VIT®

Vellore Institute of Technology

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

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2023-2024)

M.Tech (CSE) - Virtusa 5-Year Integrated

School of Computer Science and Engineering

M.Tech (CSE) - Virtusa 5 Year Integrated

CURRICULUM AND SYLLABUS

(2023-2024 Admitted Students)

VIT®
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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

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

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

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

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

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

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

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

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.
- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- To foster vibrant outreach programs for industry, research organizations, academia and society.

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School of Computer Science and Engineering

M.Tech (CSE) - Virtusa 5-Year Integrated

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

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M. Tech Computer Science and Engineering
Virtusa 5-Year Integrated

PROGRAMME OUTCOMES (POs)

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

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

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

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

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

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

PO_7 Having adaptive thinking and adaptability

PO_8 Having a clear understanding of professional and ethical responsibility

PO_9 Having cross cultural competency exhibited by working in teams

PO_10 Having a good working knowledge of communicating in English

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

PO_12 Having interest in lifelong learning

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School of Computer Science and Engineering

M.Tech (CSE) - Virtusa 5-Year Integrated

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Apply knowledge of recent computing technologies, skills and current tools of computer science and engineering.

2. Acquire proficiency in Front-end design, expertise in server side frameworks and Data-exchange technologies in the direction of full stack Engineers.

3. Apply technological advancements in end to end industry ready projects and computing skills to carry out research in emerging areas.

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SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

M.Tech Computer Science and Engineering 5 years Integrated (in collaborationwith Virtusa) - MIC

Curriculum – AY (2023–2024)

Sl.NO	Category	Total No. of Credits
1	University Core (UC)	**65**
2	Programme Core (PC)	**81**
3	University Elective (UE)	**12**
4	Programme Elective (PE)	**62**
	Total	**220**

University Core [65 Credits]

Course Code	Course Title	L	T	P	J	C	Pre-Req
ENG1000	Foundation English – I / Foundation English – II (Non Credit)	0	0	4	0	2(0)	
ENG1901/ENG1902	Technical English – I / Technical English – II / Technical English – III / Advanced Technical English	0 0	0 0	0 4	4/2	2/2	A pass in VIT EPT Marks → Foundation English I / Foundation English II
	Foreign Language	2	0	0	0	2	
CHY1002	Environmental Sciences	3	0	0	0	3	
CHY1701	Engineering Chemistry	3	0	2	0	4	
CSE1001	Problem Solving and Programming	0	0	6	0	3	
CSE1002	Problem Solving and Object Oriented Programming	0	0	6	0	3	
HUM1021	Ethics and Values	2	0	0	0	2	
MAT1011	Calculus for Engineers	3	0	2	0	4	
MAT2001	Statistics for Engineers	3	0	2	0	4	MAT1011
MGT1022	Lean Start-up Management	1	0	0	4	2	
PHY1701	Engineering Physics	3	0	2	0	4	
PHY1901	Introduction to Innovative Projects	1	0	0	0	1	
CSI3999	Technical Answers for Real World Problems (TARP)	1	0	0	4	2	PHY1999
CSI4098	Comprehensive Examination	0	0	0	0	1	
CSI4099	Co-op/Capstone Project	0	0	0	0	18	
CSI3099	Industrial Internship	0	0	0	0	1	
EXC4097	Co-Extra Curricular Basket	0	0	0	0	2	
STS5097	Soft Skills (8 Courses)	3	0	0	0	8	
CSI1006	Mini Project	0	0	0	0	4	
	Total	**65 Credits**					

University Elective [12 Credits]

Program Core [81 credits]

Course Code	Course Title	L	T	P	J	C	Pre-Requisite
MAT1014	Discrete Mathematics and Graph Theory	3	2	0	0	4	
MAT1022	Linear Algebra	3	0	0	0	3	
EEE1024	Fundamentals of Electrical and Electronics Engineering	2	0	2	0	3	
CSI2001	Digital logic and Computer Design	3	0	2	0	4	
CSI1004	Computer Organization and Architecture	3	0	0	0	3	
CSI2002	Data Structures and Algorithm Analysis	3	0	2	0	4	
CSI2003	Advanced Algorithms	2	0	2	0	3	CSE2003
CSI2004	Advanced Database Management Systems	3	0	0	0	3	CSI1001
CSI1001	Principles of Database Systems	2	0	2	0	3	
CSI1007	Software Engineering Principles	2	0	2	0	3	
CSI1003	Formal Languages and Automata Theory	3	0	0	0	3	
CSI2005	Principles of Complier Design	3	0	0	0	3	
CSI1002	Operating System Principles	2	0	2	0	3	
CSI3001	Cloud Computing Methodologies	3	0	2	0	4	
CSI2006	Microprocessor and Interfacing Techniques	2	0	2	0	3	
CSI2007	Data Communication and Networks	3	0	2	0	4	
CSI3002	Applied Cryptography and Network Security	2	0	2	0	3	
CSI2008	Programming in Java	3	0	2	0	4	
CSI3003	Artificial Intelligence and Experts Systems	3	0	0	0	3	
CSE2010	Advanced C Programming	2	0	2	0	3	
CSI3025	Application Development and Deployment Architecture	2	0	2	0	3	CSI3023
CSI3023	Advanced Server Side Programming	2	0	2	0	3	CSI3029
CSI3024	Software Application Architecture	3	0	0	0	3	
CSI3029	Front End Design and Testing	2	0	2	0	3	
CSI3026	Machine Learning	2	0	2	0	3	

Program Electives [62 Credits]

MAT2002	Applications of Differential and Difference Equations	3	0	2	0	4	MAT1011
CSI1017	Internetworking with TCP/IP	3	0	0	0	3	
CSI1018	Natural Language Processing and Computational Linguistics	3	0	0	4	4	
CSI1019	Logic and Combinatorics for Computer Science	3	0	0	0	3	
CSI3011	Computer Graphics and Multimedia	3	0	2	0	4	
CSI1021	Computer Oriented Numerical Methods	3	0	2	0	4	
CSI3012	Distributed Systems	3	0	2	0	4	
CSI1023	Text Mining	3	0	0	0	3	
CSI3008	Internet of Everything	3	0	2	0	4	
CSI3006	Soft Computing Techniques	3	0	0	4	4	
CSI3009	Advanced Wireless Networks	3	0	2	0	4	
CSI1027	Augmented Reality and virtual Reality	3	0	0	4	4	
CSI3013	Block chain Technologies	3	0	0	4	4	
CSI1029	Quantum Computing Techniques	3	0	0	0	3	
CSI3014	Software Verification and Validation	3	0	0	0	3	
CSI3021	Advanced Computer Architecture	3	0	0	0	3	
CSI1032	Advances in Pervasive Computing	3	0	0	0	3	
CSI1033	Game Theory	3	0	0	0	3	
CSI1034	GPU Programming	3	0	0	0	3	
CSI3019	Advanced Data Compression Techniques	3	0	0	0	3	
CSI1037	Programming Paradigms	3	0	2	0	4	
CSI3022	Cyber Security and Application Security	3	0	2	0	4	
CSI3020	Advanced Graph Algorithms	3	0	0	0	3	
CSI3015	Software project Management	3	0	0	0	3	
CSI3016	Robotics: Machines and Controls	3	0	0	0	3	
CSI1042	Mathematical Modelling and Simulation	3	0	0	0	3	
CSI1043	Adavanced Predictive Analytics	3	0	2	0	4	
CSI3010	Data Warehousing and Data Mining	3	0	2	0	4	
CSI3027	R Programming	2	0	2	0	3	
MDI3002	Foundations of Data Science	3	0	0	0	3	
CSI3005	Advanced Data Visualization Techniques	3	0	2	0	4	
CSI3028	Deep Learning	3	0	0	0	3	
MCI1012	Fault Tolerant Computing System	3	0	0	0	3	

MCI1013	Vision and Image Processing	3	0	2	0	4	
CSI1045	Cognitive Science and Decision Making	3	0	0	0	3	
CSI1047	Web Mining and social Network Analysis	3	0	0	4	4	
CSI3007	Advanced Python Programming	2	0	4	0	4	CSE1001
	Total	**62 Credits**					

Course Code	Course Title	L	T	P	J	C
CHY1002	Environmental Sciences	3	0	0	0	3

Pre-requisite		Syllabus version
		1.1

Course Objectives:

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

Expected Course Outcome: Students will be able to

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

Module:1	Environment and Ecosystem	7 hours

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

Module:2	Biodiversity	6 hours

Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rarespecies; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity and Aquatic
biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservationmethods.

Module:3	Sustaining Natural Resources andEnvironmental Quality	7 hours

Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. 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, 15th Edition, Cengage learning.
2. George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.

Reference Books

1. David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), 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

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

Course Objectives:

1. To impart technological aspects of applied chemistry
2. To lay foundation for practical application of chemistry in engineering aspects

Expected Course Outcome:

1. 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

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 weight-Numerical problems-three way catalytic converter- selective catalytic reduction of NO_X; 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.
2. Ltd., Educational and Technical Publishers, New Delhi, 3rd Ed., 2015.
3. O.G. Palanna, McGraw Hill Education (India) Pvt. Ltd., 9th Reprint, 2015.
4. B. Sivasankar, Engineering Chemistry 1st Ed., McGraw Hill Education, 2008
5. "Photovoltaic Solar Energy: From Fundamentals to Applications", Angèle Reinders et al., Wiley publishers, 2017.

Reference Books

1. O.V. Roussak and H.D. Gesser, ***Applied Chemistry - A Text Book for Engineers and Technologists***, Springer Science Business Media, New York, 2nd Edition, 2013.
2. S. S. Dara, ***A Text book of Engineering Chemistry,*** S. Chand & Co Ltd., New Delhi, 20th Edition, 2013.

Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

List of Experiments

1.	Experiment title	Hours
2.	Water Purification: Estimation of water hardness by EDTAmethod and its removal by ion-exchange resin	**3 hours**
3.	Water Quality Monitoring: Assessment of total dissolved oxygen in different watersamples by Winkler's method Estimation of sulphate/chloride in drinking water byconductivity method	**6 hours**
4.	Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital-imaging methods	**6 hours**

5.	Arduino microcontroller based sensor for monitoring pH/temperature/conductivity in samples	**3 hours**
6.	Iron in carbon steel by potentiometry	**3 hours**
7.	Construction and working of an Zn-Cu electrochemical cell	**3 hours**
8.	Determination of viscosity-average molecular weight ofdifferent natural/synthetic polymers	**6 hours**
9.	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 4. Construction of dye sensitized solar cell and demonstration of its working 5. Calcium in food samples 6. Air quality analysis	Non-contact hours
	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

Course Code	Course Title	L	T	P	J	C
CSE1001	PROBLEM SOLVING AND PROGRAMMING	0	0	6	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

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

Expected Course Outcome: After completion of this course, the student shall be able to:

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

List of Challenging Experiments (Indicative)

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

17	Files and its Operations	6 Hours
	Total hours:	**90 hours**

Text Book(s)	
1.	John V. Guttag., 2016. Introduction to computation and programming using python: with applicationsto 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

Course Code	Course Title	L	T	P	J	C
CSE1002	PROBLEM SOLVING AND OBJECT ORIENTED PROGRAMMING	0	0	6	0	3
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To emphasize the benefits of object oriented concepts.

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

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

Expected Course Outcome: After completion of this course, the student shall be able to:

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

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

3.Demonstrate the usage of classes and objects of the real world entities in applications.

4.Discriminate the reusability and multiple interfaces with same functionality based features to solve complex computing problems.

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

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

List of Challenging Experiments (Indicative)

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

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

	almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), andthymine (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, givena 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 minimumcable required.	10 hours
	Total Laboratory Hours	**90 hours**

Text Book(s)	
1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, C++ primer, Fifth edition, Addison-Wesley, 2012.
2	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999.
3	Brian W. Kernighan, Dennis M. Ritchie , The C programming Language, 2nd edition, Prentice Hall Inc., 1988.

Reference Books	
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Eduction, 2014.

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

HUM1021	ETHICS AND VALUES	L	T	P	J	C
		2	0	0	0	2
Pre-requisite	**Nil**	**Syllabus version**				
		1.2				

Course Objectives:

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

Expected Course Outcome:

Students will be able to:

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

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

Gandhian values such as truth and non-violence – comparative analysis on leaders of past and present

– society's interests versus self-interests–Personal Social Responsibility: Helping the needy,charity and serving the society.

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

Harassment – types - Prevention of harassment, violence and terrorism

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

Corruption: ethical values, causes, impact, laws, prevention – electoral malpractices white collarcrimes – 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 andprevention

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

Dishonesty - Stealing - Malpractices in Examinations – Plagiarism

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

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

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

Reference Books

1. Dhaliwal, K.K (2016), "Gandhian Philosophy of Ethics: A Study of Relationship between hisPresupposition and Precepts, Writers Choice, New Delhi, India
2. Vittal, N (2012), "Ending Corruption? - How to Clean up India?", Penguin Publishers, UK
3. Pagliaro, L.A. and Pagliaro, A.M (2012), "Handbook of Child and Adolescent Drug and

	Substance Abuse: Pharmacological , Developmental and Clinical Considerations", Wiley Publishers, U.S.A		
4.	Pandey, P. K (2012), "Sexual Harassment and Law in India", Lambert Publishers, Germany		
Mode of Evaluation: CAT, Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	26.07.2017		
Approved by Academic Council	46th ACM	**Date**	24.08.2017

Course Code	Course Title	L	T	P	J	C
MAT1011	Calculus for Engineers	3	0	2	0	4
Pre-requisite		Syllabus Version				
		1.0				

Course Objectives :

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

Expected Course Outcomes:

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

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

Module:1	Application of Single Variable Calculus	9 hours

Differentiation- Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem-Increasing and Decreasing functions and First derivative test-Second derivative testMaxima and Minima-Concavity. Integration-Averagefunction 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 functionsLaplace transform of unit step function, Impulse function-Inverse Laplace transformConvolution.

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 derivativedivergence 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, 13th edition, Pearson, 2014.
[2] Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley India, 2015.

Reference Books

1. Higher Engineering Mathematics, B.S. Grewal, 43rd Edition ,Khanna Publishers, 2015
2. Higher Engineering Mathematics, John Bird, 6th Edition,Elsevier Limited, 2017.
3. Calculus: Early Transcendentals, James Stewart, 8th edition, Cengage Learning, 2017.
4. Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 7thEdition, 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 – Symbolic computations using MATLAB	3 hours
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

Course Code	Course Title	L	T	P	J	C
MAT2001	Statistics for Engineers	3	0	2	0	4

Prerequisites	MAT1011 – Calculus for Engineers	Syllabus Version: 1.1

Course Objectives :

1. To provide students with a framework that will help them choose theappropriate descriptive methods in various data analysis situations.
2. To analyse distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Expected Course Outcome:

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

1. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.
6. demonstrate R programming for statistical data

Module: 1	Introduction to Statistics	6 hours

Introduction to statistics and data analysis-Measures of central tendency –Measures of variability-[Moments-Skewness-Kurtosis (Concepts only)].

