



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

(2019-2020)

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



VIT[®]
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

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.



VIT[®]

Vellore Institute of Technology

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

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.



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

PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyze complex engineering problems.

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

PO_04: Having an ability to design and conduct experiments, as well as to analyze and interpret data, and synthesis of information

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working as a member or in teams

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society

PO_11: Having a good cognitive load management skills related to project management and finance

PO_12: Having interest and recognize the need for independent and lifelong learning



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

ADDITIONAL PROGRAMME OUTCOMES (APOs)

APO_01: Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)

APO_02: Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)

APO_03: Having design thinking capability

APO_04: Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)

APO_05: Having Virtual Collaborating ability

APO_06: Having an ability to use the social media effectively for productive use

APO_07: Having critical thinking and innovative skills

APO_08: Having a good digital footprint



VIT[®]

Vellore Institute of Technology

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

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.



SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
5 Year integrated M.Tech CSE with Spl. in Data Science
Curriculum for 2019-2020 Batch

Sl.NO	Category	Total No. of Credits
1	University Core	61
2	Programme Core	85
3	University Elective	12
4	Programme Elective	62
	Total	220

University Core (61 Credits)

Sl.No	Course Code	Course Title	L	T	P	J	C	Pre-Req	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 85 Credits – PC 71+DS core 14)

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.	MAT2002	Applications of Differential and Difference Equations	3	0	2	0	4	MAT1011	S
5.	CSI3002	Applied Cryptography and Network Security	2	0	2	0	3	-	E
6.	CSI3003	Artificial Intelligence and Expert Systems	3	0	0	0	3	-	E
7.	CSI3001	Cloud Computing Methodologies	3	0	2	0	4	-	E
8.	CSI1004	Computer Organization and Architecture	3	0	0	0	3	CSE1003	E
9.	CSI2007	Data Communication and Networks	3	0	2	0	4	-	E
10.	CSE2003	Data Structures and Algorithms	2	0	2	4	4	-	E
11.	CSE1003	Digital logic and Design	3	0	2	0	4	-	E
12.	MAT1014	Discrete Mathematics and Graph Theory	3	2	0	0	4	-	S
13.	CSI1003	Formal Languages and Automata Theory	3	0	0	0	3	-	E
14.	EEE1024	Fundamentals of Electrical and Electronics Engineering	2	0	2	0	3	-	E
15.	MAT1022	Linear Algebra	3	0	0	0	3	-	S
16.	CSI2006	Microprocessor and Interfacing Techniques	2	0	2	0	3	-	E
17.	CSI1002	Operating System Principles	2	0	2	0	3	-	E
18.	CSI2005	Principles of Compiler Design	3	0	0	0	3	-	E
19.	CSI1001	Principles of Database Systems	2	0	2	0	3	-	E
20.	CSI2008	Programming in Java	3	0	2	0	4	-	E
21.	CSI1007	Software Engineering Principles	2	0	2	0	3	-	E
		Total	71 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 62 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	CSII032	Advances in Pervasive Computing	3	0	0	0	3	-	E
7	CSII027	Augmented Reality and Virtual Reality	3	0	0	4	4	-	E
8	CSI3013	Blockchain Technologies	3	0	0	4	4	-	E
9	CSI3011	Computer Graphics and Multimedia	3	0	2	0	4	-	E
10	CSII021	Computer Oriented Numerical Methods	3	0	2	0	4	-	E
11	CSI3022	Cyber Security and Application Security	3	0	2	0	4	-	E
12	CSI3012	Distributed Systems	3	0	2	0	4	-	E
13	CSII033	Game Theory	3	0	0	0	3	-	E
14	CSII034	GPU Programming	3	0	0	0	3	-	E
15	CSI3008	Internet of Everything	3	0	2	0	4	-	E
16	CSII017	Internetworking with TCP/IP	3	0	0	0	3	-	E
17	CSII019	Logic and Combinatorics for Computer Science	3	0	0	0	3	-	E
18	CSII042	Mathematical Modeling and Simulation	3	0	0	0	3	-	E

19	CSII018	Natural Language Processing and Computational Linguistics	3	0	0	4	4	-	S
20	CSII037	Programming Paradigms	3	0	2	0	4	-	E
21	CSI3007	Advanced Python Programming	2	0	4	0	4	CSE1001	E
22	CSII029	Quantum Computing Techniques	3	0	0	0	3	-	E
23	CSI3016	Robotics: Machines and Controls	3	0	0	0	3	-	E
24	CSI3006	Soft Computing Techniques	3	0	0	4	4	-	E
25	CSI3015	Software Project Management	3	0	0	0	3	-	E
26	CSI3014	Software verification and validation	3	0	0	0	3	-	E
27	CSII023	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	
2	MDI1013	Advanced Data Analytics	3	0	0	0	3	-	E
3	CSII043	Advanced Predictive Analytics	3	0	2	0	4	-	E
4	MDI010	Advances in Data Engineering	3	0	0	4	4	-	E
5	CSII046	Advances in Database Administration and Security	3	0	0	0	3	-	E
6	MDI1014	Bayesian Statistical Methods	3	0	0	4	4	-	E
7	CSI3017	Business Intelligence	3	1	0	0	4	-	E
8	CSII045	Cognitive Science and Decision making	3	0	0	0	3	-	E
9	CSI3010	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	3	0	0	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				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO):		1, 12, 14				
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

