – Information Value – Data Redundancy - Application of compression

Module:2	**Basic Concepts of Information Theory**	**6 hours**

Concepts of information theory – Models and Coding – Algorithmic information theory – Physical Models – Probability models – Markov models.

Module:3	**Arithmetic Coding**	**5 hours**

Shannon-Fano Algorithm – Huffman Algorithm – Adaptive Huffman Coding – Golomb codes – Rice codes – Tunstall codes – Applications of Huffman coding.

Module:4	**Loss Less Coding**	**6 hours**

Dictionary Methods: LZ77, LZ78, LZW Algorithms – Lossless Compression standards zip, gzip, bzip, unix compress, GIF, JBIG – Dynamic Markoy Compression.		
Module:5	**Basics Of Lossy Coding &Vector Quantization**	**5 hours**
Basics of lossy coding and mathematical concepts – Distortion criteria – Scalar quantization - The Quantization problem – Uniform quantizer – Adaptive quantization – Advantages of vector quantization over scalar quantization – LBG algorithm.		
Module:6	**Image & Video Compression**	**6 hours**
Image Compression: Discrete Cosine Transform – JPEG – Video Compression: Motion Compensation – Temporal and Spatial Prediction - MPEG and H.264.		
Module:7	**Wavelet Based Compression**	**5 hours**
Fundamentals of wavelets –Various standard wavelet bases – Multi resolution analysis and scaling function – JPEG 2000.		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Khalid Sayood, Morgan Kauffman Introduction to Data Compression, 5th Edition, Elsevier, 2020.

Reference Books

1. Colton McAnlis, Aleks Haecky, Understanding Compression: Data Compression for Modern Developers, O‟Reilly.2016.

2. Feng Wu, Advances in Visual Data Compression and Communication Meeting the Requirements of New Applications, Auerbach Publications 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSI3018	Advanced Java	2	0	2	0	3
Pre-Requisite	CSI2008	Syllabus version v.1.0				

Course Objectives:

1. To understand advanced database programming with Java
2. To be able to effectively and efficiently work with servlets and JSP.
3. To understand web development and network programming in Java.

Expected Course Outcome:

At the end of this course students should be able to:

1. Analyze the programs involving the advanced networking program constructs.
2. Choose the appropriate database technique for solving the real world problem.
3. Demonstrate hibernate and use them in appropriate applications.
4. Propose the use of JSF for different scenarios.
5. Explore various methods for web application development.
6. Choose appropriate elements to facilitate network event

Module:1	JDBC Programming	4 hours

JDBC Architecture, Creating simple JDBC Application, Statements, ResultSet Operations, Batch Updates in JDBC, Creating CRUD Application, Using Rowsets Objects, Managing Database Transaction.

Module:2	Servlet API and JSP – Overview	4 hours

Servlet Introduction, Working with ServletContext and ServletConfig Objects, Response and Redirection, Filter API, Hidden Form Fields and URL Rewriting, Servlet Events - ContextLevel and SessionLevel. JSP Architecture, JSP Scripting Elements, JSP Directives, JSP Action, JSP Implicit Objects, JSP Standard Tag Libraries, JSP Custom Tag

Module:3	J2EE and Web Development	4 hours

Java Platform, J2EE Architecture Types, Java EE Containers, Servers in J2EE Application, Web Application Structure, Web Containers and Web Architecture Models. Request Processing in

Web Application.		
Module:4	**Advance Networking**	**4 hours**
Introduction of Socket, Types of Socket, Socket API, TCP/IP client sockets, URL, TCP/IP server sockets, Datagrams, java.net package Socket, ServerSocket, InetAddress, URLConnection, RMI Architecture, Client Server Application using RMI		
Module:5	**Hibernate**	**4 hours**
Introduction to Hibernate, Exploring Architecture of Hibernate, O/R Mapping with Hibernate, Hibernate Annotation, Hibernate Query Language, CRUD Operation using Hibernate API.		
Module:6	**Java Web Frameworks: Spring MVC**	**4 hours**
Spring Introduction, Spring Architecture, Spring MVC Module, Life Cycle of Bean Factory, Constructor Injection, Dependency Injection, Inner Beans, Aliases in Bean, Bean Scopes, Spring Annotations, Spring AOP Module, Spring DAO, Database Transaction Management, CRUD Operation using DAO and Spring API.		
Module:7	**Java Server Faces**	**4 hours**
Features of JSF, JSP Architecture, JSF request processing Life cycle, JSF Elements, JSF Expression Language, JSF Standard Component, JSF Facelets Tag, JSF Convertor Tag, JSF Validation Tag, JSF Database Access, JSF PrimeFaces.		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours:		**30 hours**
Text Book(s)		
1. Core and Advanced Java, Black Book, Recommended by CDAC, Revised and Upgraded by Dreamtech Press, 2018 2. Richard M Reese, Learning Network Programming with Java, Packt publisher, 2015		
Reference Books		
1. Craig walls ,Spring in Action, 5th edition, Manning Publication,2020. 2. Pankaj B. Brahmankar, Advanced JAVA Programming, Tech Neo Publications, 2019.		