Module: 2	Random variables	8 hours

Introduction -random variables-Probability mass Function, distribution and density functions - joint Probability distribution and joint density functions- Marginal, conditional distribution and density functions- Mathematical expectation, and its properties Covariance , moment generating function – characteristic function.

Module: 3	Correlation and regression	4 hours

Correlation and Regression – Rank Correlation- Partial and Multiple correlation-Multiple regression.

Module: 4	Probability Distributions	7 hours

Binomial and Poisson distributions – Normal distribution – Gamma distribution –

Exponential distribution – Weibull distribution.		
Module: 5	**Hypothesis Testing I**	**4 hours**
Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis-Large sample tests- Z test for Single Proportion, Difference of Proportion, mean and difference of means.		
Module: 6	**Hypothesis Testing II**	**9 hours**
Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance – one and two way classifications - CRD-RBD- LSD.		
Module: 7	**Reliability**	**5 hours**
Basic concepts- Hazard function-Reliabilities of series and parallel systems- SystemReliability - Maintainability-Preventive and repair maintenance- Availability.		
Module: 8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours	**45 hours**

Text book(s)

- Probability and Statistics for engineers and scientists, R.E.Walpole, R.H.Myers, S.L.Mayers and K.Ye, 9th Edition, Pearson Education (2012).
- Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th Edition, John Wiley & Sons (2016).

Reference books

- Reliability Engineering, E.Balagurusamy, Tata McGraw Hill, Tenth reprint 2017.
- Probability and Statistics, J.L.Devore, 8th Edition, Brooks/Cole, Cengage Learning (2012).
- Probability and Statistics for Engineers, R.A.Johnson, Miller Freund's, 8th edition, Prentice Hall India (2011).
- Probability, Statistics and Reliability for Engineers and Scientists, Bilal M. Ayyub and Richard H. McCuen, 3rd edition, CRC press (2011).

Mode of Evaluation

Digital Assignments, Continuous Assessment Tests, Quiz, Final Assessment Test.

List of Experiments (Indicative)		
•	Introduction: Understanding Data types; importing/exporting data.	3 hours
•	Computing Summary Statistics /plotting and visualizing	3 hours

	data using Tabulation and Graphical Representations.	
•	Applying correlation and simple linear regression model toreal dataset; computing and interpreting the coefficient of determination.	3hours
•	Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.	3 hours
•	Fitting the following probability distributions: Binomial distribution	3 hours
•	Normal distribution, Poisson distribution	3 hours
•	Testing of hypothesis for One sample mean and proportionfrom real-time problems.	3 hours
	Testing of hypothesis for Two sample means and proportion from real-time problems	3 hours
•	Applying the t test for independent and dependent samples	2 hours
•	Applying Chi-square test for goodness of fit test andContingency test to real dataset	2 hours
•	Performing ANOVA for real dataset for Completelyrandomized design, Randomized Block design ,Latin square Design	2 hours
	Total laboratory hours	**30 hours**

Mode of Evaluation			
Weekly Assessment, Final Assessment Test			
Recommended by Board of Studies	25-02-2017		
Approved by Academic Council	47	Date:	05-10-2017

MGT1022	LEAN START-UP MANAGEMENT	L	T	P	J	C
		1	0	0	4	2
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives:

To develop the ability to

1. Learn methods of company formation and management.
2. Gain practical skills in and experience of stating of business using pre-set collection of business ideas.
3. Learn basics of entrepreneurial skills.

Expected Course Outcome:

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

1. Understand developing business models and growth drivers
2. Use the business model canvas to map out key components of enterprise
3. Analyze market size, cost structure, revenue streams, and value chain
4. Understand build-measure-learn principles
5. Foreseeing and quantifying business and financial risks

Module: 1		**2hours**
Creativity and Design Thinking (identify the vertical for business opportunity, understand your customers, accurately assess market opportunity)		
Module: 2		**3 hours**
Minimum Viable Product (Value Proposition, Customer Segments, Build-measure-learn process)		
Module: 3		**3hours**
Business Model Development (Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes, Businessmodel canvas–the lean model-templates)		
Module: 4		**3 hours**
Business Plan and Access to Funding (visioning your venture, taking the product / service to market, Market plan including Digital & Viral Marketing, start-up finance – Costs / Profits & Losses / cash flow, Angel / VC / Bank Loans and Key elements of raising money)		
Module: 5		**2hours**
Legal, Regulatory, CSR, Standards,Taxes		
Module: 6		**2 hours**
Lectures by Entrepreneurs		
Total Lecture hours		**15 hours**

Text Book (s)

1.	Steve Blank, K & S Ranch (2012)The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, 1st edition
2.	Steve Blank (2013) The Four Steps to the Epiphany, K&S Ranch; 2nd edition
3.	Eric Ries (2011) The Lean Startup: How Today's Entrepreneurs Use Continuous

	Innovation to Create Radically Successful Businesses, Crown Business			
Reference Books				
1.	Holding a Cat by the Tail, Steve Blank, K & S Ranch Publishing LLC (August 14, 2014)			
2.	Product Design and Development, Karal TUlrich, SDEppinger, McGrawHill			
3.	Zero to One: Notes on Startups, or How to Build the Future, Peter Thiel, Crown Business (2014)			
4.	Lean Analytics: Use Data to Build a Better Startup Faster (Lean Series), Alistair Croll & Benjamin Yoskovitz, O' Reilly Media; 1st Edition (March 21, 2013)			
5.	Inspired: How to create Products Customers Love, Marty Cagan,S VPG Press; 1st edition (June18, 2008)			
6.	**Website References:** 1. http://theleanstartup.com/ 2. https://www.kickstarter.com/projects/881308232/only-on-kickstarter-the-leaders-guide-by-eric-ries 3. http://businessmodelgeneration.com/ 4. https://www.leanstartupmachine.com/ 5. https://www.youtube.com/watch?v=fEvKo90qBns 6. http://thenextweb.com/entrepreneur/2015/07/05/whats-wrong-with-the-lean-startup-methodology/#gref 7. http://www.businessinsider.in/Whats-Lean-about-Lean-Startup/articleshow/53615661.cms 8. https://steveblank.com/tools-and-blogs-for-entrepreneurs/ 9. https://hbr.org/2013/05/why-the-lean-start-up-changes-everything 10. chventures.blogspot.in/platformsandnetworks.blogspot.in/p/saas-model.html			
Teaching Modes: Assignments; Field Trips, Case Studies; e-learning; Learning through research, TED Talks				
Project				
1.	Project	60 hours		
Total Project		**60 hours**		
Recommended by Board of Studies		08.06.2015		
Approved by Academic Council		37th ACM	**Date**	16.06.2015

Course Code	Course Title	L	T	P	J	C
PHY1701	Engineering Physics	3	0	2	0	4

Pre-requisite	Physics of 12th standard or equivalent	Syllabus version
		1.0

Course Objectives:

1. 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

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

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 Nanomaterials, 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
2. Hill.
3. William Silfvast, Laser Fundamentals, 2008, Cambridge University Press.
4. D. J. Griffith, Introduction to Electrodynamics, 2014, 4th Edition, Pearson.
5. Djafar K. Mynbaev and Lowell L.Scheiner, Fiber Optic Communication Technology, 2011, Pearson

Reference Books

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

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		**CO:8**
1.	Determination of Planck's constant using electroluminescence process	2 hrs
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

PHY1901	INTRODUCTION TO INNOVATIVE PROJECTS	L	T	P	J	C
		1	0	0	4	2
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

This course is offered to the students in the 1st Year of B. Tech. in order to orient them towards independent, systemic thinking and be innovative.

1. To make students confident enough to handle the day to day issues.
2. To develop the "Thinking Skill" of the students, especially Creative Thinking Skills
3. To train the students to be innovative in all their activities
4. To prepare a project report on a socially relevant theme as a solution to the existing issues

Expected Course Outcome:

1. To understand the various types of thinking skills.
2. To enhance the innovative and creative ideas.
3. To find out a suitable solution for socially relevant issues-J component

Module: 1A	Self Confidence	1 hour

Understanding self – Johari Window – SWOT Analysis – Self Esteem – Being a contributor – Case Study

Project : Exploring self, understanding surrounding, thinking about how s(he) can be acontributor Forthe society, Creating a big picture of being an innovator–writing a 1000 words imaginary Autobiography of self–Topic "Mr. X–the great innovator of 2015" and upload. (**non-contact hours)**

Module: 1B	Thinking Skill	1 hour

Thinking and Behaviour–Types of thinking–Concrete– Abstract, Convergent, Divergent, Creative, Analytical, Sequential and Holistic thinking–Chunking Triangle–Context Grid – Examples – Case Study.

Project: Meeting atleast 50 people belonging to various strata of life and talk to them / make field visits to identify a min. of 100 society related issues, problems for which they need solutions and categories them and upload along with details of people met and lessons learnt. **(4 non-contact hours)**

Module: 1C	Lateral ThinkingSkill	1 hour

Blooms Taxonomy–HOTS–Out of the box thinking–de Bono lateral thinking model–Examples

Project : Last weeks-incomplete portion to be done and uploaded

Module: 2A	Creativity	1 hour

Creativity Models–Walla–Barrons–Koberg & Begnall–Examples

Project: Selecting 5 out of 100 issues identified for future work. Criteria based approach for prioritisation, use of statistical tools & upload. **(4 non-contact hours)**

Module: 2B	Brain storming	1 hour

25 brainstorming techniques and examples

Project: Brainstorm and come out with as many solutions as possible for the top 5 issues identified & upload. **(4 non-contact hours)**

Module: 3	Mind Mapping	1 hour

Mind Mapping techniques and guidelines. Drawing a mind map **Project:** Using Mind Maps get another set of solutions for the next 5 issues (issue 6–10). **(4 non-contact hours)**		
Module: 4A	**Systems thinking**	**1 hour**
Systems Thinking essentials–examples–Counter Intuitive condemns **Project:** Select 1 issue / problem for which the possible solutions are available with you. Apply Systems Thinking process and pick up one solution [explanation should be given why the other possible solutions have been left out].Goback to the customer and assess the acceptability and upload. **(4 non-contact hours)**		
Module: 4B	**Design Thinking**	**1 hour**
Design thinking process–Human element of design thinking– case study **Project:** Apply design thinking to the selected solution; apply the engineering & scientific tinge to it. Participate in "design week" celebration sup load the weeks learning out come.		
Module: 5A	**Innovation**	**1 hour**
Difference between Creativity and Innovation–Examples of innovation–Being innovative. **Project:** A literature searches on proto typing of your solution finalized. Prepare a proto type model or processand upload. **(4 non-contact hours)**		
Module: 5B	**Blocks for Innovation**	**1 hour**
Identify Blocks for creativity and innovation – overcoming obstacles – Case Study **Project:** Project presentation on problem identification, solution, innovations-expected results–Interim review with PPT presentation. **(4 non-contact hours)**		
Module: 5C	**Innovation Process**	**1 hour**
Steps for Innovation–right climate for innovation **Project:** Refining the project, based on the review report and uploading the text. **(4 non-contact hours)**		
Module: 6A	**Innovation in India**	**1 hour**
Stories of 10 Indian innovations **Project:** Making the project better with add ons. **(4 non- contact hours)**		
Module: 6B	**JUGAAD Innovation**	**1 hour**
Frugal and flexible approach to innovation-doing more with less Indian Examples **Project:** Fine tuning the innovation project with JUGAAD principles and uploading (Credit for JUGAAD implementation). **(4 non-contact hours)**		
Module: 7A	**Innovation Project Proposal Presentation**	**1 hour**
Project proposal contents, economicinput, ROI–Template **Project:** Presentation of the innovative project proposal and upload. **(4 non- contact hours)**		
Module: 8A	**Contemporary issue in Innovation**	**1 hour**
Contemporary issue in Innovation **Project:** Final project Presentation, Vivavoce Exam (**4 non-contact hours)**		
Total Lecture hours		**15 hours**
Text Book(s)		
1.	How to have Creative Ideas, Edward debone,Vermil on publication, UK, 2007	

2.	The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd., UK, 2008		
Reference Books			
1.	Creating Confidence, Meribeth Bonct, Kogan Page India Ltd., New Delhi, 2000		
2.	Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008		
3.	Indian Innovators, Akhat Agrawal, Jaico Books, Mumbai, 2015		
4.	JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar Three reviews with weightage of 25 : 25 : 50 along with reports			
Recommended by Board of Studies			
Approved by Academic Council	37	**Date**	16.06.2015

Course Code	Course Title	L	T	P	J	C
STS1022	Introduction to Personal Skills	3	0	0	0	1
Pre-requisite		Syllabus version				
		2				

Course Objectives:

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

Expected Course Outcome:

- Enabling students to exhibit appropriate presentation and analytical skills

Module:1	Presentation skills – Preparing presentation and Organizing materials and Maintaining and preparing visual aids and Dealing with questions	7 hours

10 Tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test, Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation, Importance and types of visual aids, Animation to captivate your audience, Design of posters, Setting out the ground
rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions

Module:2	Analytical Writing – Articulate and support complex ideas	6 hours

30 minute - Analyse an Issue, 30 minute - Analyse an Argument, Construct and Evaluate arguments ,Focused and Coherent discussion

Module:3	Speed Reading and Things to avoid during speed reading	6 hours

Skimming, Meta guiding, Auditory reading, Visual reading, Eye span expansion, Pareto principle,Applications of Pareto principle, Sub-vocalization, Regression, Pen Tracing

Module:4	Debate	8 hours

Idea generation, Research, Articulating, Style, Preparation of arguments –Rebuttal, Use of statistics,Practice rounds

Module:5	PEST Analysis	7 hours

SLEPT, STEEPLE, 360 Feedback

Module:6	Lean Concepts	3 hours

Product life cycle, Waste reduction, Technology change, Product support

Module:7	Listening	8 hours

Types of Listening, Hearing, Focus, Voice, Verbal and Non-verbal messages

	Total Lecture hours:	45 hours

Reference Books

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

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

PROGRAMME CORE

Course Code	Course Title	L	T	P	J	C
MAT1014	Discrete Mathematics and Graph Theory	3	2	0	0	4
Pre-requisite	None	Syllabus Version				
		1.1				

Course Objectives (CoB): 1,2,3

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

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

At the end of this course, students are expected to

1. Form truth tables, proving results by truth tables, finding normal forms,
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 agraph.
5. Solve Science and Engineering problems using Graph theory.