Approved by Academic Council

No. 37

Date

16-06-2015

CSE1002	Problem solving and object oriented programming	L	T	P	J	C
		0	0	6	0	3
Pre-requisite	Nil	Syllabus version				
		1.0				
Course Objectives:						
<p>1. To emphasize the benefits of object oriented concepts.</p> <p>2.To enable students to solve the real time applications using object oriented programming features</p> <p>3.To improve the skills of a logical thinking and to solve the problems using any processing elements</p>						
Expected Course Outcome:						
<p>1. Demonstrate the basics of procedural programming and to represent the real world entities as programming constructs.</p> <p>2.Enumerate object oriented concepts and translate real-world applications into graphical representations.</p> <p>3.Demonstrate the usage of classes and objects of the real world entities in applications.</p> <p>4.Discriminate the reusability and multiple interfaces with same functionality based features to solve complex computing problems.</p> <p>5.Illustrate possible error-handling constructs for unanticipated states/inputs and to use generic programming constructs to accommodate different datatypes.</p> <p>6. Validate the program against file inputs towards solving the problem..</p>						
Student Learning Outcomes (SLO):		1,9,17				
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.	<p>Missionaries and Cannibals</p> <p>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.</p>	10 hours
4.	<p>Register Allocation Problem</p> <p>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) t_1 and t_2 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</p>	15 hours
5.	<p>Selective Job Scheduling Problem</p> <p>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</p>	15 hours
6.	<p>Fragment Assembly in DNA Sequencing</p> <p>DNA, or deoxyribonucleic acid, is the hereditary material in humans and</p>	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 Education, 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				
					1.1				
Course Objectives:									
<ol style="list-style-type: none"> 1. To make students understand and appreciate the unity of life in all its forms, the implications 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 local environment. 									
Expected Course Outcome: Students will be able to									
<ol style="list-style-type: none"> 1. Students will recognize the environmental issues in a problem oriented interdisciplinary perspectives 2. Students will understand the key environmental issues, the science behind those problems and 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 as well as enter a career in an environmental profession or higher education. 									
Student Learning Outcomes (SLO):					1,2,3,4,5,9,11,12				
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 activities on 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 and Aquatic biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation methods.									
Module:3	Sustaining Natural Resources and Environmental 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. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous 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 of India (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, 15 th Edition, Cengage learning.	
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17 th Edition, Brooks/Cole, USA.	
Reference Books		
1.	David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), Visualizing Environmental 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				
		1.0				
Course Objectives:						
<ul style="list-style-type: none"> To impart technological aspects of applied chemistry To lay foundation for practical application of chemistry in engineering aspects 						
Expected Course Outcome:						
<ul style="list-style-type: none"> Students will be familiar with the water treatment, corrosion and its control, engineering applications of polymers, types of fuels and their applications, basic aspects of electrochemistry and electrochemical energy storage devices 						
Student Learning Outcomes (SLO):		1,2,14				
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 analysis for 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- Sand Filtration - 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 art forms, 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, PVD and 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 by						

Knocking 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., Pvt. Ltd., Educational and Technical Publishers, New Delhi, 3 rd Ed., 2015.		
2	O.G. Palanna, McGraw Hill Education (India) Pvt. Ltd., 9 th Reprint, 2015.		
3	B. Sivasankar, Engineering Chemistry 1 st Ed., McGraw Hill Education, 2008		
4	"Photovoltaic Solar Energy: From Fundamentals to Applications", Angèle Reinders et al., Wiley publishers, 2017.		
Reference Books			
1	O.V. Roussak and H.D. Gesser, <i>Applied Chemistry - A Text Book for Engineers and Technologists</i> , Springer Science Business Media, New York, 2 nd Edition, 2013.		
2	S. S. Dara, <i>A Text book of Engineering Chemistry</i> , S. Chand & Co Ltd., New Delhi, 20 th Edition, 2013.		
Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
List of Experiments		SLO: 14	
	Experiment title	Hours	
1.	Water Purification: Estimation of water hardness by EDTA method and its removal by ion-exchange resin	3 hours	
2.	Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by Winkler's method	6 hours	
3.	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				
		1.2				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 1. Follow sound morals and ethical values scrupulously to prove as good citizens 2. Understand various social 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 						
Student Learning Outcomes (SLO):		2, 10, 11, 12				
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 his Presupposition 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		46 th ACM	Date 24.08.2017

CSE2003	DATA STRUCTURES AND ALGORITHMS	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. To impart the basic concepts of data structures and algorithms. 2. To assess how the choice of data structures and algorithm design methods impacts the performance of programs. 3. To provide an insight into the intrinsic nature of the problem and to develop software systems of varying complexity. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Evaluating and providing suitable techniques for solving a problem using basic properties of Data Structures. 2. Analyse the performance of algorithms using asymptotic notations. 3. Demonstrate knowledge of basic data structures and legal operations on them. 4. Illustrate different types of algorithmic approaches to problem solving and assess the trade-offs involved. 5. Analyse basic graph algorithms, operations and applications through a structured (well-defined) algorithmic approach. 6. Categorize the feasibility and limitations of solutions to real-world problems. 7. Provide efficient algorithmic solution to real-world problems. 						
Student Learning Outcomes (SLO): 1,6,9						
Module:1	Introduction to Data structures and Algorithms	1 hour				
Overview and importance of algorithms and data structures, Stages of algorithm development for solving a problem: Describing the problem, Identifying a suitable technique, Design of an Algorithm, Proof of Correctness of the Algorithm, Computing the time complexity of the Algorithm.						
Module:2	Analysis of Algorithms	3 hours				
Asymptotic notations and their significance, Running time of an algorithm, Time-complexity of an algorithm, Performance analysis of an algorithm, Analysis of iterative and recursive algorithms, Master theorem (without proof).						
Module:3	Data Structures	7 hours				
Importance of data structures, Arrays, Stacks, Queues, Linked list, Trees, Hashing table, Binary Search Tree, Heaps.						
Module:4	Algorithm Design Paradigms	8 hours				
Divide and Conquer, Brute force, Greedy, Recursive Backtracking and Dynamic programming.						
Module:5	Graph Algorithms	4 hours				
Breadth First Search (BFS), Depth First Search (DFS), Minimum Spanning Tree (MST), Single Source Shortest Paths.						
Module:6	Computational Complexity classes	5 hours				
Tractable and Intractable Problems, Decidable and Undecidable problems, Computational complexity Classes: P, NP and NP complete - Cooks Theorem (without proof),3-CNF-SAT						

Problem, Reduction of 3-CNF-SAT to Clique Problem, Reduction of 3-CNF-SAT to Subset sum problem.			
Module:7	Recent Trends	2 hours	
Algorithms related to Search Engines			
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.		
Reference Books			
1.	Sanjoy Dasgupta, C.Papadimitriou and U.Vazirani , Algorithms , Tata McGraw-Hill, 2008.		
2.	A. V. Aho, J.E. Hopcroft and J. D. Ullman, Data Structures and Algorithms ,Pearson India, 1st Edition, 2002		
3.	A. V. Aho, J.E. Hopcroft and J. D. Ullman, The Design and Analysis of Computer Algorithms ,Pearson,1st edition, 2006.		
4.	Sara Baase , Allen Van Gelder, Computer Algorithms, Introduction to Design and Analysis, 3rd edition, Wesley Longman Publishing, 1999.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Extract the features based on various color models and apply on image and video retrieval	2 hours	
2.	Arrays, loops and Lists	2 hours	
3.	Stacks and Queues	2 hours	
4.	Searching and Sorting	3 hours	
5.	Linked List and operations	4 hours	
6.	Brute force technique	2 hours	
7.	Greedy Technique	2 hours	
8.	Backtracking	2 hours	
9.	Dynamic Programming	2 hours	
10.	Trees and Tree Operations	3 hours	
11.	BFS and DFS	3 hours	
12.	Minimum Spanning Tree	3 hours	
Total Laboratory Hours			30 hours
Mode of assessment: Project/Activity			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