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	Write an application which will retrieve IP address for given website.	2 hours
2.	Write a JDBC application which will interact with Database and perform the following task. 1) Create Student Table with RollNo, Name, and Address field and insert few records. 2) Using PreparedStatement Object display the content of Record. 3) Using PreparedStatement Object Insert Two Record. 4) Using PreparedStatement Object Update One Record. 5) Using PreparedStatement Object Delete One Record. 6) Using PreparedStatement Object display the content of Record.	4 hours
3.	Create Servlet file which contains following functions: 1. Connect 2. Create Database 3. Create Table 4. Insert Records into respective table 5. Update records of particular table of database 6. Delete Records from table. 7. Delete table and also database.	4 hours
4.	Write down the program in which input the two numbers in an html file and then display the addition in JSP file. Write down a program which demonstrates the core tag of JSTL.	4 hours
5.	Use Hibernate Query Language to insert, update and delete records in database.	4 hours
6.	Study and Implement MVC using Spring Framework	4 hours
7.	Inject Service using Aspect Oriented Programming.	4 hours
8.	Use JSF Standard Components and Facelets Tags.	4 hours
Total Laboratory Hours		30 hours
Mode of assessment: Project/Activity		

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Advanced Computer Architecture	L	T	P	J	C
CSI3021		3	0	0	0	3
Pre-requisite	CSI1004	Syllabus version v.1.0				

Course Objectives:

1. Introduce the recent trends in the field of Computer Architecture and identify performance related parameters.
2. Apply fundamental techniques to speed-up program execution.
3. Expose the different types of multicore architectures and Programming.

Expected Course Outcome:

1. Understand the organization and performance characteristics of modern computer architectures.
2. Interpret techniques to improve processor‟s ability to exploit Instruction Level Parallelism.
3. Point out how data level and thread level parallelisms is exploited in architectures.
4. Identify characteristics and challenges in multiprocessor and multicore architectures.
5. Develop parallel programming for computer problems.

Module:1	Introduction to Advanced Computer Design	5 hours

Fundamentals of Computer Design- Fundamentals of RISC, CISC architecture- Data path implementation-Single cycle Data path- Multi cycle data path-Multi cycle Instruction execution-Instruction Scheduling.

Module:2	Instruction Level Parallelism	8 hours

Introduction to Instruction Level Parallelism – Concepts and Challenges – Advanced Branch Prediction - Dynamic Scheduling – Static scheduling- Hardware-Based Speculation – Multithreading - Limitations of ILP.

Module:3	Data Level Parallelism	5 hours

Vector architecture – SIMD extensions – Graphical Processing Units and applications – Loop level parallelism.

Module:4	Multi-Threading Concepts	6 hours

Basic concepts of threading- Concurrency, Parallelism -Threading design concepts for developing an application- Correctness Concepts: Critical Region, Mutual exclusion, Synchronization, Race Conditions- Performance Concepts: Simple Speedup, Computing Speedup, Efficiency , Granularity , Load Balance		
Module:5	**Multi-Processor Architecture**	**6 hours**
Need for multi-core architectures, Architecting with multi-cores, Homogenous and heterogeneous cores, Shared recourses, shared busses, and optimal resource sharing strategies. Performance evaluation of multi-core processors, Error management		
Module:6	**Multi core architecture**	**7 hours**
Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency		
Module:7	**Multi Core and GPU Programming**	**6 hours**
Multi core programming using OpenMP, OpenMP Directives, Parallel constructs, Work-sharing constructs, Data environment constructs, Synchronization constructs		
Module:8	**Recent Trends**	**2 hours**
	Total hours:	**45 hours**

Text Book(s)

1.	John L. Hennessey and David A. Patterson, ―Computer Architecture – A Quantitative Approach, Morgan Kaufmann , Elsevier, 6th edition, 2017.