Module:1	Mathematical Logic and Statement Calculus	6 hours

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

Module:2	Predicate Calculus	4 hours

The Predicate Calculus - Inference Theory of the Predicate Calculus.

Module:3	Algebraic Structures	5 hours

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

Module:4	Lattices	5 hours

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

Module:5	Boolean algebra	5 hours

Boolean algebra - Boolean Functions-Representation and Minimization ofBoolean Funtions-Karunaugh 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-Treetraversals-Fundamentalcircuitsandcut-sets.Bipartitegraphs-Chromatic number – Chromatic partitioning – Chromatic polynomial - matching – Covering–Four Colour problem.		
Module:8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorialclass. • Another 5 problems per Tutorial Class to be given as homework. **Mode:** Individual Exercises, Team Exercises, Online Quizzes, Online, Discussion Forums	**30 hours**

Text Book(s)

1. DiscreteMathematicalStructureswithApplicationstoComputerScience,J.P. Trembley and R. Manohar, Tata McGraw Hill-35th reprint,2017.
2. GraphtheorywithapplicationtoEngineeringandComputerScience,Narasing Deo, Prentice Hall India 2016.

Reference Books

1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, TataMcGraw 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. DiscreteMathematics, S.LipschutzandM.Lipson, McGrawHillEducation(India)2017.
5. ElementsofDiscreteMathematics–AComputerOrientedApproach,C.L.Liu,TataMcGraw Hill, Special Indian Edition,2017.
6. IntroductiontoGraphTheory,D.B.West,3rdEdition,Prentice-Hall,EnglewoodCliffs,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	Course title	L	T	P	J	C
MAT1022	Linear Algebra	3	0	0	0	3
Pre-requisite	MAT1011	Syllabus Version				

Course Objectives :

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

Course Outcome :

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

Module:1	System of Linear Equations:	6 hours

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

Module:2	Vector Spaces	6 hours

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

Module:3	Subspace Properties:	6 hours

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

Module:4	Linear Transformations and applications	7 hours

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

Module:5	Inner Product Spaces:	6 hours

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

Module:6	Applications of Inner Product Spaces:	6 hours

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

Module:7	Applications of Linear equations :	6 hours

An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption.			
Module:8	**Contemporary Issues:**	**2 hours**	
Industry Expert Lecture and R & D.			
	Total Lecture hours:	**45 hours**	
Text Book(s)			
Linear Algebra, JinHoKwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1,3,4 &5) Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.			
Reference Books			
1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016) 2. Applied Abstract Algebra, Rudolf Lidl, GuterPilz, 2nd Edition, Springer 2004. 3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003 4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).			
Mode of Evaluation			
Digital Assignments,Continuous Assessments, Final Assessment Test			
Recommended by Board of Studies	30.06.2021		
Approved by Academic Council		Date	

Course code	Course Title	L	T	P	J	C
EEE1024	Fundamentals of Electrical and Electronics Engineering	2	0	2	0	3

Pre-requisite	Nil	Syllabus version
		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: : Students will be able to

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

1. Solve simple DC circuits using me and no data 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 semi conduct or devices and circuits
5. Interpret the architecture of microprocessor & microcontrollers
6. Measure the various signals using the sensors
7. Discuss the overview of communication systems.
8. Design and Conduct experiments ,as well as analyze and interpret data

Module:1	Fundamentals of DC circuits:	Hours:5	

Basic circuit elements and sources, Ohms law, Kirchhoff's laws, Node voltage analysis, Meshcurrent analysis, Thevenin's and Maximum power transfer the orem.

Module:2	Fundamentals of AC Circuits:	Hours:4	

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

Module:3	Digital Systems:	Hours:4	

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

Module:4	Semi conduct or devices:	Hours:3	

Conduction in semi conduct or materials, principle of operation, V-I characteristics of Conjunction diode, Zener diode, BJT, half wave rectifier, full wave rectifier.

Module:5	Micro processor & microcontroller:	Hours:4	

Overview of ARM architecture, Different modes of ARM processor, various instructions, 8051 Micro controller architecture, Applications.			
Module:6	**Measuring Instruments and Sensors:**	**Hours:5**	
Measuring Instruments: Classification of instruments, Working principle of PMMC, MI, Digital & Smart Meters, Ammeter, Volt meter & watt meter. **Sensors:** Transducers classification & selections, Resistive, Inductive and capacitive sensors, Optical and Digital sensors			
Module:7	**Communication systems**	**Hours:3**	
Modulation and Demodulation– Amplitude, frequency, digital modulation, wired and wireless communication –concept and types			
Module:8	**Contemporary issues**	**Hours:2**	
Total Lecture hours:		**Hours:30**	

SoftwareExperiments		
1.	Analysis and verification of circuit using Mesh and Nodal analysis	2 hrs
2.	Verification of network the orems using Maximum power transfer	2 hrs
3.	Analysis of Single AC circuit with R, RL and RC loads	2 hrs
4.	Design of half adder and full adder	2 hrs
5.	Single phase halfwave	2 hrs
6.	Full wave rectifier	2 hrs
7.	Design of controlled switch using BJT	2 hrs
Hardware Experiment		
1.	Verification of network the orems using Thevenin’s	2 hrs
2.	Regulated power supply using Zener diode	2 hrs
3.	Design of alamp dimmer circuit using Darling to n pair	2 hrs
4.	Design and verification of logic circuit by simplifying the Boolean expression	2 hrs
5.	Calibration of voltmeter and Ammeter	2 hrs

6.	Wiring connection for Fan	2 hrs
7.	Staircase wiring layout formulti-storied building	2 hrs
8.	Study on Microprocess or kit	2 hrs
	Total Laboratory Hours	**30 hrs**

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 G illispie Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson education, 2nd Edition, 2014.
4	D.V.S.Murthy, "Transducers and Instrumentation", Prentice Hall of India Learning Pvt. Ltd.2nd edition 2012.
5	Simon Haykin; Michael Moher, "An Introduction to Analog and Digital Communications.", Hoboken :WileyTextbooks,2ndEdition ,2012.
Reference Books	
1.	Charles K Alexander, Mathew NOS a diku,'Fundamentals of Electric Circuits',TataMcGrawHill,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,December1994.
4.	D.Roy Choudhary, ShailB. Jain,'Linear Integrated Circuits',4th/e,New Age International, 2010.
5.	A.K.Sawhney,"A Course In Electrical And Electronic Measurements And Instrumentation", Dhanpat Rai Publications, 2012.

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

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

Course Objectives:

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

Expected Course Outcomes:

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

1. Differentiate and represent the different types of number system.
2. Express and reduce the logic functions using Boolean Algebra and K-map.
3. Design minimal combinational logic circuits.
4. Analyze the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, 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.

2. Having a clear understanding of the subject related concepts and of contemporary issues
5. Having design thinking capability
14. Ability to design and conduct experiments, as well as to analyze and interpret data.

Module:1	INTRODUCTION TO DIGITAL LOGIC	3 hours

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

Module:2	BOOLEAN ALGEBRA	6 hours

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

Module:3	INTRODUCTION TO COMBINATIONAL CIRUIT	6 hours

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

Module:4	DESIGN AND ANALYSES OF COMBINATIONAL CIRCUIT	9 hours

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

Module:5	SEQUENTIAL CIRCUITS	7 hours

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

Module:6	DESIGN OF REGISTERS AND COUNTERS	6 hours

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

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

Text Book

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

Reference Books

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

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

List of Indicative Experiments

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

	leaves the queue, the count is reduced by one and the count is increased by one if a customer joins a queue. Two sensors (control signals) are used to sense customers leaving and joining the queue respectively. Design a circuit that displays the number of customers waiting in the queue in binary format using LEDs. Binary 1 is represented by LED glow and 0 otherwise.			
			Total Laboratory Hours	30 hours
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
Recommended by Board of Studies	05.02.2020			
Approved by Academic Council	No. 61	Date	18.02.2021	

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:

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

Expected Course Outcome:

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

Module:1	Introduction to computer architecture	4 hours	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	7 hours	CO:4

	fundamentals		
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. *Computer organization and design:The Hardware/software interface RISC-V edition* Morgan Kaufmann, 2017.
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.

Reference Books

1.	Mano, M. Morris. *Computer system architecture*. Prentice-Hall of India, 3rd Edition, 2003.
2.	Computer Architecture and Organization by William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003

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

Course Code	Course Title	L	T	P	J	C
CSI2002	DATA STRUCTURES AND ALGORITHM ANALYSIS	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v. xx.xx				

Course Objectives:

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

Expected Course Outcomes:

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

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

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 DATA STRUCTURES	5 hours

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

Module:2	ANALYSIS OF ALGORITHMS	5 hours

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

Module:3	LISTS, STACKS AND QUEUES	9 hours

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

Module:4	TREES	6 hours

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

Module:5	HASHING AND HEAPS	6 hours

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

Module:6	**SORTING**	**5 hours**
Preliminaries, Insertion Sort, Bubble Sort, Selection Sort, Shell Sort, Merge Sort, Quick Sort, Radix Sort		
Module:7	**GRAPH ALGORITHMS**	**7 hours**
Types of Graphs, Graph Representation, Shortest Path Algorithm: Dijikstra's Algorithm, Floydd Warshal's Algorithms, Graph Traversal, Minimum Spanning Tree		
Module:8	**RECENT TRENDS**	**2 hours**

	Total Lecture hours:	**45 hours**	

Text Book(s) and Journals	
1.	Mark Allen Weiss, "Data structures and algorithm analysis in C", 2nd edition, Pearson education, 2013.
Reference Books	
1.	Debasis Samanta, "Classic data structures", PHI, 2nd edition, 2014.
2.	Seymour Lipschutz "Data Structures by Schaum Series" 2nd edition,TMH 2013.
3.	Adam Drozdek, "Data structures and algorithms in C++", Cengage learning, 4th edition, 2015.
4.	Michael Goodrich, Roberto Tamassta, Michael H.GoldWasser "Data structures and algorithms in Java" 6th Edition, 2014.
	Authors, book title, year of publication, edition number, press, place
Mode of Evaluation: CAT / Assignment / Quiz / FAT / LAB / Seminar	
List of Indicative Experiments	
1.	Arrays , Loops and Structures
2.	Stack Implementations
3.	Stack Applications: Infix to postfix conversion, evaluation of postfix notation
4.	Queue and its applications
5.	Singly and doubly linked lists.
6.	Circular Singly Linked list
7.	Represent a polynomial as a linked list and write functions for polynomial addition.
8.	Insertion, Bubble, and selection sorts
9.	Merge and quick Sort
10.	Linear and Binary Search
11.	Binary tree. pre-order, in-order, and post-order traversals.
12.	Binary search tree insertion and deletion.
13,	Graph traversal
14.	Shortest Path Algorithm
Total Laboratory Hours	30 hours
Mode of assessment: CAT / Assignment / Quiz / FAT / Seminar	

Recommended by Board of Studies	05.02.2020		
Approved by Academic Council	No. 61	Date	18.02.2021

Course code	ADVANCED ALGORITHMS	L	T	P	J	C
CSI2003		2	0	2	0	3
Pre-requisite	CSE2003	Syllabus version				
		v. 1.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Algorithm Design Techniques	5hours

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

Module:2	Network Flow	4 hours

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

Module:3	Computational Complexity	5 hours

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

Module:4	Randomized Algorithms	3 hours

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

Module:5	Approximation Algorithms	4 hours

Limits to Approximability, Bin Packing (First fit, Best fit),2 – Approximation algorithm for Metric TSP, Euclidean TSP, Max-SAT and Vertex Cover

Module:6	Computational Geometry	4 hours

Segment-intersection algorithm, Algorithms for finding convex hull: Graham's scan, Gift wrapping Algorithm. Finding the closest pair of points.

Module:7	Algorithms for AI	3 hours

Uninformed search, Heuristic search (8 queen and tiling problems), A* and AO* algorithms.

Module:8	Recent Trends	2 hours
	Total Lecture hours:	30 hours

Text Book(s)	
1.	T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, 'Introduction to algorithms',3rd Edition, MIT Press, 2009.
2.	S. Sridhar, 'Design and Analysis of Algorithms', Oxford University Press, 2015. (Module 4 & 5)
	.
Reference Books	
1	M.T.Goodrich and R.Tomassia, 'Algorithm Design: Foundations, Analysis and Internet examples' , John Wiley and sons, 2011.
2.	Sara Baase, Allen, Van, Gelder, 'Computer Algorithms, Introduction to Design and Analysis', 3rd Edition, Pearson Education., 2003.
3.	A.Levitin, 'Introduction to the Design and Analysis of Algorithms', Third Edition, Pearson Education, 2012.