Course code	Course Title	L	T	P	J	C
CSI1001	Principles of Database Systems	2	0	2	0	3
Pre-requisite		Syllabus version				
Course Objectives:						
<ol style="list-style-type: none"> To understand the basic concepts of DBMS and ER Modeling. To comprehend the concepts normalization, query optimization and relational algebra. To apply the concurrency control, recovery, security and indexing for the existent domain problems. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> Acquire a good understanding of the architecture and functioning of database management systems Ability to construct an ER model, derive the relational schemas from the model Analyze and improve a database design by normalization. Ability to associate the basic database storage structure and access techniques including B Tree and B+ Tress Analyze the basics of query evaluation and heuristic query optimization techniques. Learn concepts of concurrency control for the desirable database problem. Analyze the fundamental concepts of recovery mechanisms and learn the recent trends in database. 						
Student Learning Outcomes (SLO): 1, 5, 7						
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having design thinking capability Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning) 						
Module:1	DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE	4 hours			CO: 1	
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			CO: 2	
Entity Relationship Model: Types of Attributes, Relationship, Structural Constraints – Relational Model, Relational Model Constraints – Mapping ER model to a Relational Schema – Integrity Constraints-Extended E-R model - Generalisation – Specialization - Aggregation						
Module:3	DATABASE DESIGN	5 hours			CO: 3	
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 TRANSACTION PROCESSING	5 hours			CO: 4	
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	CO: 5
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	CO: 6
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	CO: 7
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	CO: 7
Total Lecture hours:		30 hours	
Text Book(s)			
1.	R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7 th Edition, 2016.		
2.	A. Silberschatz, H. F. Korth & S. Sudershan, Database System Concepts, McGraw Hill, 7 th 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, 6 th Edition, 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		CO: 2, 5	
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 cursor	3 hours	
7.	Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure	3 hours	
8.	Practicing User Defined Exception and 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. XX.XX				
Course Objectives:						
<ol style="list-style-type: none"> 1. To introduce Operating system concepts, designs and provide the skills required to implement the services. 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 file system. 						
Expected Course Outcome:						
<p>Upon completion of the course, the students will be able to</p> <ol style="list-style-type: none"> 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 stages of 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 principle algorithms for enumerating those tasks. 						
Student Learning Outcomes (SLO):						
		2, 11, 14				
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues 11. Having interest in lifelong learning 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data 						
Module:1	Introduction	4 hours			CO:1, 2	
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			CO:2	
Process Concept, Operations on Processes, Inter-process Communication, Threads - Overview, Multithreading Models.						
Module:3	CPU Scheduling	4 hours			CO:3	
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			CO:4	
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			CO:5	
Introduction, Swapping, Contiguous Memory Allocation, Segmentation, Paging, structure of the Page Table.						

Module:6	Virtual Memory	4 hours	CO:5
Background, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Introduction to Virtualization.			
Module:7	Mass-Storage Structure	4 hours	CO:6
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	CO:6
		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-Dusseu, Andrea C. Arpaci-Dusseu, Operating Systems, Three Easy Pieces, Arpaci-Dusseu Books, Inc (2015).		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Experiments		CO:3, 4, 5, 6	
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

CSE1003	DIGITAL LOGIC AND DESIGN				L	T	P	J	C
					3	0	2	0	4
Pre-requisite	NIL				Syllabus version				
					v1.1				
Course Objectives:									
<ol style="list-style-type: none"> 1. Introduce the concept of digital and binary systems. 2. Analyze and Design combinational and sequential logic circuits. 3. Reinforce theory and techniques taught in the classroom through experiments in the laboratory. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> 1. Comprehend the different types of number system. 2. Evaluate and simplify 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, demultiplexer. 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. 									
Student Learning Outcomes (SLO): 1,2,5,14									
Module:1	INTRODUCTION				3 hours				
Number System - Base Conversion - Binary Codes - Complements(Binary and Decimal)									
Module:2	BOOLEAN ALGEBRA				8 hours				
Boolean algebra - Properties of Boolean algebra - Boolean functions - Canonical and Standard forms - Logic gates - Universal gates – Karnaugh map - Don't care conditions - Tabulation Method									
Module:3	COMBINATIONAL CIRCUIT - I				4 hours				
Adder - Subtractor - Code Converter - Analyzing a Combinational Circuit									
Module:4	COMBINATIONAL CIRCUIT –II				6 hours				
Binary Parallel Adder- Look ahead carry - Magnitude Comparator - Decoders – Encoders - Multiplexers –Demultiplexers.									
Module:5	SEQUENTIAL CIRCUITS – I				6 hours				
Flip Flops - Sequential Circuit: Design and Analysis - Finite State Machine: Moore and Mealy model - Sequence Detector.									
Module:6	SEQUENTIAL CIRCUITS – II				7 hours				
Registers - Shift Registers - Counters - Ripple and Synchronous Counters - Modulo counters - Ring and Johnson counters									
Module:7	ARITHMETIC LOGIC UNIT				9 hours				
Bus Organization - ALU - Design of ALU - Status Register - Design of Shifter - Processor Unit - Design of specific Arithmetic Circuits Accumulator - Design of Accumulator.									

Module:8	Contemporary Issues: RECENT TRENDS	2 hours
	Total Lecture hours:	45 hours
Text Book(s)		
1.	M. Morris Mano and Michael D.Ciletti– Digital Design: With an introduction to Verilog HDL, Pearson Education – 5th Edition- 2014. ISBN:9789332535763.	
Reference Books		
1.	Peterson, L.L. and Davie, B.S., 2007. Computer networks: a systems approach. Elsevier.	
2.	Thomas L Floyd. 2015. Digital Fundamentals. Pearson Education. ISBN: 9780132737968	
3.	Malvino, A.P. and Leach, D.P. and Goutam Saha. 2014. Digital Principles and Applications (SIE). Tata McGraw Hill. ISBN: 9789339203405.	
4.	Morris Mano, M. and Michael D.Ciletti. 2014. Digital Design: With an introduction to Verilog HDL. Pearson Education. ISBN:9789332535763	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Realization of Logic gates using discrete components, verification of truth table for logic gates, realization of basic gates using NAND and NOR gates	4.5 hours
	Implementation of Logic Circuits by verification of Boolean laws and verification of De Morgans law	3 hours
	Adder and Subtractor circuit realization by implementation of Half-Adder and Full-Adder, and by implementation of Half-Subtractor and Full-Subtractor	4.5 hours
	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	4.5 hours
	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	4.5 hours
	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.	4.5 hours
	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.	4.5 hours
Total Laboratory Hours		30 hours
Mode of assessment: Project/Activity		
Recommended by Board of Studies		

Approved by Academic Council	No. 47	Date	05.10.2017
------------------------------	--------	------	------------