Reference Books

1.Kai Hwang, Naresh Jotwani, Advanced Computer Architecture: Parallelism, Scalability,

Programmability, Tata McGraw Hill Education Pvt. Ltd., India, Second Edition, 2011.

2. Barbara Chapman, Gabriele Jost, Ruud van van de Pas, Using OpenMP: Portable shared memory, parallel programming (scientific and engineering computation),, 1st Edition, MIT Press, 2008.

3. David B Kirk, Wen-mei W Hwu, Programing Massively Parallel Processors: A Handson Approach(Application of GPU Computing Series) , 2 nd Edition, Morgan Kaufmann,2013.

Mode of Evaluation: CAT/ Digital Assignments/Quiz/FAT/ Project.			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Advanced Graph Algorithms	L	T	P	J	C
CSI3020		3	0	0	0	3
Pre-requisite	Nil	Syllabus version v.1.0				

Course Objectives:

1. To understand the fundamental concepts and techniques of Graphs.
2. To comprehend the concepts of various graph algorithms
3. The module covers advanced material on graph algorithms with emphasis on efficient algorithms, and explores their use in a variety of application areas
4. To understand the mathematical approaches of solving graph algorithms with the help of fundamental data structures.

Expected Course Outcome:

1. Acquire the concept of conceptual and operations, properties on graphs.
2. Learn the concept of various graph algorithms and its uses.
3. Obtain the knowledge of Exponential algorithm
4. Analyze the graph classes and parameter Algorithm.
5. Implement the concepts approximation on various graph algorithms.

Module:1	Basics of Graph and Operations	4 hours

Fundamental concepts - basic definitions of graphs and digraphs -Subgraphs and other graphtypes- Representing graphs as matrices- Graph transformation - operations, properties, proof styles

Module:2	Graph Algorithms	6 hours

Elementary Graph Algorithms -Representations of graphs - Breadth-first search - Depth-first search -Topological sort - Strongly connected components -Representing graphs in a computer - Minimum Spanning Trees - Growing a minimum spanning tree - The algorithms of Kruskal and Prim .

Module:3	Shortest Path Algorithm	5 hours

Single-Source Shortest Paths - The Bellman-Ford algorithm - Single-source shortest paths in directed acyclic graphs - Dijkstra‟s algorithm -Difference constraints and shortest paths - Proofs of shortest-paths properties - All-Pairs Shortest Paths -Shortest paths and matrix multiplication - The Floyd-Warshall algorithm - Johnson‟s algorithm for sparse graphs .

Module:4	**Maximum Flow**	**5 hours**
Maximum Flow - Flow networks - The Ford-Fulkerson method - Maximum bipartite matching - Push-relabel algorithms - The relabel-to-front algorithm.		
Module:5	**Exponential Algorithm**	**7 hours**
Independent set-Chromatic Number-Domatic Partition-The travelling Salesman Problem-Set Cover- Dominating Set-Subset Sum.		
Module:6	**Graph Classes and Fixed Parameter Algorithms**	**8 hours**
Perfect Graph-Cographs-Distance Hereditary graph-Chordal Graphs-Interval Graph-Permutation graphs-Vertex Cover-Kernel of Vertex cover-Minimum fill in-Homogeneous colouring of perfect graph.		
Module:7	**Approximation Algorithms**	**8 hours**
Approximation Algorithms - The vertex-cover problem - The traveling-salesman problem - The set-covering problem - Randomization and linear programming - The subset-sum problem		
Module:8	**Recent Trends**	**2 hours**
	Total hours:	**45 hours**

Text Book(s)

1.	Tim Roughgarden "Algorithms Illuminated (Part 2): Graph Algorithms and Data Structures", First Edition , Soundlikeyourself Publishing LLC,Sanfrancisco,CA,2018.
2.	Thomas H. Cormen Charles E. Leiserson Ronald L. Rivest Clifford Stein, "Introduction to algorithm" 3rd Edition, The MIT Press Cambridge 2009.

Reference Books

1	A.V Aho, J.E. Hopcroft and J.D. Ullman. Design and Analysis of Computer Algorithms, Addison Wesley, 1974.
2.	T.Kloks "Advance Graph Algorithms" – Kloks, 2012

Mode of Evaluation: CAT/ Digital Assignments/Quiz/FAT/ Project.