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

List of Experiments		
1.	Implementation of algorithms for problems that can be solved by some 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, FloydWashall algorithm, Ford-Fulkerson Method and Edmonds-Karp Algorithm	6 hours
9	A simple polygon is defined as a flat shape consisting of straight non-intersecting line segments or sides that are joined pair –wise to from a closed path. Let P {p1, p2 , p3 ,....pn} be a set of points in the two dimensional plane. a. Write a program to find the simple polygon of P . b. Write a program (linear time) to convert that the simple polygon of P to a Convex Hull.	2 hours
	Total Laboratory Hours	30 hours

Mode of evaluation: Regular Assignments, Continuous Assessment Test / FAT (Lab)

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

Course code	Course Title	L	T	P	J	C
CSI2004	ADVANCED DATABASE MANAGEMENT SYSTEMS	3	0	0	0	3
Pre-requisite	CSI1001	Syllabus version				
		v.1.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Database Design Techniques	5 hours	

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

Module:2	Parallel Databases	6 hours	

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

Module:3	Distributed Databases	7 hours	

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

Module:4	Multimedia and Spatial Databases	7 hours	

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

Module:5	Mobile and Cloud Databases	8 hours	

1. 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.	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.	Raghu Ramakrishnan, Database Management Systems, ,4th edition, Mcgraw-Hill,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	Course Title	L	T	P	J	C
CSI1001	Principles of Database Systems	2	0	2	0	3
Pre-requisite		Syllabus version				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE	4 hours	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 ImmediateUpdate – 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, 7th Edition, 2016.
2.	A. Silberschatz, H. F. Korth& S. Sudershan, Database System Concepts, McGraw Hill, 7th Edition 2019.
Reference Books	
1.	Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2015.
2.	Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6thEdition,Pearson,2015
3.	C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006

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

List ofExperiments		**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 curso	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
CSI1007	SOFTWARE ENGINEERING PRINCIPLES	2	0	2	0	3
Pre-requisite	Nil	Syllabus version 1.0				

Course Objectives:

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

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

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

Expected Course Outcome:

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

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

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

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

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

6. Apply benchmarking standards in process and in product.

Module:1	INTRODUCTION	5 hours

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

Module:2	SOFTWARE REQUIREMENT ANALYSIS	5 hours

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

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

Module:3	SOFTWARE DESIGN	5 hours

Design concepts and principles - Abstraction - Refinement - Modularity – Cohesion & coupling, Architectural design, Detailed Design – Transaction & Transformation, Refactoring of designs, Object-oriented Design User-Interface Design; Object Oriented Design Concepts and Diagrams - Use Case Diagrams - Class Diagrams - Interaction Diagrams - State chart Diagrams - Activity Diagrams - Package Diagrams - Component Diagrams – Deployment Diagrams		
Module:4	**SOFTWARE IMPLEMENTATION**	**4 hours**
Structured coding Techniques-Coding Styles-Standards and Guidelines- Documentation Guidelines-Modern Programming Language Features: Type checking-User defined data types- Data Abstraction-Exception Handling- Concurrency Mechanism – Seven Steps of implementing software – Implementation Challenges and its resolution.		
Module:5	**SOFTWARE TESTING**	**4 hours**
TESTING: Introduction; Software Testing Fundamental; Testing Principles; Testing Levels; Verification and Validation: Validation Testing, Validation Test Criteria; Test Plan: Test Documentation; Test Strategies: Top-Down Testing, Bottom-Up Testing, Thread testing, Stress testing, Back-to-back testing; Testing methods and tools: Testing through reviews, Black-box testing (Functional testing), White box testing (glass-box testing), Testing software changes;Additional requirements in testing OO Systems; Metrics Collection, Computation, and Evaluation; Test and QA plan; Managing Testing Functions.		
Module:6	**SOFTWARE MAINTENANCE**	**3 hours**
Software Maintenance, Types of Maintenance, Structured versus unstructured maintenance – Maintenance costs – Typical problems with maintenance and its side-effects – Maintenance process - Software Configuration Management – Component Reusability - Overview of RE- engineering & Reverse Engineering- Business Process Reengineering- Restructuring- Forward Engineering- Economics of Reengineering.		
Module:7	**PROJECT PLANNING AND RISK MANAGEMENT**	**2 hours**
Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.		
Module:8	**RECENT TRENDS**	**2 hours**
	Total Hours	**30 Hrs**
Lab Experiments		
1. Work Break-down Structure (Process Based, Product Based, Geographic Based and Role Based) 2. Estimations – Cost & Schedule 3. Entity Relationship Diagram, Context flow diagram, DFD (Structural Modeling and Functional Modeling) 4. State Transition Diagrams (Behavioral Modeling) 5. System Requirements Specification 6. UML diagrams for OO Design 7. Tools for Version Control		**30 Hrs**

8. Black-box, White-box testing Non-functional testing			
Text Book(s)			
1.	Roger Pressman and Bruce Maxim, Software Engineering: A Practitioner's Approach, 9th Edition, McGraw-Hill, 2020.		
Reference Books			
1.	Ian Sommerville, Software Engineering, 10 th Edition, Addision-Wesley, 2015		
2.	Pankaj Jalote, An Integrated Approach to Software Engineering (Texts in Computer Science),Reprint Springer, 2010		
3.	William E. Lewis , "Software Testing and Continuous Quality Improvement", Third Edition, Auerbach Publications, 2008		
4.	David Gustafson , Schaum's Outline of Software Engineering,1st Edition, 2020		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar/Lab			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No.61	Date	18.02.2021

Course code	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

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- Pumpinglemma 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 BrokecoleCengage 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	PRINCIPLES OF COMPILER DESIGN	L	T	P	J	C
CSI2005		3	0	0	0	3
Pre-requisite	Nil	Syllabus version				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	INTRODUCTION TO COMPILATION AND LEXCIAL ANALYSIS	7 hours

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

Module:2	SYNTAX ANALYSIS –TOP DOWN	5 hours

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

Module:3	SYNTAX ANALYSIS –BOTTOM UP	7 hours

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

Module:4	SEMANTIC ANALYSIS	6 hours

Syntax Directed Definition – Evaluation Order - Applications of Syntax Directed Translation - Syntax Directed Translation Schemes - Implementation of L attributed Syntax Directed Definition.

Module:5	INTERMEDIATE CODE GENERATION	7 hours

Variants of syntax trees - Three address code- Types – Declarations - Procedures - Assignment Statements - Translation of Expressions - Control Flow - Back Patching- Switch Case Statements.

Module:6	CODE OPTIMIZATION	6 hours

Loop optimizations- Principal sources of optimization -Introduction to Data Flow Analysis - Basic Blocks - The DAG Representation of Basic Blocks -Loops in Flow Graphs.

Module:7	**CODE GENERATION & OTHER TRANSLATIONS ISSUES**	**5 hours**
Issues in the design of a code generator- Target Machine- Next-Use Information - Optimization of basic blocks - Peephole Optimization - Register Allocation and Assignment.		
Module:8	Recent Trends	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, Techniques, & Tools, Second Edition, , Pearson Education, 2007

Reference Books

1.	Andrew A.Appel , Modern Compiler Implementation in Java, 2nd edition ,Cambridge University Press;, 2002.
2.	Torbengidius Mogensen, "Basics of Compiler Design", Springer, 2011.
3.	K. D. Cooper and L. Torczon, Engineering a Compiler, Morgan Kaufmann, 2nd edition, 2011

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

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
CSI1002	Operating System Principles	2	0	2	0	3
Pre-requisite		Syllabus version				
		v. xx.xx				

Course Objectives:

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:

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

1. Gain extensive knowledge on principles and modules of operating systems
2. Interpret the evolution of OS functionality, structures, layers and different system calls to find the 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.

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-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces, Arpaci-Dusseau Books, Inc (2015).
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Experiments	**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

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

Pre-requisite	Nil	Syllabus version	v.1.0

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Introduction	5 hours

Overview of Computing Paradigm, Cloud Computing- NIST Cloud Computing Reference Architecture, Types of Cloud Deployment Models - Private, Public, Hybrid, Agency Clouds

Module:2	Cloud Service Models	5 hours

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

Module:3	Virtualization	7 hours

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

Module:4	Cloud Environments	7 hours

Cloud Environments - Case study: One cloud service provider per service model (eg. Amazon EC2, Google App Engine, Sales Force, Microsoft Azure, Open Source tools)

Module:5	Cloud Application Development	8 hours

Cloud application development using third party APIs, Working with EC2 API – Google App Engine API - Facebook API, Twitter API , HDFS, Map Reduce Programming Model.

Module:6	Security	7 hours

Cloud Security Challenges and Risks – Software-as-a- Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security

Module:7	**Advances in Cloud**	**4 hours**
MQTT in Cloud, MQTT working example – Fog Computing basics – Comparing Cloud, Fog and Mist Computing		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books

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

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

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

	Total Laboratory Hours		**30 hours**
Mode of assessment: CAT1/CAT2/FAT			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course Code	Course Title	L	T	P	J	C
CSI2006	MICROPROCESSOR AND INTERFACING TECHNIQUES	2	0	2	0	3
Pre-requisite	Nil	Syllabus version				
		v.1.00				

Course Objectives:

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

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

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

Module:1	Intel x86/ARM Processors	5 hours

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

Module:2	Assembly Language Programming and Tools	5 hours

Addressing modes and Instruction Set, Assembler Directives and Operators, Introduction to emu8086 emulator and MASM assembler, Assembly Language example programs.

Module:3	Special Architectural Features and Programming	3 hours

Stack – stack structure of 8086/ARM and programming; Interrupt – interrupt cycle, non-mask-able, mask- able, Interrupt Service Routine, programming; procedure and macro– definition and passing parameters; handling larger programs; timing and delays – clock cycle, states, instruction execution time, clock count for generating delays; file management – create, open, close, read, write and delete operations;

Module:4	Basic Peripherals Interfacing	4 hours

Memory Interfacing – Interleaving, static and dynamic RAM interfacing; IO Ports Interfacing –

memory mapped I/O, I/O mapped I/O; PIO 8255 – architecture, pin, control word register, operation modes; A/D Interfacing – 0808 SAR, 7109 dual-slope, interfacing; D/A – 7523, DAC0800; Stepper Motor – 4 winding internal schematic, excitation sequence, sample programs.		
Module:5	**Special Purpose Programmable Peripheral Interfacing**	**5 hours**
Timer/Counter 8253 – architecture, pin, control word register, operation modes, programming; PIC-8259 – architecture, pin, interrupt sequence, command words, operation modes, programming; 8279 – architecture, pin, operation modes, programming; 8251 – communication methods, architecture, pin, operation modes, programming; 8257 – architecture, pin, DMA transfers and operations, programming.		
Module:6	**Numeric Co-Processor 8087**	**4 hours**
Overview, compatible processor and coprocessor, pin, architecture, block diagram - control unit, numeric execution unit, registers, status word, circuit connection of 8086-8087,data types, IEEE floating point standard, instruction set, sample programs.		
Module:7	**Case Study on Microcontroller Boards**	**2 hours**
Introduction to Microcontroller, UNO Board, IDE, Programming using GPIO for LED, LCD, Keypad, Motor, Sensor interfacing, case study on smart system design.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours	**30 hours**
Text Book(s)		
1.	A.K. Ray and K.M. Bhurchandi Advanced Microprocessors and Peripherals, 3rd Edition, Tata McGraw Hill, 2017.	
2.	Barry B Bray , The Intel Microprocessor 8086/8088, 80186,80286, 80386 and 80486 Architecture, programming and interfacing, 8th Edition ,PHI, , 2011	
Reference Book(s)		
1.	Douglas V. Hall, SSSP Rao" Microprocessors and Interfacing Programming and Hardware". Third edition, Tata McGraw Hill, 2017.	
2.	Mohamed Rafiquazzaman, "Microprocessor and Microcomputer based system design," Second edition, Universal Book stall, 1995	
3.	K Uday Kumar, B S Umashankar, Advanced Micro processors & IBM-PC Assembly Language Programming, Tata McGraw Hill, 2017.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	Arithmetic operations 8/16 bit using different addressing modes.	2 hours
2.	Finding the factorial of an 8 /16 bit number	1 hour
3.	(a) Solving nCr and nPr (b) Compute nCr and nPr using recursive procedure. Assume that 'n' and 'r' are non-negative integers.	2 hours
4.	Fibonacci series	1 hours

5.	Sorting in ascending and descending order	2 hours
6.	(a) Search a given number or a word in an array of given numbers. (b) Search a key element in a list of „n‟ 16-bit numbers using the Binary search algorithm.	2 hours
7.	To find the smallest and biggest numbers in a given array.	2 hours
8.	ALP for number bases conversions	2 hours
9.	String operations (String length, reverse, comparison, concatenation, 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	Course Title	L	T	P	J	C
CSI2007	DATA COMMUNICATION AND NETWORKS	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		V.1.0				

Course Objectives:

1. Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications
2. Gain expertise in design, implement and analyze performance perspective of TCP/IP layered Architecture
3. Deal with the major issues of the layers of the model.

Expected Course Outcomes:

1. Describe the layered structure of a typical networked architecture
2. Identify and analyze the different types of network topologies, error and flow control mechanisms
3. Design sub-netting and enhance the performance of routing mechanisms.
4. Compare various congestion control mechanisms and identify suitable Transport layer protocol for real time applications
5. Identify various Application layer protocols for specific applications
6. Design and Implement various Network protocols

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

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

Module:2	Physical Layer	5 hours

Analog and digital data communication, 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.	Behrouz A. Forouzan, Data Communications and Networking, , 5th Ed. McGraw Hill Education,2012
Reference Books	
1	Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, 5th Ed**,** Elsevier, 2011.
2	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012.
3	James Kurose , Keith Ross, Computer Networking: A Top-Down Approach, 7th editionPearson, , 2016

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

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

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

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

Course Objectives:

1. To learn the emerging concepts of cryptography and algorithms
2. To defend the security attacks on information systems using secure algorithms and Authentication process
3. To categorize and analyze the key concepts in network and wireless security

Expected Course Outcome:

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

Module:1	Introduction to Cryptography	4 hours

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

Module:2	Symmetric Key Cryptography	4 hours

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

Module:3	Asymmetric Key Cryptography	4 hours

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

Module:4	Hash Functions and Authentication	4 hours

Message Authentication Code (MAC), MD5, Secure Hash algorithms (SHA), HMAC,Digital Signatures, Digital Signature Standard (DSS).

Module:5	Basic Applied Cryptography	3 hours

Key management and distribution, digital certificates, identity-based encryption, Identification and authentication, zero knowledge protocols

Module:6	Advanced Applied cryptography	5 hours

Side-channel attack, Pretty Good Privacy (PGP), S/MIME, Kerberos, Homomorphic encryption, Quantum Cryptography, DNA Cryptography, Chaos Based Cryptosystem

Module:7	Web and Wireless Security	4 hours

IPsec: AH and ESP, IKE- SSL/TLS, Types of Firewalls, Intrusion detection and Prevention systems, Wireless Application Protocol (WAP)		
Module:8	Recent Trends	**2 hours**
Total Hours:	**30 hours**	
List of Experiments		
1	Implement DES, Triple DES and AES Key Algorithms	**4 Hours**
2	Implement RSA, ECC and Diffie-Hellman Key Establishment.	**4 Hours**
3	Implement a Secret-Sharing algorithm and Homomorphic Encryption algorithm	**2 Hours**
4	Implement message authentication (MAC) and HASH algorithms	**3 Hours**
5	Consider and examine the Wireless network security and technology integration for compliance using the case study of Cisco.	**2 Hours**
6	Explore the Snort Intrusion Detection Systems. Study Snort IDS, a signature-based intrusion detection system used to detect network attacks. Snort can also be used as a simple packet logger. For the purpose of this lab the 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 – • Create a public/private key pair in PGP • Create a revocation ley • Exchange PGP keys with other students • Signing the new key • Encrypting a file using your partner's public key • Decrypting the file using your private key • Encrypting and signing a file • Verifying the signature • Sending secure Email with PGP • Adding a public key and sending secure email.	**4 Hours**
9	Send and receive an encrypted email message using S/MIME.	**3 Hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed. Pearson Publishers, 2017.
2.	Behrouz A. Forouzan, Cryptography and Network Security:6th Ed. McGraw-Hill, 2017.
Reference Books	
1.	Kaufman, Perlman and Speciner. Network Security: Private Communication in a Public World., 2nd edition, Pearson Publishers, 2002.

2	Menezes, van Oorschot, and Vanstone, The Handbook of Applied Cryptography, 20th Edition, WILEY, 2015		
3	H. Silverman, A Friendly Introduction to Number Theory, 4th Ed. Boston: Pearson, 2012.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Lab			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course code	Course Title	L	T	P	J	C
CSI2008	Programming in Java	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v.1.0				

Course Objectives:

1. Understand Object Oriented Programming & Functional Programming in Java, Handling Exceptions and Multithreading.
2. Able to perform File Handling, Manipulating Strings, Generic Programming.
3. Use of Java for Event Handling and Web applications using Servlets.