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. XX.XX				
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									
Student Learning Outcomes (SLO): 1, 5, 9									
1. Having an ability to apply mathematics and science in engineering applications									
5. Having design thinking capability									
9. Having problem solving ability - solving social issues and engineering problems									
Module:1	Introduction to Languages and Grammars	4 hours	CO: 1						
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	CO: 2,4						
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	CO: 2,3						
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	CO: 1,2						
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	CO: 3,4						
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	CO: 3,4						

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	CO: 1,4
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	CO: 4
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. XX.XX				
Course Objectives:						
<ol style="list-style-type: none"> To familiarize students with the fundamental components, architecture, register organization and performance metrics of a computer. To make students capable for understanding and analyzing the effects of each instruction execution and the data path in those instruction execution. To impart the knowledge of data representation in binary and understand implementation of arithmetic algorithms in a typical computer. 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:						
<ol style="list-style-type: none"> Understand the general architecture of a computer system and the instruction based architecture. Illustrate various binary data representations for fixed and floating point data. Validate efficient algorithm for arithmetic operations. 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. 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. Understand some system performance enhancement techniques such as pipeline concepts, parallel execution, etc. Introduction to some of the advanced architectures. 						
Student Learning Outcomes (SLO):		1, 2, 5				
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having a clear understanding of the subject related concepts and of contemporary issues Having design thinking capability 						
Module:1	Introduction to computer architecture	4 hours		CO:1		
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		CO:1		
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		CO:2		
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		CO:3		
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		CO:4		

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	CO:3
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	CO:5
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	CO:5
Total Lecture hours:		45 hours	
Text Book(s)			
1.	Patterson, D.A., Hennessy, J. L. <i>Computer organization and design: The Hardware/software interface RISC-V edition</i> Morgan Kaufmann, 2017.		
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, <i>Computer organization</i> , Mc Graw Hill, Fifth edition, Reprint 2011.		
Reference Books			
1.	Mano, M. Morris. <i>Computer system architecture</i> . Prentice-Hall of India, 3 rd Edition, 2003.		
2.	<i>Computer Architecture and Organization</i> 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				
Anti-requisite		v. 1.0				
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						
Student Learning Outcomes (SLO):		1, 2, 5				
Module:1	Fundamentals of DC circuits:	Hours: 5		SLO: 1, 2, 5		
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:	Hours: 4	SLO: 1, 2, 5
Introduction to AC circuits, Steady state AC analysis of a RL, RC, RLC Series circuits, AC power calculations.			
Module:3	Digital Systems:	Hours: 4	SLO: 1, 2, 5
Number system, Boolean algebra, Logic circuit concepts, Multiplexer, Demultiplexer, Half adder, Full adder, Computer organization, Memory types, Flip Flops, Counters.			
Module:4	Semiconductor devices:	Hours: 3	SLO: 1, 2
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:	Hours: 4	SLO: 1, 2
Overview of ARM architecture, Different modes of ARM processor, various instructions, 8051 Microcontroller architecture, Applications.			
Module:6	Measuring Instruments and Sensors:	Hours: 5	SLO: 1, 2
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	Hours: 3	SLO: 1, 2
Modulation and Demodulation – Amplitude, frequency, digital modulation, wired and wireless communication – concept and types			
Module:8	Lecture by industry experts.	Hours: 2	SLO: 1, 2, 5
	Total Lecture hours:	Hours: 30	
List of Challenging Experiments (Indicative)			SLO: 1, 2, 5

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, 2 nd Edition, 2014.
4	D.V.S.Murthy, "Transducers and Instrumentation", Prentice Hall of India Learning Pvt. Ltd. 2 nd edition 2012.
5	Simon Haykin; Michael Moher, "An Introduction to Analog and Digital Communications.", Hoboken : Wiley Textbooks, 2 nd 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

MAT1011	Calculus for Engineers	L	T	P	J	C
		3	0	2	0	4
Pre-requisite		Syllabus Version				
		1.0				
Course Objectives :						
<ol style="list-style-type: none"> To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration 						
Expected Course Outcomes:						
At the end of this course the students should be able to						
<ol style="list-style-type: none"> apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates. understand gradient, directional derivatives, divergence, curl and Greens', Stokes, Gauss theorems demonstrate MATLAB code for challenging problems in engineering 						
Student Learning Outcome (SLO):		1, 2, 9				
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- divergence and 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, 13 th edition, Pearson, 2014. [2] Advanced Engineering Mathematics, Erwin Kreyszig, 10 th Edition, Wiley India, 2015.		
Reference Books		
<ol style="list-style-type: none"> Higher Engineering Mathematics, B.S. Grewal, 43rd Edition ,Khanna Publishers, 2015 Higher Engineering Mathematics, John Bird, 6th Edition, Elsevier Limited, 2017. Calculus: Early Transcendentals, James Stewart, 8th edition, Cengage Learning, 2017. 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				
		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 Sturm-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						
Student Learning Outcomes (SLO):		1, 2, 9				
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 of Cauchy-Euler and Cauchy-Legendre differential equations						
Module:4	Solution of differential equations through Laplace 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 <input type="text"/> <input type="text"/>		
Module:5	Strum Liouville's problems and power series Solutions:	6 hours
The Strum-Liouville's Problem - Orthogonality of Eigen functions - Series solutions of differential equations about ordinary and regular singular points - Legendre differential equation - Bessel's differential equation		
Module:6	Z-Transform:	6 hours
Z-transform -transforms of standard functions - Inverse Z-transform: by partial fractions and 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, 10 th Edition, John Wiley India, 2015	
Reference Books		
1.	Higher Engineering Mathematics, B. S. Grewal, 43 rd Edition, Khanna Publishers, India, 2015	
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2 nd Edition, Pearson Education, Indian edition, 2006	
Mode of Evaluation		
Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Quiz, Final Assessment Test		
1.	Solving Homogeneous differential equations arising in engineering problems	2 hours
2.	Solving non-homogeneous differential equations and Cauchy, Legendre equations	2 hours
3.	Applying the technique of Laplace transform to solve differential equations	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	2 hours

	applications	
7.	Applying the Power series method to solve differential equations arising in engineering applications	3 hours
8.	Applying the Frobenius method to solve differential equations arising 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 of Studies		
Approved by Academic Council	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				
		1.0				
Course Objectives:						
To enable the students to understand the basics of the latest advancements in Physics viz., Quantum Mechanics, Nanotechnology, Lasers, Electro Magnetic Theory and Fiber Optics.						
Expected Course Outcome: : Students will be able to						
<ol style="list-style-type: none"> 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 principle of 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 optical fiber communication system. 8. Demonstrate the quantum mechanical ideas 						
Student Learning Outcomes (SLO): 2, 4, 5, 9						
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 evidence of 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 of Optical 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 Hill.	
2.	William Silfvast, Laser Fundamentals, 2008, Cambridge University Press.	
3.	D. J. Griffith, Introduction to Electrodynamics, 2014, 4 th Edition, Pearson.	
4.	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, 3 rd 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.	
7.	Matthew N.O. Sadiku, Principles of Electromagnetics, 2010, Fourth Edition, Oxford.	
8.	Ajoy Ghatak and K. Thyagarajan, Introduction to Fiber Optics, 2010, Cambridge University Press.	
9.	S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, 2008, 3 rd Edition, Wiley.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		CO:

2.	Electron diffraction	2 hrs
3.	Determination of wavelength of laser source (He -Ne laser and diode lasers of different wavelengths) using diffraction technique	2 hrs
4.	Determination of size of fine particle using laser diffraction	2 hrs
5.	Determination of the track width (periodicity) in a written CD	2 hrs
6.	Optical Fiber communication (source + optical fiber + detector)	2 hrs
7.	Analysis of crystallite size and strain in a nano -crystalline film using X-ray diffraction	2 hrs
8.	Numerical solutions of Schrödinger equation (e.g. particle in a box problem) (can be given as an assignment)	2 hrs
9.	Laser coherence length measurement	2 hrs
10.	Proof for transverse nature of E.M. waves	2 hrs
11.	Quantum confinement and Heisenberg's uncertainty principle	2 hrs
12.	Determination of angle of prism and refractive index for various colour – Spectrometer	2 hrs
13.	Determination of divergence of a laser beam	2 hrs
14.	Determination of crystalline size for nanomaterial (Computer simulation)	2 hrs
15.	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				
		2				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ul style="list-style-type: none"> Enabling students to exhibit appropriate presentation and analytical skills 						
Student Learning Outcomes (SLO): 16, 18						
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. 45 th 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				
					1.1				
Course Objectives (CoB): 1,2,3									
<ul style="list-style-type: none"> <input type="checkbox"/> To address the challenge of the relevance of lattice theory, coding theory and algebraic structures to computer science and engineering problems. <input type="checkbox"/> To use number theory, in particular congruence theory to cryptography and computer science problems. <input type="checkbox"/> 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									
<ol style="list-style-type: none"> 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 algebra for minimizing Boolean expressions. 4. learn basic concepts of graph theory, shortest path algorithms, concepts of trees and minimum spanning tree and graph colouring, chromatic number of a graph. 5. Solve Science and Engineering problems using Graph theory. 									
Student Learning Outcomes (SLO):					1, 2, 7				
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	<ul style="list-style-type: none"> • A minimum of 10 problems to be worked out by students in every Tutorial class. • Another 5 problems per Tutorial Class to be given as home work. Mode: Individual Exercises, Team Exercises, Online Quizzes, Online, Discussion Forums	30 hours
Text Book(s)		
<ol style="list-style-type: none"> 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		
<ol style="list-style-type: none"> 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		

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:						
<ol style="list-style-type: none"> To focus on the design of algorithms in various domains To provide a foundation for designing efficient algorithms. 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:						
<ol style="list-style-type: none"> Familiarize students with different algorithmic techniques Apply advanced methods of designing and analyzing algorithms. Choose appropriate algorithms and use it for a specific problem. Understand different classes of problems concerning their computation difficulties. Implement algorithm, compare their performance characteristics, and estimate their potential effectiveness in applications. 						
Student Learning Outcomes (SLO):						
1,5,14						
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having design thinking capability Having an ability to design and conduct experiments, as well as to analyze and interpret data 						
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’,3 rd 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 form a closed path. Let $P = \{p_1, p_2, p_3, \dots, p_n\}$ 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

Student Learning Outcomes (SLO): 1, 5, 7

1. Having an ability to apply mathematics and science in engineering applications
5. Having design thinking capability
7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning)

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, 4 th 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 1.0				
Course Objectives:						
<p>1.To introduce the essential software engineering concepts involved in developing software products and components</p> <p>2. To impart development skills during design, implementation and testing of reliable software systems across various disciplines</p> <p>3. To familiarize engineering practices and standards used in developing software products and components</p>						
Expected Course Outcome:						
<p>1. Apply the principles of Software engineering methodology during software development and deployment process.</p> <p>2. Document various processes like Requirement Engineering, Design and Testing.</p> <p>3. Demonstrate an ability to use the techniques and tools necessary for significant application domains</p> <p>4. Apply software testing and quality knowledge and engineering methods for various applications</p> <p>5. Analyze the effectiveness of managing software projects through various techniques like Estimations, Scheduling and Quality Models</p> <p>6. Apply benchmarking standards in process and in product.</p>						
Student Learning Outcomes (SLO): 6,9,13						
<p>6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints</p> <p>9. Having problem solving ability- solving social issues and engineering problems</p> <p>13. Having cross cultural competency exhibited by working in teams</p>						

Module:1	INTRODUCTION	5 hours
<p>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.</p>		
Module:2	SOFTWARE REQUIREMENT ANALYSIS	5 hours
<p>Requirements Engineering-Establishing the Groundwork-Eliciting Requirements- Developing use cases-Building the requirements model-Negotiating, validating Requirements-Requirements Analysis-Requirements Modeling Strategies.</p> <p>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.</p>		
Module:3	SOFTWARE DESIGN	5 hours
<p>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</p>		
Module:4	SOFTWARE IMPLEMENTATION	4 hours
<p>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.</p>		
Module:5	SOFTWARE TESTING	4 hours
<p>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</p>		

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

<ol style="list-style-type: none"> 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, Addison-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				
Course Objectives:									
<ol style="list-style-type: none"> 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:									
<ol style="list-style-type: none"> 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 									
Student Learning Outcomes (SLO): 1,2,5									
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications. 2. Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems. 5. Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice 									
Module:1	INTRODUCTION TO COMPILATION AND LEXICAL 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)

A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers:

1.	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

<ul style="list-style-type: none"> 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 		
<p>Student Learning Outcomes (SLO): 5,9,17</p>		
<ul style="list-style-type: none"> 5. Having design thinking capability 9. Having problem solving ability- solving social issues and engineering problems 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice 		
Module:1	Introduction	5 hours
<p>Overview of Computing Paradigm, Cloud Computing- NIST Cloud Computing Reference Architecture, Types of Cloud Deployment Models - Private, Public, Hybrid, Agency Clouds</p>		
Module:2	Cloud Service Models	5 hours
<p>Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Anything as a Service(XaaS)</p>		
Module:3	Virtualization	7 hours
<p>Need for Virtualization – Pros and cons of Virtualization, Types - Implementation Levels – CPU, Memory, I/O Devices, Virtual Clusters and Resource management</p>		
Module:4	Cloud Environments	7 hours
<p>Cloud Environments - Case study: One cloud service provider per service model (eg. Amazon EC2, Google App Engine, Sales Force, Microsoft Azure, Open Source tools)</p>		
Module:5	Cloud Application Development	8 hours
<p>Cloud application development using third party APIs, Working with EC2 API – Google App Engine API - Facebook API, Twitter API , HDFS, Map Reduce Programming Model.</p>		

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, 1 st 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”, 2 nd Edition , Springer International Publishing, 2020	
2.	Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing” , 1 st 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”, 2 nd 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	2 hours

	access web page from 2nd VM on another subnetwork	
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.1.00				
Course Objectives:						
<ol style="list-style-type: none"> 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						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):		2,5,9				
2: Having a clear understanding of the subject related concepts and of contemporary issues						
5: Having design thinking capability						
9: Having problem solving ability- solving social issues and engineering problems						
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. Mohamed Rafiquazzaman, “Microprocessor and Microcomputer based system design,” Second edition, Universal Book stall, 1995
2.	K Uday Kumar, B S Umashankar, Advanced Micro processors & IBM-PC Assembly Language Programming, Tata McGraw Hill, 2017.
3.	