Recommended by Board of Studies	11-02-2021

Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course title	L	T	P	J	C
CSI3022	**Cyber Security and Application Security**	**3**	**0**	**2**	**0**	**4**
Pre-requisite		**Syllabus version v.1.0**				

Course Objectives:

1. To learn the concepts of number theory, Information and Network Security
2. To learn the basics of cryptography and cryptographic techniques.
3. To familiarize with various cyber threats, attacks, vulnerabilities, defensive mechanisms, security policies, practices
4. To learn how to implement application level security

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Know the fundamental mathematical concepts related to security
2. Know the basic concepts of information and network security
3. Understand and implement the cryptographic techniques and know the real time applications of various cryptographic techniques.
4. Know fundamentals of cybercrimes and the cyber offenses.
5. Understand the cyber threats, attacks, vulnerabilities and its defensive mechanisms
6. Design suitable security policies and know about the industry practices

Module:1	**Number Theory Basics**	**5 hours**

Finite Fields and Number Theory: Algebraic Structures(Groups)-Modular arithmetic – GCD using Euclidian Algorithm – Primality Testing – Fermat‟s and Euler‟s theorem –Chinese Reminder theorem – Discrete Logarithms

Module:2	**Information and Network Security**	**6 hours**

Introduction-Computer Security-Information Security-Security Threats and Vulnerabilities – Security Services – Security Mechanisms- Model for Network Security

Module:3	**Cryptography Basics and Techniques**	**6 hours**

Basics of Cryptography- Symmetric key cryptographic techniques: Introduction to Stream cipher – Block cipher: DES – AES-Asymmetric key cryptographic techniques: principles – RSA –

ElGamal - Elliptic Curve cryptography – Key distribution and Key exchange protocols.		
Module:4	**Cybercrimes and Cyber offenses**	**7 hours**
Classification of cybercrimes, Planning of attacks, Social Engineering:Human based, Computer based, Cyberstalking, Cybercafe and Cybercrimes		
Module:5	**Cyber Threats, Attacks and Prevention:**	**7 hours**
Phishing – Password cracking – Keyloggers and Spywares – DoS and DDoS attacks – SQL Injection- Identity Theft (ID) : Types of identity theft – Techniques of ID theft		
Module:6	**Cybersecurity Policies and Practices**	**7 hours**
What security policies are – Determining the policy needs – Writing security policies – Internet and email security policies – Compliance and Enforcement of policies- Review		
Module:7	**Application Security**	**5 hours**
Security Architectures and Models- Email security-PGP and SMIME, Web Security, Database Security-Wireless Network Security		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Cryptography and Network security, William Stallings, Pearson Education, 7th Edition, 2016

2. Network Security Essentials Applications and Standards, William Stallings, Pearson Education, 6th Edition, 2018

3.Cyber Security, Understanding cyber crimes, computer forensics and legal perspectives, Nina Godbole,Sunit Belapure, Wiley Publications, Reprint 2016

Reference Books

1. Cybersecurity for Dummies, Brian Underdahl, Wiley, 2011

2. Cryptography and Network security, Behrouz A. Forouzan , Debdeep Mukhopadhyay, Mcgraw Hill Education, 2nd Edition, 2011

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Indicative Experiments		
1.	Analysis of security in Unix/Linux.	2 hours
2.	Administration of users, password policies, privileges and roles	2 hours
3.	Eavesdropping Attacks and its prevention using SSH	2 hours
4.	Deep Packet Inspection on IP/ICMP Vulnerabilities	2 hours
5.	Deep Packet Inspection on TCP/IP Vulnerabilities	4 hours
6.	Implement your design using Windows Folder structure to activate directory and computer to create security groups that meets your requirement	4 hours
7.	Group Policy Management to edit the default domain policy to a specific organization unit.	2 hours
8.	Create new rules in Windows firewall to allow the HTTP connection and verify that the new rules allow the HTTP incoming request.	2 hours
9.	Basic defensive practice skills against malicious SQL injection attacks in mobile software development.	2 hours
10.	Defense of Brute Force Approach of Gaining Access MySQL Database with Weak Authentication	2 hours
11.	Design a system to detect all the instances of an attack using signatures	4 hours
12.	Examine network traffic and identify potentially malicious traffic	2 hours
Total Laboratory Hours		**30 hours**

Recommended by Board of Studies	11-02-2021		
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