Expected Course Outcome:

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

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

Module:1	Introduction to Java Programming	4 hours

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

Module:2	Object, Class and Packages	7 hours

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

Module:3	Exceptions and Threads	7 hours

Exception Handling: Fundamentals, Types, Uncaught Exceptions, Using try and catch, Multiple catch clauses, Nested try, Built-in Exceptions, Creating your own exception subclasses.
Threads: Java thread model, Main thread, Creating a thread, Creating multiple threads, Thread priorities, Synchronization, Inter thread communication, Thread's states, Multithreading.

Module:4	Files and Generics	6 hours

I/O streams – Console I/O – The PrintWriter class – Reading and Writing files. Generics: Basics, A Generic class, General form, Using wildcard arguments, Generic methods, Generic Interfaces, Generic Class hierarchy, Type inference.

Module:5	Lambda Expressions and Strings	6 hours

Lambda Expressions: Introduction, Block Lambda expressions, Passing Lambda expressions as arguments, Lambda Expressions and Exceptions. String Handling: The String Constructors, Various String Operations, StringBuffer and StringBuilder Classes.

Module:6	Java Event Handling and GUI Programming	6 hours

Event Handling mechanism, Event Delegation, Event and KeyEvent Classes, EventListener Interfaces. GUI Programming with JavaFX: UI Controls, Layout Classes, Collection Classes, Media Classes.		
Module:7	**Java Servlets and JDBC**	**7 hours**
Background - Lifecycle of a servlet – Development – The Servlet API – The javax.servlet package – Reading Servlet Parameters - Handling http requests and responses – Using Cookies – Session Tracking – JDBC-Servlets with JDBC		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Herbert Schildt, "Java: The Complete Reference", , 11th Edition., McGraw-Hill Publishers December 2018.
2.	Cay S. Horstmann, "Core Java Volume I--Fundamentals", 11th Edition. , Pearson Publishers. August 2018.
Reference Books	
1.	Ben Evans, David Flanagan, "Java in a Nutshell 7th Edition., O'Reilly Media, Inc. December 2018.
2.	Joshua Bloch, "Effective Java".., 3rd Edition. Addison Wesley Publishers December 2018

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

List of Experiments		
1.	Programs to demonstrate the use of arrays and various OOP concepts.	2 hours
2.	Programs to understand various exceptions and handling them.	2 hours
3.	Programs to demonstrate the concept of threads and multithreading in Java	2 hours
4.	Programs to understand Generic Programming technique and Lambda expressions.	4 hours
5.	Programs to create and manipulate file using different I/O methods.	4 hours
6.	Programs to explore various string handling methods.	3 hours
7.	Programs to idealize the use of different collection frameworks in java.util package and use of java.lang packages.	3 hours
8.	Programs to explore various swing elements to deepen the understanding of javaFX	3 hours
9.	Programs to realize the power of Java for internet programming through servlets.	3 hours
10.	Programs to realize the power of Java for internet programming through servlets with JDBC	4 hours
	Total Laboratory Hours	30 hours

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

Course code	Course Title	L	T	P	J	C
CSI3003	Artificial Intelligence and Experts Systems	3	0	0	0	3

Pre-requisite	Nil	Syllabus version
		v. 1.0

Course Objectives:

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

Expected Course Outcome:

On completion of this course the students will be able to

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3. Analyze and illustrate how search algorithms play vital role in problem solving
4. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
5. Understand and Illustrate the construction of expert system
6. Discuss current scope and limitations of AI and societal implications.

Module:1	Introduction to Artificial Intelligence	4 hours

OverviewofArtificial 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 bysearching - 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	7 hours

Situational Calculus - Representation of Planning - Partial order Planning- Practical Planners – Conditional Planning - Replanning Agents

Module:6	Knowledge Reasoning	7 hours

Uncertainty - Bayes Rule – Inference-Hidden Markov Model- Belief Network, Decision Network

Module:7	Design of Expert System	5 hours

Architecture of expert systems - Stages in the development of an Expert Systems - Roles of expert

systems – Expert System Tools-Difficulties in Developing Expert Systems- Knowledge Acquisition and elicitation - Meta knowledge - Typical expert systems – MYCIN			
Module:8	**Recent Trends**		**2 hours**
	Total hours:		**45 hours**
Text Book(s)			
1.	Russell, S. and Norvig, P. Artificial Intelligence - A Modern Approach, 4th edition, Prentice Hall, 2020		
2.	Poole, D. and Mackworth, A. Artificial Intelligence: Foundations of Computational Agents, 2nd edition Cambridge University Press, 2017		
Reference Books			
1.	Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007		
2.	Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007		
3	Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", 3rd Edition, McGraw Hill, 2008		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course code	Course Title	L	T	P	J	C
CSE2010	Advanced C Programming	2	0	2	0	3
Pre-requisite	CSE1001	Syllabus version				
Anti-requisite	CSE1008	v. xx.xx				

Course Objectives:

1. In depth understanding of storage classes, memory allocation and pointer manipulation.
2. High level and low level organization of files.
3. Explore the power of macros and preprocessor directives.

Expected Course Outcome:

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

1. Learn various control structures and derived data types for solving real world problems using user defined functions.
2. Explore dynamic memory allocations strategies and user defined data types.
3. Realize the features of various Input and Output methods including files.
4. Idealize the power of preprocessor directives and recognize programming methods
5. Able to modularize the programming using various input, output, mathematical and utility functions in C and unix system interfaces.
6. Able to design the software in c using features of graphics, embedded programming concepts.
7. Apply the learned concepts and design algorithmic solutions for the real world problems.

Module:1	Control Structures, Functions and Pointer	3 hours	CO: 1

Review of C fundamentals : Data types, Operators and Expressions, Control structures, Arrays, Functions, String, Pointers and Structures.

Module:2	Memory Allocation	5 hours	CO: 2

The memory layout in c programming, dynamic memory allocation: malloc(), calloc(), realloc(), free(), core dump, memory leak, dangling pointer. Pointers and array: Pointer and one dimensional arrays, Array of pointers, Pointers and two dimensional arrays, Subscripting pointer to an array, Dynamic 1D and 2D array.

Module:3	User defined data types	5 hours	CO: 2

Structures, array of structures, passing structure to functions, function pointers : Passing and returning values using pointers, Array as function argument, Using Pointers as Arguments, Functions returning address, Function returning pointers, Pointer to a function, Calling a function through function pointer, Functions with varying number of arguments. arrays and structures within structures, Unions, Bit fields, enumerations, typedef.

Module:4	Input/Output Manipulation and Files	5 hours	CO: 3

I/O Manipulation: Standard I/O, Formatted Output - printf, Formated Input - scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions. Files manipulations: File Descriptors, File pointer, Working with text files, working with binary files, Character I/O, EOF, Sequential and random access.

Module:5	Preprocessor Directives and programming method	4 hours	CO: 4

Preprocessor Directives: #include statements, #define statements, #error, Conditional compilation, #undef, The # and ## preprocessor operators, Predefined macro names, Nested macros, Multiline macros, Macros pitfalls, Macros Vs enums, Inline functions, Macros vs inline functions, Inline recursive functions, Command line arguments, Environment Variables in C Programs, Type qualifiers. Programming Method: Debugging, User Defined Header, User Defined Library Function, makefile utility.			
Module:6	**Standard Library functions and Unix system Interface**	**3 hours**	**CO: 5**
Standard Library functions: I/O functions, string and character functions, mathematical functions, time, date and localization functions, utility functions, wide-character functions. Unix system Interface: File Descriptor, Low level I/O - read and write, Open, create, close and unlink, Random access - Iseek, Discussions on Listing Directory, Storage allocator.			
Module:7	**Graphics, embedded C and Software development using C**	**3 hours**	**CO: 6**
Graphics: writing a text graphics program, writing a pixel graphics program, two dimensional graphics. Embedded C programming : Basics, Data types, keywords, programming structure, basic embedded c programming. Software development using c: Building a windows 2000 skeleton, software engineering using c, efficiency, porting programming.			
Module:8	**Recent Trends**	**2 hours**	**CO: 7**
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Byron Gottfried and JitenderChhabra , "Programming with C (Schaum's Outlines Series)", Third Edition. McGraw Hill Education. ISBN: 978-0070145900, July 2017.
2.	Herbert Schildt., "C: The Complete Reference", Fourth Edition. McGraw Hill Education. 978-0070411838. July 2017.
3.	Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", Pearson Education India; 2nd Edition. ISBN: 978-9332549449. 2015.
4.	Peter Prinz and Tony Crawford, "C in a Nutshell: The Definitive Reference". O'Reilly Media. Inc., Second Edition. ISBN: 978-1491904756. December 2015.
5.	K R. Venugopal, Sudeep. R Prasad, "Mastering C", McGraw Hill Publishers, Second Edition. ISBN: 9789332901278. May 2015.
Reference Books	
1.	Jeff Szuhay, "Learn C Programming: A beginner's guide to learning C programming the easy and disciplined way", Packt Publishing Limited, First Edition, ISBN: 978-1789349917. June 2020.
2.	Zed A Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)", First Edition. Addison Wesley. ISBN: 978-0-321-88492-3. September 2015.
3.	Richard M. Reeses, "Understanding and Using C Pointers", First Edition. O'Reilly Publishers, ISBN: 9781449344184. January 2013.
4.	A.R. Bradley, "Programming for Engineers", Springer, Berlin, Heidelberg. First Edition.

	ISBN: 978-3-642-23303-6, 2011.			
5.	A. Forouzan and Richard F. Gilberg, “Computer Science: A Structured Programming Approach Using C”, CENGAGE LEARNING (RS), Third Edition.ISBN: 978-8131503638, 2007.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Experiments (Indicative)			**CO: 7**	
1.	Programs to demonstrate the use of various data types and storage classes.			2 hours
2.	Programs to understand various control structures.			2 hours
3.	Programs for Manipulating Arrays (One dimensional and Two dimensional)			4 hours
4.	Programs to understand memory allocations using pointers (simple and arrays)			2 hours
5.	Programs using pointers to arrays including strings (One dimensional and two dimensional)			6 hours
6.	Programs to explore different kinds of macros.			2 hours
7.	Programs to manipulate different records (employee, students, HR) using structures (with and without pointers)			6 hours
8.	Programs to manipulate different files (sequential and random)			6 hours
			Total Laboratory Hours	30 hours
Mode of evaluation:				
Recommended by Board of Studies	09-09-2020			
Approved by Academic Council	No. 59	Date	24-09-2020	

Course code	Course Title	L	T	P	J	C
CSI3025	APPLICATION DEVELOPMENT AND DEPLOYMENT ARCHITECTURE	2	0	2	0	3
Pre-requisite	CSI3023				Syllabus version	
					v. 1.0	

Course Objectives:

1. To understand various process & methodologies to be followed during development life cycle
2. To design the deployment architecture and preparing for the release management plan.
3. To use the various tools and framework associated with development and deployment of the applications.

Expected Course Outcome:

On completion of the course, the students able to:

1. Understand the complexities in setting up an Enterprise grade development and deployment of architecture.
2. Analyse and make a plan for release management
3. Design and rollout Deployment Architecture
4. Analyze various tools and framework associated with development and deployment.

Module:1	Development Life Cycle and Processes	5 hours

Waterfall, Agile & Scrum Methodologies, Iterative Development, Development Productivity Tools such as Accelerators, Reusable Components, Centralized Library Repository, Application Debugging (local and remote), Project Setup & Configuration, Introduction to Function Point Estimate, Introduction to Size and Complexity Estimation.

Module:2	Build, Source Control and Release Management	3 hours

Build Management: Build Life Cycle, Build Goals, Build Profile, Build Plugins, Build Test, Release Management: managing, planning, scheduling and controlling a software build through different stages and environments; including testing and deploying software releases.

Module:3	Code Baseline	5 hours

Code Baseline, Tagging Process, Release/Master/Feature Branch, Pull Request, Local Repo, Resolve Conflicts, Merge contributions from many source, Version history management, integrating with issue tracker

Module:4	Deployment Architecture	5 hours

Network Topology – VLAN, DMZ's, Private and Public Subnets, Security Group, NAT Gateways, Host-Names, Capacity Planning and Sizing (application and data), Security Architecture (Data on transit, Data on storage, User & Application Security, Federation) , Cloud Architecture, DR & BCP Planning, Infra & Service Monitoring (Network, Apps, Data, Logs) , Centralized Log Management (ELK).

Module:5	Containers and Virtualization	5 hours

Docker CE, Kubernetes, API and SDK, Failover, Scalability, Distributed Data, Detection and Self-Healing, Release Management (Planning, Re-Routing, Installation, Pre-Validation, Rollback

Strategy)		
Module:6	**DevOps**	**5 hours**
Intro to DevOps, LifeCycle, Continuous Integration , Delivery and Deployment, Pipelines, Integration with Unit Tests, Integration Tests, Performance or Load Test & Security Test Cases, Reporting, , Integration with Containers and Kubernetes or equivalent.,		
Module:7	**Security Management**	**4 hours**
WORM, Data Cloning, HSM, Centralized Log Management, Password Management, Release Management (Planning, Re-Routing, Installation, Pre-Validation, Rollback Strategy)		
Module:8	**RECENT TRENDS**	**2 hours**
	Total Lecture hours	**30 hours**

Text Books	
1.	Davis, J., & Daniels, R., Effective DevOps: building a culture of collaboration, affinity, and tooling at scale. " O'Reilly Media, Inc.", 2016
2.	Howard, D. IT release management: A hands-on guide. CRC Press, 2010

Reference Books	
1	Ryan Lister, Docker: The Complete Beginner's Guide Paperback. Createspace Independent Pub., 2017
3	Joseph D. Moore, Kubernetes: The Complete Guide to Master Kubernetes. Kindle Edition, 2019.
4	Richard Bullington-McGuire, Andrew K. Dennis, Michael Schwartz., Docker for Developers: Develop and run your application with Docker containers using DevOps tools for continuous delivery, Packt Publishing, 2020
	Web Links: • https://try.github.io/ • https://www.bugzilla.org/docs/2.16/html/how.html • https://maven.apache.org/guides/getting-started/maven-in-five-minutes.html

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

List of Experiments		
1	Technical Stack/Framework- Java 8+, Jenkins and it usage in real world applications with a scenario.	4 hours
2	Technical Stack/Framework-SonarQube and it usage in real world applications with a scenario.	4 hours
3	Technical Stack/Framework-Maven, JUnit5 and it usage in real world applications with a scenario.	4 hours
4	Technical Stack/Framework- Selenium, Git Client, Git Server and it usage in real world applications with a scenario.	6 hours
5	Technical Stack/Framework- Bugzilla, Eclipse STS and it usage in real world applications with a scenario.	4 hours
6	Technical Stack/Framework- Docker and it usage in real world applications with a scenario.	4 hours
7	Technical Stack/Framework- Kubernetes, CGroup and it usage in real world applications with a scenario.	4 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:

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
CSI3023	ADVANCED SERVER-SIDE PROGRAMMING	2	0	2	0	3
Pre-requisite	CSI3029	Syllabus Ver.				
		v. 1.0				

Course Objectives:

1. To understand different types of server-side programming and technologies like Servlets, JSP, ASP, EJB, JSF, PHP, Node.
2. Understand the various server-side Spring Frameworks, REST, SOAP, ORM, Security.