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’	2 hours

	are non-negative integers.	
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, palindrome)	2 hours
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:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO):		2,5,6				
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues 5. Having design thinking capability 6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints 						
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, 7 th 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”, 5 th Edition, Pearson, 2011.
4	

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	4 hours

	protocols	
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.						
Student Learning Outcomes (SLO):						
1, 9, 18						
1. Having an ability to apply mathematics and science in engineering applications 9. Having problem solving ability- solving social issues and engineering problems 18. Having critical thinking and innovative skills.						

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 students will use snort as a packet sniffer and write their own IDS rules	4 Hours
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 – <ul style="list-style-type: none">• Create a public/private key pair in PGP• Create a revocation key• 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, 7 th Ed. Pearson Publishers, 2017.
2.	Behrouz A. Forouzan, Cryptography and Network Security:6 th Ed. McGraw-Hill, 2017.

Reference Books

1.	Kaufman, Perlman and Speciner. Network Security: Private Communication in a Public World., 2 nd 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, 4 th 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:						
<p>1. Understand Object Oriented Programming & Functional Programming in Java, Handling Exceptions and Multithreading.</p> <p>2. Able to perform File Handling, Manipulating Strings, Generic Programming.</p> <p>3. Use of Java for Event Handling and Web applications using Servlets.</p>						
Expected Course Outcome:						
At the end of this course students should be able to:						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):						
		1, 9, 14				
<p>1. Having an ability to apply mathematics and science in engineering applications</p> <p>9. Having problem solving ability, solving social issues and engineering problems</p> <p>14. Having an ability to design and conduct experiments, as well as to analyze and interpret data</p>						
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, ActionListener 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”, , 11 th Edition., McGraw-Hill Publishers December 2018.	
2.	Cay S. Horstmann, “Core Java Volume I--Fundamentals”, 11 th Edition. , Pearson Publishers. August 2018.	
Reference Books		
1.	Ben Evans, David Flanagan, “Java in a Nutshell 7 th Edition., O'Reilly Media, Inc. December 2018.	
2.	Joshua Bloch, “Effective Java”.., 3 rd 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
1	Programs to realize the power of Java for internet programming through	4 hours

0.	servlets with JDBC		
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:						
<ol style="list-style-type: none"> 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:						
<p>On completion of this course the students will be able to</p> <ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):		1, 7, 17				
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications 7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning) 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering Practice 						

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, 2 nd edition Cambridge University Press, 2017	
Reference Books		
1.	Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007	
	Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007	
2.	Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", 3 rd Edition, McGraw Hill, 2008	
3		
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. XX.XX				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):		1,5,14				
<ol style="list-style-type: none"> 2. Having an ability to apply mathematics and science in engineering applications 5. Having design thinking capability 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data 						
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				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO):		1, 5, 14				
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications 5. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning) 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data 						
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.	Hadley Wickham, Garrett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize and Model Data, O'Reilly, 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., 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				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO):		1, 5, 14				
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications 5. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning) 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data 						
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, 2 nd 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				
		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.						
Student Learning Outcomes (SLO): 4, 7, 12						
4. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified) 7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning) 12. Having adaptive thinking and adaptability						
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		
<ol style="list-style-type: none"> 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		
<ol style="list-style-type: none"> 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				3	0	0	0	3
Pre-requisite					Syllabus version				
					V. XX.XX				
Course Objectives:									
<ol style="list-style-type: none"> To understand the basics of User Interface Design. To design the user interface, menu creation and windows creation To understand the concept of menus, windows, interfaces, business functions, various problems in windows design with colour, text, Non-anthropomorphic Design. To study the design process and evaluations 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Knowledge on development methodologies, evaluation techniques and user interface building tools Explore a representative range of design guidelines and gain experience in applying design guidelines to user interface design tasks. Ability to design their own Human Computer be able to perform task analysis for user interface design and usability analysis including heuristic analysis understand the innovative features of interactive system and be able to improve existing interfaces by considering these features 									
Student Learning Outcomes (SLO): 6, 8, 17									
<ol style="list-style-type: none"> Having an ability to design a component or a product applying all the relevant standards and with realistic constraints Having Virtual Collaborating ability Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice 									
Module:1	INTERACTIVE SOFTWARE AND INTERACTION DEVICE	6 hours	CO:1,2						
Human – Computer Interface – Characteristics Of Graphics Interface – Direct Manipulation Graphical System – Web User Interface – Popularity – Characteristic & Principles.									
Module:2	HUMAN COMPUTER INTERACTION	6 hours	CO:2						
User Interface Design Process – Obstacles – Usability – Human Characteristics In Design – Human Interaction Speed – Business Functions – Requirement Analysis – Direct – Indirect Methods – Basic Business Functions – Design Standards – General Design Principles – Conceptual Model Design – Conceptual Model Mock-Ups									
Module:3	USER INTERFACE DESIGN PRINCIPLES AND MODELS	8 hours	CO:2,3						
Shneiderman's eight golden rules, Norman's Seven 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 - CMN-GOMS Analysis, Modeling Structure, State Transition Networks - Three-State Model, Glimpse Model, Physical Models.									

Module:4	HUMAN FACTORS IN UI DESIGN	6 hours	CO:3
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 – Functions Of Menus – Contents Of Menu – Formatting – Phrasing The Menu – Selecting Menu Choice – Navigating Menus – Graphical Menus. Operate Control – Text Boxes – Selection Control – Combination Control – Custom Control – Presentation Control			
Module:5	UI DESIGN PROCESS AND EVALUATION	4 hours	CO:2,4
User Interface Design Process - Usability Testing - Usability Requirements and Specification procedures and techniques - User Interface Design Evaluation			
Module:6	MULTIMEDIA & MOBILE USER EXPERIENCE DESIGN	8 hours	CO:2,4
Text For Web Pages – Effective Feedback – Guidance & Assistance – Internationalization – Accessibility – Icons – Image – Multimedia – Coloring - Case Study: Addressing usability in E- Commerce sites			
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 – User Input and Mobile User Experience			
Module:7	USER AND TASK MODELS	5 hours	CO:4,5
Cognitive Models - Socio-organizational Issues and Stakeholder Requirements - Groupware - Ubiquitous Computing - Virtual and Augmented Reality – Multi-model Interface Characteristics — Multi-model interface Types (Voice & Gesture Recognition) - Hypertext and world wide web – Communication and Collaboration models			
Module:8	Recent Trends	2 hours	
		Total Lecture hours:	45 hours
Text Books			
	<ol style="list-style-type: none"> 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, Designing the User Interface: Strategies for Effective Human-Computer Interaction, 3rd Ed., Addison Wesley, 2000. 		
Reference Books			
	<ol style="list-style-type: none"> 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. Wilbent. O. Galitz, “The Essential Guide to User Interface Design”, John Wiley& Sons, 2001. 4. Jenifer Tidwell, “Designing Interfaces”, O’Reilly,2011 5. 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

Course Code	Course Title	L	T	P	J	C
CSI3007	ADVANCED PYTHON PROGRAMMING	2	0	4	0	4
Pre-requisite	CSE1001	Syllabus version				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> To be able to apply advanced python programming concepts for industry standard problems. To perform advanced Data Preprocessing tasks like Data Merging and Mugging To be able to develop powerful Web-Apps using Python 						
Expected Course Outcome:						
<ol style="list-style-type: none"> Understand the nuances of Data Structures Derive an understanding of a classes and objects and their potential Gain knowledge of multithreading concepts and implementing the same Appreciate the difference between different data processing techniques Learn to apply Python features for Data Science Get an insight into Metrics Analysis Develop web-apps and build models for IoT 						
Student Learning Outcomes (SLO): 1, 5, 14						
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning) Having an ability to design and conduct experiments, as well as to analyze and interpret data 						
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 – MATPLOTLIB		
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		Hours
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.						
Student Learning Outcomes (SLO):		2, 5 6				
2. Having a clear understanding of the subject related concepts and of contemporary issues 5. Having design thinking capability 6. Having ability to design a component or a product applying all the relevant standards and with realistic constraints.						
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	

2.	Performance of 4G-LTE Networks: A Practical Approach”, John Wiley & Sons, 2014. W. Stallings, "Wireless Communications and Networks", 2 nd edition, Pearson Education, 2013.
----	--

Reference Books

1.	Dharma Prakash Agrawal and Qing-An Zeng, “Introduction to Wireless and Mobile Systems”, 3 rd edition ,Tomson, , 2011.
2.	Theodore S. Rappaport, “Wireless Communications -Principles Practice”,2 nd 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 INFRASTRUCTURE 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:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes:		2, 9, 12				
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues 9. Having problem solving ability- solving social issues and engineering problems 12. Having adaptive thinking and adaptability 						
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:		
<ol style="list-style-type: none"> 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. <i>Mining multimedia documents</i>. CRC Press, 2017. 		
REFERENCE BOOKS:		
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):						
		2,5,6				
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues. 5. Having design thinking capability. 6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints 						
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

Student Learning Outcomes (SLO): 1, 7, 14

1. Having an ability to apply mathematics and science in engineering applications
7. Having computational thinking (Ability to translate vast data into abstract concepts and to

understand database reasoning).

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

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, Backpropagation 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”, 3 rd ed, Wiley Publications, 2018.
2.	Jang, Jyh-Shing Roger, Chuen-Tsai Sun, and Eiji Mizutani. "Neuro-fuzzy and soft computing- a computational approach to learning and machine intelligence" Pearson, 1997.

Reference Books

1.	D. K. Pratihari, Soft Computing : Fundamentals and Applications (2nd Ed.) (Narosa, 2013)
2.	Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, 3 rd 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

<ul style="list-style-type: none"> • 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:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):		1,5,6				
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications. 5. Having design thinking capability. 6. Having ability to design a component or a product applying all the relevant standards and with realistic constraints. 						
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, Addison-Wesley, 2016	
3	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						
Student Learning Outcomes (SLO):		2,5				
2. Having a clear understanding of the subject related concepts and of contemporary issues.						
5. Having design thinking capability						
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 and 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	Nil	Syllabus version				
		v. 1.0				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO): 2,9,11						
2. Having a clear understanding of the subject related concepts and of contemporary Issues						
9. Having problem solving ability- solving social issues and engineering problems						
11. Having interest in lifelong learning						
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] Steinmetz, Ralf, and Klara Nahrstedt. Multimedia systems. Springer Science & Business Media, 2013.
----	---

2.		
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:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO):		1, 5, 7				
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications 6. Having design thinking capability 7. Having computational thinking (Ability to translate vast data into abstract concepts and to understand database reasoning) 						
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, Collision 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				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> 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						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):		2,12,13				
Having a clear understanding of the subject related concepts and of contemporary issues Having adaptive thinking and adaptability Having cross cultural competency exhibited by working in teams						
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.2.0				

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

Student Learning Outcomes (SLO):	1,9,14
---	---------------

- 1: Having an ability to apply mathematics and science in engineering applications
- 9: Having problem solving ability- solving social issues and engineering problems
- 14: Having an ability to design and conduct experiments, as well as to analyze and interpret data

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” 4 th edition Pearson 2016	
Reference Books		
1.	Saeed B.Nikku, Introduction to robotics, analysis, control and applications, Wiley-India, 2 nd edition 2011	
2.	Richard 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. XX.XX				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):		5, 6, 17				
5. Having design thinking capability						
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints						
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice						
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)		
<p>1. Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5th edition, Pearson Education, 2018.</p> <p>2. Brad Dayley, Node.js, MongoDB, and AngularJS Web Development, Addison Wesley, November 2017.</p>		
Reference Books		
<p>1. Lindsay Bassett, Introduction to JavaScript Object Notation, 1st Edition, O'Reilly Media, 2015</p> <p>2. Fritz Schneider, Thomas Powell, JavaScript – The Complete Reference, 3rd Edition, Mc-Graw Hill, 2017</p> <p>3. Barry Burd, “Java for Dummies”.. 6th Edition, John Wiley & Sons Publishers 2014.</p>		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments :		
1.	<p>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</p> <p>Input Types:- Textfields, Textarea, checkbox, radio button, submit button, reset button, drop down box, images (if required).</p> <p>Apply styles, Formatting tags of HTML for good design.</p> <p>Use HTML 5 new input types to display additional contents</p>	2 hours
2	<p>CSS – internal, external and inline</p> <p>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</p>	3 hours

	brick-wall behind the picture shown, draw_on_canvas () function	
3.	<p>Design the following using JavaScript and DOM</p> <p>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.</p> <p>b) Include Image Slide Show Digital clock, Survey Poll to make your webpage</p> <p style="padding-left: 40px;">i) Dynamic.</p> <p>Develop a web application to implement online quiz system. The application includes only client side script</p>	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.	<p>a) Validate the Event Registration Form given below using JQuery for the following conditions.</p> <p style="padding-left: 40px;">All fields are mandatory</p> <p style="padding-left: 40px;">Zip code should be exactly five digits</p> <p style="padding-left: 40px;">Email validation</p> <p>b) Create a JSON file for a list of cities. Provide autocomplete option for city field using the</p> <p style="padding-left: 40px;">JSON file as source.</p>	4 hours