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Understand advanced server-side programming concepts and use technologies like Servlets, JSP, JSF and ASP
2. Adopt conveniently, ORM technique to bridge object and relational models of data.
3. Develop, real world API and Services using SOAP and REST.
4. Create application using Node.js and JMS API that provides the facility to create, send and read messages.
5. Efficiently create fast, secure, and responsive web applications using Spring Framework.

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Module:1	Servlets, JSP, JSF and ASP	6 hours

JSP, JSTL, Spring Tag Libraries, Spring Controllers , Template & Layout, Spring Form Validations(Standard and Custom),jQuery, CSS3, Web Descriptor Language, AJAX, Web Socker Support, Java server Faces, JSF flows, UI Model-Framework – JSP, JSTL, Tiles/Thymeleaf, Spring MVC on Spring Boot, Hibernate Validator

Module:2	REST	3 hours

Webservices, Types of Webservices, REST, JAX-RS, Rest Frameworks, Rest Methods and APIs, REST Clients.

Module:3	SOAP	3 hours

SOAP, JAX-WS, WSDL, SOAP Registries, SOAP Frameworks, SOAP Clients, Develop SOAP and REST API and Services. Framework – Spring MVC, Web-Services, Spring Security

Module:4	ORM	5 hours

Object Relation Mapping, JPA, Hibernate, Entity – Annotations, Association and In heritance mapping, Hibernate Session and Transaction, Caching, Native Query, HQL, Batch Processing and Intercepting Filter, Criteria Builder, Projections API, Named & Native Query. Framework – Spring Data JPA, Hibernate and JPA,MySQL/any rdbms Database

Module:5	JMS, Node JS	4 hours

JMS, Queues and Topics, Creating Queues and Topics, Sending and Receiving messages using Queues and Topics. Introduction to Node JS, Benefits and Features, NPM in Node JS, Event Handling. Framework – ActiveMQ or RabbitMQ, Spring JMS integration, NodeJS, NPM

Module:6	Spring Framework	4 hours

Developing a Batch Application that gets executed in the background process, and gets triggered

at a specific regular intervals, Task/Tasklet, Steps, Sharing Batch Context Information between Steps			
Module:7	**Exception Handling**	**3 hours**	
Exception Handling, Transaction Commit Intervals, Chunk Processing, File/DB/JMS based Reader and Writers. Framework – Spring Boot, Spring Batch, Spring Data JPA, JMS and MySQL			
Module:8	**Recent Trends**	**2 hours**	
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Christian Bauer, Gavin King, Gary Gregory, Linda Demichiel, Java Persistence with Hibernate, 2ed, MANNING Publications, 2016
Reference Books(Links)	

1. David R. Heffelfinger , Java EE 8 Application Development, Packt Publishing, 2017.
2. Dhruti Shah , Node .js Guidebook, , First edition ,BPB Publications, 2018.
3. https://microservices.io/
4. https://javaee.github.io/javaee-spec/
5. https://spring.io/projects/
6. https://nodejs.org/en/

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

List of Experiments		
1.	Develop a web application with AJAX and UI model framework	5 hours
2.	Create an application implementing a RESTful **API**	5 hours
3.	Create Web application using HTML, CSS and Node.js	5 hours
4.	Integrate Spring with ORM framework	5 hours
5.	Develop Web Applications using Spring Framework	5 hours
6	Create UI Management for Spring Boot and Node js applications	5 hours
	Total Laboratory Hours	30 hours

Mode of evaluation: CAT//Assignment/ 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
CSI3024	SOFTWARE APPLICATION ARCHITECTURE	3	0	0	0	3
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

1. To understand the architectures, frameworks, design patterns and its application architecture.
2. To understand the Core Java Design patterns, GOF, JEE Blue Print patterns and principles.
3. Monolithic, Need of Micro services Architecture, MS implementation, MS tools and technologies.
4. To understand what is an API, APIs classification and types, Technology specific APIs, API Tools.

Expected Course Outcome:

Upon Completion of the course, the students able to

1. Design an application components using the appropriate design patterns (where, when, how and why).
2. Understand the difference between the Monolithic and Microservices architecture with patterns.
3. Design an applications using Microservices architecture based tools and technologies.
4. Analysis APIs for various types of services using different technologies

Module:1	Design Patterns	4 hours

Architecture Styles and Patterns, Design Patterns and Principles, Frameworks, Architecture, Enterprise Architecture, Various Architecture Design pattern, Patterns History, MVC Design Patterns, Standards, Benefits.

Module:2	Java Patterns	7 hours

GOF and JEE Blue Print Patterns, Creational, Structural and Behavioural patterns, Modern Java EE Patterns, Core J2EE Patterns.

Module:3	Architecture Types & Microservices Architecture	6 hours

What are Microservices, Monolithic Vs Microservices, Microservices Challenges, Application Architecture Patterns, Service Decomposition, Building Microservices application,

Module:4	Microservices Architecture Tools and Technologies	6 hours

Deployment Patterns, Communication Style, Service Discovery, Externa API, Data Management, Security, Testing, Develop Spring Boot Microservices application.

Module:5	Microservices Design Patterns	7 hours

Managing transactions with SAGA, Distributed transactions, DDD aggregate pattern, Microservices Logging, Monitoring and Security, Microservices Cloud, Deploy

Microservices with Docker, Adherence to QoS / NFR, Capacity Planning.		
Module:6	**Introduction to API Tools and Technologies**	**7 hours**
API - API Design Principles, Types of APIs, Web APIs, REST APIs, SOAP APIs, Message APIs, RPCs, API Standards. API Architecture, Building and using APIs, Exposing APIs, API Integration, API Documentation, API Clients, Securing APIs, Best Practices, API governance, API management and testing tools.		
Module:7	**Batch and MQ Based Architecture**	**6 hours**
Web application & Batch Architecture, EAI Patterns and Implementations, Message based Integrations		
Module:8	**RECENT TRENDS**	**2 hours**
	Total Lecture hours:	**45 Hrs**

Text Books

1. Freeman, E., Robson, E., Bates, B., & Sierra, K., Head first design patterns: A Brain-Friendly Guide - 10th Edition (Covers Java 8). " O'Reilly Media, Inc.", 2016.
2. Fowler, M., Patterns of Enterprise Application Architecture, Addison-Wesley, 2012

Reference Books

1. Alur, D., Crupi, J., & Malks, D., Core J2EE patterns: best practices and design strategies. Prentice Hall Professional, 2003
2. Richardson, C. Microservices patterns. Manning Publications Company,2018
3. Nadareishvili, I., Mitra, R., McLarty, M., & Amundsen, M. , Microservice architecture: aligning principles, practices, and culture. " O'Reilly Media, Inc., 2016.
4. Ajay Kumar,. Microservices architecture. Kindle Edition, 2018
5. Piotr Mińkowski, Mastering Spring Cloud: Build self-healing, microservices-based, distributed systems using Spring Cloud. 1st edition, Packt Publishing, 2018
6. Jin, B., Sahni, S., & Shevat, ADesigning Web APIs: Building APIs That Developers Love. " O'Reilly Media, Inc.", 2018)
7. Medjaoui, M., Wilde, E., Mitra, R., & Amundsen, M, Continuous API Management: Making the right decisions in an evolving landscape. O'Reilly Media, 2018
8. Masse, M.). REST API Design Rulebook: Designing Consistent RESTful Web Service Interfaces. " O'Reilly Media, Inc.",2011
9. Hapner, M., Burridge, R., Sharma, R., & Fialli, J. Java Message Service API tutorial and reference: messaging for the J2EE platform. Addison-Wesley Professional.,2002.
10. Web Links:
    - https://spring.io/projects/
    - https://microservices.io/
    - https://any-api.com/
    - http://www.corej2eepatterns.com/

Mode of assessment: Continuous Assessment Test / Assignments / 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
CSI3029	FRONT END DESIGN AND TESTING	2	0	2	0	3
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

1. To understand JavaScript based MVC Framework, UI Componentization and steps to develop a scalable UI application.
2. To acquire knowledge on Reactive Programming, Responsive web Design, Multi Device Compatible applications (RWD), Native Mobile Apps.

Expected Course Outcome:

1. Apply HTML, CSS to create and design websites.
2. Apply JavaScript effectively to create interactive and dynamic websites.
3. Design and Develop Scalable Web Apps using SPA framework - AngularJS
4. Develop routing and servicing applications.
5. Apply supporting functions for logging, exception handling and performance engineering.
6. Implement Responsive web design using Bootstrap and multi device compatible App with native mobile support.
7. Design and perform unit testing.

Module:1	HTML and CSS	5 hours

HTML5 – Form elements, Input types and Media elements, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface

Module:2	JavaScript	3 hours

JavaScript Introduction –Functions – Arrays – DOM, Built-in Objects, Regular Expression, Event handling.

Module:3	Introduction to SPA	4 hours

Introduction to Single Page Application (SPA)& Angular Architecture, TypeScript Language and its Feature, SPA's Components and Templates, Forms (Template/Reactive), Promise and Observable, CLI Features

Module:4	Service and Routes	3 hours

Service Definition and Injection, Routes and Navigation, Data Integrity enablement, State Management, Security (Authentication & Authorization, Auth-Guards), Pipes & Directives, Promise and Observable, Subject & Behaviour Subject, Intra Component Communication, ngrx, rxjs, of keyword.

Module:5	Supporting Functions	4 hours

I18n & i10N, Logging and Exceptions handling, Interceptors, Performance Engineering, Unit Testing using Jasmine and Karma, DevOps Enablement.

Module:6	Responsive web Design, Mobile Apps	3 hours

Responsive Web design using Bootstrap and MD, Native Mobile apps using Ionic/Cardova/Native Script, Desktop Applications

Module:7	Unit Testing	6 hours

Unit Testing using Jasmine and Karma,Development of Re-usable web components ,Deployment, Mono Repo		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)	
1	Fritz Schneider, Thomas Powell, JavaScript – The Complete Reference, 3rd Edition, McGraw Hill, 2017.
2	'Mastering TypeScript 3: Build enterprise-ready, industrial-strength web applications using TypeScript 3 and modern frameworks, 3rd Edition', by Nathan Rozentals, Birmingham : Packt Publishing Ltd, 2019.
Reference Books	
1	Responsive Web Design with HTML5 and CSS: Develop future-proof responsive websites using the latest HTML5 and CSS techniques by Ben Frain, 3rd Edition, Packt Publishing, April, 2020.
2	'Hands-On Functional Programming with TypeScript: Explore functional and reactive programming to create robust and testable TypeScript applications', by Remo H. Janse, Packt Publishing, January 2019.
3	"Angular 2 Cookbook", by Matt Frisbie, Packt Publishing Limited, January 2017.
	https://angular.io/ https://api.jquery.com/ https://material.io/design/ https://getbootstrap.com/

Mode of Evaluation: CAT / Assignment / Quiz / FAT

Lab Experiments		
The problem statement chosen for this lab exercises is FEE Framework.		
1	Develop the website with at least 5 pages using HTML and CSS.	2 hours
2	Develop JavaScript code to perform client side validation.	2 hours
3	Programs on AngularJS components	3 hours
4	Implementation of simple business logic using CLI of AngularJS.	4 hours
5	Program for AngularJS routing	4 hours
6	Program to perform unit test using AngularJS.	4 hours
7	Create a responsive web Design using Bootstrap.	3 hours
8	Develop native mobile application using iconic framework	4 hours
9	Perform unit testing using Jasmine and Karma	4 hours
	Total hours	**30 hours**

Mode of Assessment:			
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
CSI3026	MACHINE LEARNING	2	0	2	0	3
Pre-requisite	MAT2001			Syllabus version		
				v. 1.0		

Course Objectives:

1. Understand the basics and mathematical concepts of machine learning algorithms.
2. Choose and apply appropriate machine learning models for real world application.
3. Assess the performance of algorithms and to provide solution for various real-world problems.

Expected Course Outcome:

1. Understand the characteristics of machine learning strategies.
2. Apply suitable supervised learning methods to suitable problems.
3. Enhance the performance of learning by identifying and integrating more than one machine learning technique.
4. Handle unknown pattern by creating suitable probabilistic and unsupervised learning models.
5. Choose appropriate preprocessing methods to data before applying to real-world applications and to evaluate the performance and analyse the results.

Module:1	INTRODUCTION TO MACHINE LEARNING	3 hours

Introduction, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension.

Module:2	SUPERVISED LEARNING	9 hours

Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.

Module:3	NEURAL NETWORKS AND SUPPORT VECTOR MACHINES	3 hours

Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Back-propagation, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors

Module:4	ENSEMBLE LEARNING METHODS	5 hours

Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking

Module:5	UNSUPERVISED LEARNING METHODS	3 hours

Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Principal Component Analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis

Module:6	STATISTICAL LEARNING METHODS	3 hours

Naïve Bayes Classifier, Bayesian Belief Networks. Reinforcement Learning - Introduction, types of reinforcement learning algorithms, application and challenges in reinforcement learning

Module:7	PERFORMANCE EVALUATION	2 hours

Design, Analysis and Evaluation of Machine Learning Algorithms with various datasets, Other Issues: Handling imbalanced data sets, missing data and outliers.

Module:8	**RECENT TRENDS**		**2 hours**
	Total Lecture hours:	**30 hours**	

Text Book(s)

1. Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Third Edition, 2014.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.

Reference Books

1. Tom Mitchell, "Machine Learning", 3rd Edition, McGraw Hill, 1997.
2. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
3. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.