Event Registration Form

First Name

Last Name

Mailing Address

City

State

Zip Code

Are you speaking at the conference Yes No

Conference Pass 1-day Pass
 2-day Pass
 3-day Pass
 4-day Pass

Meal Preference

Submit

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

- Meenal
- Palak
- Andrea

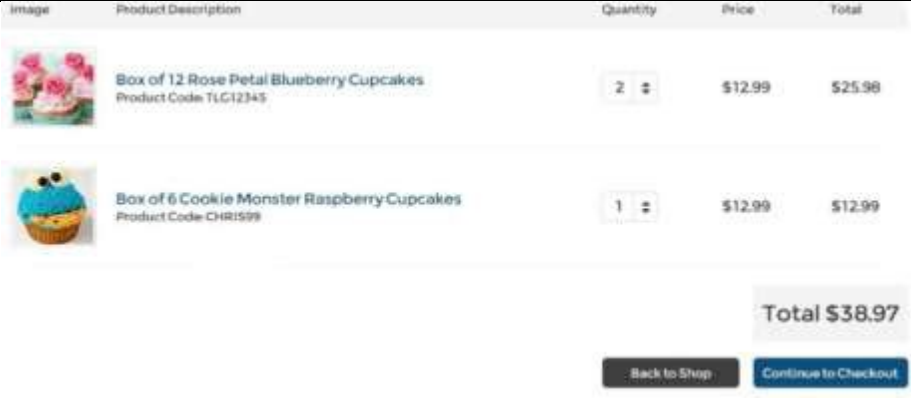
- Meenal
- Palak
- Andrea
- Parul

Parul

add

add

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.	<p>Create a MongoDB collection of “books” with the following details: <i>Title, ISBN(unique id), Authors, Publication ,Year of Publication and Price.</i></p> <p>Write commands for the following:</p> <ol style="list-style-type: none"> Insert a new document with multiple authors. Update a document with change in price Remove documents with year of publication lesser than 1990. 	3 hours
9.	<p>A MongoDB collection of words has the document structure as:</p> <pre>{ word:<word>, first:<first_letter>, last:<last_letter>, size: <character_count> }</pre> <p>Perform the following operations on those documents using Nodejs.</p> <p>Find the set of words which starts with letters ‘a’,’b’ or ‘c’.</p> <p>Find the set of words which exactly has 12 letters.</p> <p>Count the number of words that starts and ends with a vowel.</p> <p>Find the first ten words that end with the letter ‘e’ and display it in descending order.</p>	2 hours
10.	<p>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</p>	2 hours

	maintain account number and balance		
11.	<p>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.</p> <p>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.</p> <p>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.</p>		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. XX.XX				
Course Objectives:						
<p>1. Understand and Acquire the skills of BI lifecycle & its architecture to plan and implement the ETL processes.</p> <p>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.</p> <p>3. Apply Business Performance Management and IT/strategic frameworks that are enabled by Business Intelligence tools and practices</p>						
Expected Course Outcome:						
<p>7. Take initiatives to use BI for Organizational Decision making.</p> <p>8. Plan and execute a BI industrial Project.</p> <p>9. Perform Meta Data Repository Analysis.</p> <p>10. Articulate examples of how businesses are using Business Intelligence tools to enhance competitiveness and profitability.</p> <p>11. Adopt Business Intelligence tools and practices that align with business strategies based on a case analysis.</p>						
Student Learning Outcomes (SLO):						
		1,7, 14				
<p>1. Having an ability to apply mathematics and science in engineering applications</p> <p>7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning</p> <p>14. Having an ability to design and conduct experiments, as well as to analyze and interpret data</p>						

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”, 1 st edition, Springer, 2015.		
Reference Books			
1. 2 3	<p>Gordon Linoff and Michael Berry , “ Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management” , 3rd edition , Wiley 2011.</p> <p>Joseph H. Silverman , “ Introduction to Number Theory, 4th Ed. Boston”, Pearson, 2012</p> <p>Ramesh Sharda, Dursun Delen, and Efraim Turban., “Business Intelligence and Analytics: Systems for Decision Support” , 10th edition, Pearson Education, 2014.</p>		
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.X.X				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO): 2, 9, 17						
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues 9. Having problem solving ability- solving social issues and engineering problems. 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice 						
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 Markov 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				
Anti-requisite		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO):		2, 6, 17				
2. Having a clear understanding of the subject related concepts and of contemporary issues.						
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints						
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice						
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 Converter 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. Brahmkar, 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				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<ol style="list-style-type: none"> 6. Understand the organization and performance characteristics of modern computer architectures. 7. Interpret techniques to improve processor's ability to exploit Instruction Level Parallelism. 8. Point out how data level and thread level parallelisms is exploited in architectures. 9. Identify characteristics and challenges in multiprocessor and multicore architectures. 10. Develop parallel programming for computer problems. 						
Student Learning Outcomes (SLO): 2, 12, 14						
<ol style="list-style-type: none"> 7. Having a clear understanding of the subject related concepts and of contemporary 8. Having adaptive thinking and adaptability 9. Having an ability to design and conduct experiments, as well as to analyse and interpret data 						
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 resources, shared buses, 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				
		1.0				

Course Objectives:		
<ol style="list-style-type: none"> 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:		
<ol style="list-style-type: none"> 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. 		
Student Learning Outcomes (SLO):		
1, 5, 9		
<p>1)Having an ability to apply mathematics and science in engineering applications</p> <p>5)Having design thinking capability</p> <p>9)Having problem solving ability- solving social issues and engineering problems</p>		
Module:1	Basics of Graph and Operations	4 hours
Fundamental concepts - basic definitions of graphs and digraphs -Subgraphs and other graph types-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” 3 rd 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. XX.XX				
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

Student Learning Outcomes (SLO):	1,5,9
---	--------------

1:Having an ability to apply mathematics and science in engineering applications

5:Having design thinking capability

9:Having problem solving ability- solving social issues and engineering problems

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 Remainder 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, 6 th 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	2 hours

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