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

List of Experiments

1.	Implement Decision Tree learning	2 hours
2.	Implement Logistic Regression	2 hours
3.	Implement classification using Multilayer perceptron	2 hours
4.	Implement classification using SVM	2 hours
5.	Implement Adaboost	2 hours
6.	Implement Bagging using Random Forests	3 hours
7.	Implement k-nearest Neighbors algorithm	2 hours
8.	Implement K-means, K-Modes Clustering to Find Natural Patterns in Data	3 hours
9.	Implement Hierarchical clustering	3 hours
10.	Implement Gaussian Mixture Model Using the Expectation Maximization	3 hours
11.	Implement Principle Component Analysis for Dimensionality Reduction	3 hours
12.	Evaluating ML algorithm with balanced and unbalanced datasets Comparison of Machine Learning algorithms	3 hours
	Total Laboratory Hours	30 hours

Mode of assessment:

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

Program Electives

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 eigen values 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 fromthe tabulated values

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

[3] Know the techniques of solving differential equations

[4] understand the series solution of differential equations and finding eigen values,eigen functions of Strum-Liouville'sproblem

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

[6] demonstrate MATLAB programming for engineering problems

Module:1	Fourier series:	6 hours

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

Module:2	Matrices:	6 hours

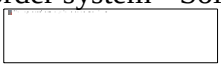
Eigenvalues and Eigen vectors - Properties of eigenvalues and eigen vectors – Cayley-Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature of quadratic form

Module:3	Solution of ordinary differential equations:	6 hours

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

Module:4	Solution of differential equations 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  and 		
Module:5	**Strum Liouville's problems and power seriesSolutions:**	**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, ErwinKreyszig,10th Edition, JohnWiley India, 2015
Reference Books	
1.	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition, Khanna Publishers, India, 2015
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2nd Edition, Pearson Education, Indian edition, 2006

Mode of Evaluation		
Digital Assignments (Solutions by using soft skills), 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

Course code	Course title	L	T	P	J	C
CSI3011	COMPUTER GRAPHICS AND MULTIMEDIA	3	0	2	0	4
Pre-requisite	Nill	Syllabus version				
		v. 1.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Graphical Concepts and Display Systems	6 hours	

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

Module:2	Output Primitives	6 hours	

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

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

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

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

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

Module:5	Modeling and Rendering Techniques	6 hours	

Visible surface determination - Z-Buffer method, Scan line method, Depth sorting Method, raytracing, Shading Model - Gouraud and Phong Shading.

Module:6	Multimedia System Design	6 hours	

Multimedia basics − Components of Multimedia − Multimedia applications – Multimedia Authoring − Hypermedia.

Module:7	**Multimedia and Communication Standards**	**6 hours**	
Digitization of Sound − Quantization of Audio − Transmission of Audio − Multimedia communication standards − JPEG, MPEG.			
Module:8	**Recent Trends**	**2 hours**	
	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	Hearn, Donald, M. Pauline Baker, and Warren R. Carithers. Computer graphics with OpenGL. Upper Saddle River, NJ: Pearson Prentice Hall, 2014. [Module 1 - Module 5]
2.	Steinmetz, Ralf, and Klara Nahrstedt. Multimedia systems. Springer Science & Business Media, 2013. [Module 6 - Module 7]

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 (Indicative)

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
CSI3012	DISTRIBUTED SYSTEMS	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Introduction	6 hours

Introduction to Distributed Systems - Examples –Trends in Distributed Systems – Focus on resourcesharing –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	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Third Edition,Pearson Education, 2017.
2.	George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, Fifth Edition, Pearson Education, 2012.

Reference Books

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

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

List of 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
CSI3008	Internet of Everything	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Introduction to Internet of Things	5 Hours

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

Module:2	An IoT Architectural Overview	6 Hours

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

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

IoT protocols and softwares - MQTT, UDP, MQTT brokers, Publish-subscribe modes, HTTP, CoAP, XMPP, and Gateway protocols. IoT point-to-point communication technologies - Communication pattern, and IoT protocol architecture. Selection of wireless technologies - LoWPAN, Zigbee, WiFi, BLE, SIG, NFC, LoRa, LiFi, and WiDi.

Module:4	Programming with Microcontrollers	6 hours

Architecture of Microcontroller IDE, Setup the Microcontroller IDE, Developing a Microcontroller program, libraries, Basics of embedded C programming for Microcontroller, Interfacing with sensors & actuators - LED, push button, ultrasonic, and buzzer, Arduino interfacing with LCD, Working with digital and analog sensors - Temperature, Gas, Humidity, Motion, and Light sensors.

Module:5	Advanced Programming with Microcontrollers	7 hours

Microcontroller interfacing with Relay Switch and Servo Motor, Basic networking with ESP8266 WiFi module, Microcontroller interfacing with Wi-Fi module, TinkerCAD simulation, Thing speak cloud synchronization with Wi-Fi module, Posting data to Thinkspeak cloud, Receiving data

from Thing speak, Various other cloud services available in the market.		
Module:6	**Developing IoT Solutions**	**8 hours**
Comparison of various Rpi Models, Understand SoC architecture, Raspberry Pi Pin description, Raspberry Pi on-board components, Rpi operating system and Linux commands, First boot and basic configuration, 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	Course Title	L	T	P	J	C
CSI3006	SOFT COMPUTING TECHNIQUES	3	0	0	4	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

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

Expected Course Outcome:

The student will be able to

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

Module:1	Introduction to Soft Computing	7 hours	

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

Module:2	Back Propagation networks	5 hours	

Architecture of a back propagation network, Backprogragation learning, Effect of tuning parameters,
Selection of parameters in back propagation network, Application domains.

Module:3	Unsupervised learning networks	6 hours	

Neural Nets based on competition, Max net, Mexican Hat, Hamming net, Kohonen Self organizing Feature Map, Counter propagation, Learning Vector Quantization , Adaptive Resonance Theory

Module:4	Fuzzy Sets and Fuzzy Relations	6 hours	

Introduction, Classical sets and fuzzy sets, Crisp Sets, Classical relations and fuzzy relations, membership functions , Fuzzy set operations, Properties of Fuzzy sets, Fuzzy to crisp conversion

Module 5	Advanced AI Techniques and Rough set concepts	7 hours	

Swarm Intelligence (SI), Particle swarm optimization (PSO), Ant Colony Optimization, Petrinets,

Coloured Petrinets, Entropy, Rough sets, Rough set theory, Set approximation, Rough membership, Attributes, Dependency of attributes, Rough equivalence, Reducts, Rough Reducts based on SVM			
Module:6	**Fuzzy Logic and Inference**	**6 hours**	
Fuzzy Logic, Predicate Logic, Fuzzy Quantifiers, Fuzzy Inference , Fuzzy knowledge and rule based system, Fuzzy decision making, Defuzzification, Applications of fuzzy logic, Neuro Fuzzy modelling			
Module:7	**Genetic Algorithms**	**6 hours**	
Basic concepts, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method			
Module:8	**Recent Trends**	**2 hours**	
	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	S.N. Sivanandam& S.N. Deepa, "Principles of Soft Computing", 3rded, Wiley Publications, 2018.
2.	Jang, Jyh-Shing Roger, Chuen-Tsai Sun, and EijiMizutani. "Neuro-fuzzy and soft computing-a computational approach to learning and machine intelligence" Pearson, 1997.

Reference Books

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

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

Project60 [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 beimplemented in any programming languages.

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

A Neuro-fuzzy Approach to Bad Debt Recovery in Healthcare			
Mode of assessment:			
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
CSI3009	ADVANCED WIRELESS NETWORKS	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, LTE and 5G
2. Understand about the wireless standards and design.
3. Understand about the wireless network architecture and its concepts.
4. Learn wireless Technologies and protocols
5. Understand about the mobility management and cellular network.
6. Learn the security concepts of wireless networks and also the recent trends.

Module:1	Introduction	7 hours	

Introduction to 1G/2G/3G/4G/5G 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 El-Nashar, Mohamed El-saidny, Mahmoud Sherif, "Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014.
2.	Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols", First Edition, John Wiley & Sons, Inc. Publication, 2010.

Reference Books

1.	W. Stallings, "Wireless Communications and Networks", 2nd edition, Pearson Education, 2013.
2.	Dharma Prakash Agrawal and Qing-An Zeng, "Introduction to Wireless and Mobile Systems", 3rd edition ,Tomson, , 2011.
3	Theodore S. Rappaport, "Wireless Communications -Principles Practice",2nd edition, Prentice Hall of India, New Delhi, 2010.

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

List of Experiments		
1.	Connecting WIFI TO BUS(CSMA) Architecture	4 hours
2.	Creating WIFI SIMPLE INFRASTUCTURE MODE	4 hours
3.	Creating WIFI SIMPLE ADHOC MODE	4 hours
4.	Connecting WIFI TO WIRED BRIDGING	4 hours
5.	Creating WIFI TO LTE(4G) CONNECTION	6 hours
6	Creating A SIMPLE WIFI ADHOC GRID	4 hours
7	Learning GSM architecture.	4 hours
	Total Laboratory Hours	30 hours

Mode of evaluation:

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

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

Pre-requisite	Nil	Syllabus version
		v.1.0

Course Objectives:

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

Expected Course Outcome:

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

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

Module:1	BLOCKCHAIN FOUNDATIONS	7 hours

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

Module:2	BITCOIN AND CRYPTOCURRENCY	7 hours

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

Module:3	DISTRIBUTED CONSENSUS	7 hours

Consensus introduction -Consensus in a Bitcoin network - Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain - Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Module:4	HYPER LEDGER FABRIC & ETHERUM	7 hours

Architecture of Hyperledger fabric v1.1-Introduction to hyperledger fabric v1.1, chain code-Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity, Smart contracts, TruffleDesign and issue Crypto currency, Mining, DApps, DAO

Module:5	SMART CONTRACTS	7 hours

Smart Contract Basics - Processing Smart Contracts - Deploying Smart Contracts - Solidity: Structure, Basic Data Types & Statements, Access Modifiers & Applications - Best Practices:

Evaluating Smart Contracts			
Module:6	**BLOCKCHAIN APPLICATIONS**	**5 hours**	
Blockchain and Enterprise - Use Case: Blockchains for Trade Finance, Blockchains for Supply Chain Financing, Cross Border Connectivity - Trusted Data Transfer, Capital Markets, Government Services & Sustainable Livelihood, Ownership and property rights, Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain - Blockchain Tradeoffs across Multichain, Ripple, Corda, EOS & Cosmos Facebook Libra & Corporate Currencies - CBDC & its paradoxes			
Module:7	**BLOCKCHAIN CHALLENGES AND CONSTRAINTS**	**3 hours**	
Blockchain risks - Technological challenges - Standards - Scalability issues - Security and privacy - Legal and regulatory problems - Social and cultural constraints - The future of blockchain technology, AI, and digital privacy			
Module:8	**Recent Trends**	**2 hours**	
	Total hours:	**45 hours**	

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

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

Course code	Course title	L	T	P	J	C
CSI3014	SOFTWARE VERIFICATION AND VALIDATION	3	0	0	0	3

Pre-requisite	Nil	Syllabus version
		v.1.0

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Overview of Software Engineering	5 hours	

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

Module:2	Testing Tools & Measurement	4 hours	

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

Module:3	Software Design & Defect Management	6 hours	

Design Concepts- Formal Specifications- Verifying the implementation against the specification-Introduction, Defect Classification-Defect Management Process-Defect Life Cycle, Defect Template- Estimate Expected Impact of a Defect, Techniques for Finding Defects, Reporting a Defect-Test Coverage-Traceability Matrix.

Module:4	Software Verification & Validation	6 hours	

Introduction to Verification and Validation-Software Inspection-Automatic Static Analysis

Module:5	Software Testing & Levels of Testing	6 hours	

Testing-Types of Testing - Test Plan- Test Design- Test Review- Software Testing Fundamentals. General characteristics of testing, seven principles of testing.

Module:6	**Test Selection & Minimization for Regression Testing**	**8 hours**	
Regression testing- Regression test process-Initial Smoke or Sanity test- Selection of regression tests- Execution Trace- Dynamic Slicing- Test Minimization- Tools for regression testing- Ad hoc Testing: Pair testing- Exploratory testing- Iterative testing- Defect seeding.			
Module:7	**Software Quality & Reliability**	**8 hours**	
Software Quality and Reliability-Software defects tracking- Test Planning, Management, Execution and Reporting- Software Test Automation: Scope of automation- Design & Architecture for automation- Generic requirements for test tool framework- Test tool selection, Testing in Object Oriented Systems-Software Metrics.			
Module:8	**Recent Trends**	**2 hours**	
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Roger Pressman, Software Engineering: A Practitioner's Approach, 8th Edition, McGraw-Hill, 2019.
Reference Books	
1.	Ian Sommerville, Software Engineering, 9th Edition, Addision-Wesley, 2016
2	PankajJalote, A Concise Introduction to Software Engineering, Springer, 2008
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
CSI3021	ADVANCED COMPUTER ARCHITECTURE	3	0	0	0	3
Pre-requisite	Nil	Syllabus version				
		V. 1.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Introduction to advanced computer design	5 hours

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

Module:2	Instruction Level Parallelism	8 hours

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

Module:3	Data Level Parallelism	5 hours

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

Module:4	Multi Threading Concepts	6 hours

Basic concepts of threading- Concurrency, Parallelism -Threading design concepts for developing an application- Correctness Concepts: Critical Region, Mutual exclusion, Synchronization, Race Conditions- Performance Concepts: Simple Speedup, Computing Speedup, Efficiency , Granularity , Load Balance

Module:5	Multi core Architecture	7 hours

Need for multi-core architectures, Architecting with multi-cores, Homogenous and heterogeneous cores, Shared recourses, shared busses, and optimal resource sharing strategies. Performance evaluation of multi-core processors, Error management

Module:6	Multi Processor Architecture	6 hours

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency

Module:7	Multi core 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	John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Waveland Press, 4th edition, 2013.
2.	Kai Hwang, Naresh Jotwani, Advanced Computer Architecture: Parallelism, Scalability, Programmability,Tata McGraw Hill, Second Edition, 2011.
3	David B Kirk, Wen-mei W Hwu, Programing Massively Parallel Processors: A Handson Approach(Application of GPU Computing Series), Morgan Kaufmann, 2nd Edition,2013.

Mode of Evaluation: CAT/ Digital Assignments/Quiz/FAT/ Project.			
Recommended by Board of Studies	09.02.2021		
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:

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

Expected Course Outcome:

1. Understand the importance of Data compression
2. Understand the idea of lossless and lossy compression
3. Understand the most common file formats for image, sound and video
4. Student will be able to develop a reasonably sophisticated data compression application.
5. Student is able to select methods and techniques appropriate for the task
6. Student is able to develop the methods and tools for the given task

Module:1	Introduction	4 hours

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

Module:2	Basic Concepts of Information Theory	6 hours

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

Module:3	Arithmetic Coding	5 hours

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

Module:4	Loss Less Coding	6 hours

Dictionary Methods: LZ77, LZ78, LZW Algorithms – Lossless Compression standards zip, gzip, bzip, unix compress, GIF, JBIG – Dynamic Markoy Compression.

Module:5	Basics Of Lossy Coding &Vector Quantization	5 hours

Basics of lossy coding and mathematical concepts – Distortion criteria – Scalar quantization - The Quantization problem – Uniform quantizer – Adaptive quantization – Advantages of vector quantization over scalar quantization – LBG algorithm.

Module:6	Image & Video Compression	6 hours

Image Compression: Discrete Cosine Transform – JPEG – Video Compression: Motion Compensation – Temporal and Spatial Prediction - MPEG and H.264.

Module:7	Wavelet Based Compression	5 hours

Fundamentals of wavelets –Various standard wavelet bases – Multi resolution analysis and scaling function – JPEG 2000.		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Khalid Sayood, Morgan Kauffman Introduction to Data Compression, 5th Edition,2020.
2.	Salomon, D., Motta, G. Handbook of Data Compression, Springer,2010.

Reference Books

1. Colton McAnlis, Aleks Haecky, Understanding Compression:Data Compression for Modern DevelopersAugust 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
CSI3022	CYBER SECURITY AND APPLICATION SECURITY	3	0	2	0	4
Pre-requisite	xxxxxxxx	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

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 –ChineseReminder 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 Keyexchange 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 – Complianceand Enforcement of policies- Review

Module:7	Application Security	5 hours

Security Architectures and Models- Email security-PGP and SMIME, Web Security, Database Security-Wireless Network Security

Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Cryptography and Network security, William Stallings, Pearson Education, 7th Edition, 2016
2. Network Security Essentials Applications and Standards, William Stallings, Pearson Education, 6th Edition, 2018
3.Cyber Security, Understanding cyber crimes, computer forensics and legal perspectives, Nina Godbole,Sunit Belapure, Wiley Publications, Reprint 2016

Reference Books

1. Cybersecurity for Dummies, Brian Underdahl, Wiley, 2011
2. Cryptography and Network security, Behrouz A. Forouzan , Debdeep Mukhopadhyay, Mcgraw Hill Education, 2nd Edition, 2011

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

List of Indicative Experiments

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

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

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

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Basics of Graph and Operations	4 hours

Fundamental concepts - basic definitions of graphs and digraphs -Subgraphs and other 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.	T.Kloks "Advance Graph Algorithms" – Kloks, 2012
2.	Thomas H. Cormen Charles E. Leiserson Ronald L. Rivest Clifford Stein, "Introduction to algorithm" 3rd Edition, The MIT Press Cambridge 2009,
Reference Books	
1	A.V Aho, J.E. Hopcroft and J.D. Ullman. Design and Analysis of Computer Algorithms, Addison Wesley, 1974.
2.	S.Even. Graph Algorithms, Computer Science Press,1979..
3.	Tim Roughgarden "Algorithms Illuminated (Part 2): Graph Algorithms and Data Structures", First Edition , Soundlikeyourself Publishing LLC,Sanfrancisco,CA,2018
Mode of Evaluation: CAT/ Digital Assignments/Quiz/FAT/ Project.	

Recommended by Board of Studies	DD-MM-YYYY		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

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

Course Objectives:

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

Expected Course Outcome:

At the end of course student should be able to

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

Module:1	Introduction to Project Management	7 hours

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

Module:2	Project Planning	6 hours

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

Module:3	Project Scheduling	7 hours

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

Module:4	Software Risk Management	7 hours

Perspectives of Risk Management - Risk Definition – Risk Categories – Risk Assessment: Approaches, techniques and good practices – Risk Identification / Analysis / Prioritization – Risk Control (Planning / Resolution / Monitoring) – Risk Retention – Risk Transfer - Failure Mode and Effects Analysis (FMEA) – Operational Risks – Supply Chain Risk Management.

Module:5	Project Cost Management	5 hours

Project Cost Management: Importance and Principles of Project Cost Management - Resource Planning - Cost Estimating - Cost Budgeting - Cost Control - Use of Software to assist in Cost Management			
Module:6	**Software Quality Management**	**5 hours**	
Project Quality: Stages of Software Quality Management - Quality Planning - Quality Assurance - Quality Control – Quality Standards – Tools for Quality control			
Module:7	**People Management**	**6 hours**	
Leadership styles – Developing Leadership skills – Leadership assessment – Motivating People – Organizational strategy – Management – Team building – Delegation – Art of Interviewing People - Team Management – Rewarding - Client Relationship Management - Organizational behavior: a background, Selecting the right person for the job –Instruction in the best methods– The Oldham-Hackman job characteristics model			
Module:8	**Recent Trends**	**2 hours**	
	Total hours	**45 hours**	

Text Book(s)	
1.	Kathy Schwalbe , Information Technology Project Management, Cengage Learning Australia, Seven Edition 2013
2.	Pankaj Jalote , Software Project Management in Practice, , 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.	Elaine Marmel , Microsoft Project 2010 Bible, Wiley; 1st edition, 2010
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

Module:1	Introduction	3 hours

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

Module:2	Robot Kinematics	7 hours

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

Module:3	Actuators and Control	6 hours

Robot drive system, functions of drive systems, pneumatic systems, electrical drives, DC motor, stepper motor, servo motor, need of sensing systems, types of sensors, robot vision system, robot end effectors, drive system for grippers, types of grippers, gripper design for machine control operations

Module:4	Introduction to Mechatronics	6 hours

Manufacturing industry, the changing environment, automation and mechatronics applications, flexible automation, CAD/CAM and CNC machine tools, Flexible manufacturing systems(FMS), robots in FMS

Module:5	Programmable Logic Controllers	6 hours

Introduction, basic structure of PLC, PLC classification, PLC operation, loading and unloading parts by robot, PC based controller introduction

Module:6	Servo control in a Robot	6 hours

Control loops, principles of servo control in a robot, PID control aspects, processor controlled digital servo system, introduction to transfer functions

Module:7	Applications of Robots	9 hours

Industrial control systems, introduction to automation, basic elements of automation, levels of automation, material handling and identification, production planning and control systems, introduction to quality control and inspection technologies,

Module:8	**Recent trends**		**2 hours**
	Total Lecture hours:		**45 hours**
Text Book(s)			
1.	S.R. Deb, "Robotics technology and flexible automation", THH-2009		
2.	Mikell.P.Groover, "Automation, Production Systems, and Computer Integrated Manufacturing" 4th edition Pearson 2016		
Reference Books			
1.	Saeed B.Nikku, Introduction to robotics, analysis, control and applications, Wiley-India, 2nd edition 2011		
2.	Richared D.Klafter. Thomas Achmielewski and Mickael Negin, Robotic Engineering and Integrated Approach, Prentice Hall India-New Delhi-2001		
3.	John Craig, " Introduction to Robotics, Mechanics and Control" February 2017, Pearson		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18.02.2021

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

Course Objectives:

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

Expected Course Outcomes:

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

Module 1	**DATA WAREHOUSE**	4 Hours

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

Module 2	**DATA PREPROCESSING**	4 Hours

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

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

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

Module 4	**CLASSIFICATION AND PREDICTION**	7 Hours

Classification - issues regarding classification and prediction -Decision Tree Induction-Bayesian classification – Support Vector Machines, Rule-Based Classification- Associative Classification Prediction, Rationale for Ensemble Method, Methods for Constructing an Ensemble Classifier, Bias-Variance Decomposition, Bagging, Boosting, Random Forests, Empirical Comparison among Ensemble Methods

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

Types of Data in cluster analysis, - Major clustering methods- The k-Means Method, Agglomerative Hierarchical Clustering, Cluster Evaluation, Outlier Analysis- Distance-Based Outlier Detection-Density-Based Local Outlier Detection		
Module 6	**MINING OF STREAM DATA**	7 Hours
Mining Streams, Time Series and Sequence Data: Mining Data Streams, Mining Time-Series Data, Mining Sequence Patterns in Transactional Databases, Mining Sequence Patterns in Biological Data, Graph Mining, Social Network Analysis and Multirelational Data Mining		
Module 7	**MULTIMEDIA AND COMPLEX DATA MINING**	7 Hours
Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web.		
Module 8	**RECENT TRENDS**	2 Hours
	Total Hours:	45 Hours

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Igual, Laura, and Santi Seguí. "Introduction to Data ScienceSpringer, 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	Course Title	L	T	P	J	C
CSI3027	**R PROGRAMMING**	2	0	2	0	3
Pre-requisite	**Nil**					**Syllabus version**
						1.0

Course Objectives:

1. To understand the fundamentals of R programming.
2. To comprehend the various functions and structures of R.
3. To design systems based on graphics and analytics using R.

Expected Course Outcome: After completion of this course, the student shall be able to:

1. Understand the basics of R programming in terms of vectors, matrices and lists.
2. Understand the working of data frames, functions and tables using R.
3. Apply various programming structures in solving statistical problems.
4. Design Systems by interfacing R with other programming languages.
5. Design and implement models to perform analytics on the given dataset.
6. Apply the R programming from a statistical perspective over the real world problems.

Module:1	**Vectors in R**	**4 hours**

Introduction to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorised operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

Module:2	**Matrices Arrays and Lists**	**5 hours**

Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists

Module:3	**Data Frames and Tables**	**4 hours**

Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions

Module:4	**Data Frames and Tables**	**5 hours**

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R

Module:5	**Object Oriented Programming and I/O**	**4 hours**

S3 Classes- S4 Classes - S3 Vs S4 classes -Managing Objects -accessing keyboard and monitor – reading and writing files – accessing the internet

Module:6	**String Manipulation and Graphics**	**3 hours**

String Manipulation – Graphics – Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots.

Module:7	**Interfacing**	**3 hours**
Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models, Non-linear models – Time Series and Auto-correlation – Clustering		
Module:8	**Recent Trends**	**2 hours**
	Total hours:	**30 hours**

Text Book(s)	
1.	Norman Matloff , "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.
2.	Wickham, H. & Grolemund, G. , "R for Data Science". O'Reilly, New York, 2018
Reference Books	
1	Gareth J,Daniela W,Trevor H & Robert T, "An Introduction to Statistical Learning: with Applications in R", Springer , 2017.
2.	Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2018.
Mode of Evaluation: CAT/ Digital Assignments/Quiz/FAT/ Project.	

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List of Experiments (Indicative)		
1	Write a R program to implement common vector operations	2 Hours
2	Write a R program to implement matrix operations	2 Hours
3	Write a R program to implement multi-dimensional array operations	2 Hours
4	Write a R program to apply functions to lists	2 Hours
5	Write a R program to implement matrix-like operations in frames and merging data frames	2 Hours
6	Write a R program to implement factors ,levels and tables	2 Hours
7	Write a R program to implement control statements and arithmetic operations	2 Hours
8	Write a R program to implement replacement functions and recursion	2 Hours
9	Perform simulation of a mathematical function	2 Hours
10	Perform simulation of analytics of a statistical data	2 Hours
11	Write a R program for assessing key board and monitor	2 Hours
12	Write a R program to implement the reading and writing of files	2 Hours
13	Write a R program to implement the internet access	2 Hours
14	Write a R program to implement input and output data visualization using graphs.	2 Hours
15	Performing analytics of a linear model.	2 Hours
	Total	30 Hours

Recommended by Board of Studies	11-02-2021		
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Course Code	Course Title	L	T	P	J	C
MDI3002	FOUNDATIONS OF DATA SCIENCE	3	0	0	0	3
Pre-requisite	NIL	Syllabus version				
		v. xx.xx				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Basics of Data Science	5 hours

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

Module:2	Statistical Foundations	7 hours

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

Module:3	Algorithmic Foundations	8 hours

Linear algebra Matrices and their properties (determinants, traces, rank, nullity, etc.); Eigenvalues and eigenvectors; Matrix factorizations; Inner products; Distance measures; Projections; Notion of hyperplanes; half-planes, elementary spectral graph theory. Sampling and VC-dimension - Random walks and graph sampling, MCMC algorithms, learning, linear and non-linear separators, PAC learning

Module:4	Optimization	7 hours

Unconstrained optimization; Necessary and sufficiency conditions for optima; Gradient descent methods; Constrained optimization, KKT conditions; Introduction to non-gradient techniques;

Introduction to least squares optimization		
Module:5	**Programming Foundation and Exploratory Data Analysis**	**6 hours**
Introduction to Python Programming, Types, Expressions and Variables, String Operations, selection, iteration, Data Structures- Strings, Regular Expression, List and Tuples, Dictionaries, Sets; Exploratory Data Analysis (EDA) - Definition, Motivation, Steps in data exploration, The basic datatypes, Data type Portability, Basic Tools of EDA, Data Analytics Life cycle, Discovery		
Module:6	**Data Handling and Visualization**	**6 hours**
Data Acquisition, Data Pre-processing and Preparation, Data Quality and Transformation, Handling Text Data; Introduction to data visualization, Visualization workflow: describing data visualization workflow, Visualization Periodic Table; Data Abstraction -Analysis: Four Levels for Validation- Task Abstraction - Analysis: Four Levels for Validation Data Representation: chart types: categorical, hierarchical, relational, temporal & spatial		
Module:7	**Data Science Tools and Techniques**	**4 hours**
Overview and Demonstration of Open source tools such as R, Octave, Scilab. Python libraries: SciPy and sci-kitLearn, PyBrain, Pylearn2; Weka.		
Module:8	**Recent Trends**	**2 hours**
Recent trends in Data Science		
Total Lecture hours:		**45 hours**

Text Book(s)

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	Course Title	L	T	P	J	C
CSI3005	ADVANCED DATA VISUALIZATION TECHNIQUES	3	0	2	0	4

Pre-requisite	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.

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

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

Module:2	Visual Analytics	5 hours

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

Module:3	Visualization Tools	6 hours

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

Module:4	Geo spatial visualization	6 hours

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

Module:5	Diverse Types Of Visual Analysis	6 hours

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

Module:6	Visualization of Streaming Data	7 hours

Introduction to Data Streaming, processing and presenting of streaming data, streaming visualization

techniques, streaming analysis.

Module:7	**Visualization Dashboard Creations**	**7 hours**

Dashboard creation using visualization tools for the use cases: Finance-marketing-insurance-healthcare etc.,

Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours	**45 hours**

Text Books

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

Reference Books

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

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

List of Experiments:

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

Mode of evaluation: Project/Activity

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

Course code	Course Title	L	T	P	J	C
CSI3028	DEEP LEARNING	3	0	0	0	3
Pre-requisite	Nil	Syllabus version				
		v.x.x				

Course Objectives:

1. To present the basic ideas, mathematical and computational models of neural network.
2. To under the concepts of developing various deep learning models
3. To provide the knowledge to apply the deep learning models in various real world applications.

Expected Course Outcome:

1. Recognize the characteristics and role of deep learning models.
2. Understand different deep learning models and develop the transfer learning models for solving real-world problems.
3. Design the sequence models for analyzing the data for variety of problems.
4. Design the deep models to encode the original data and reconstruct data.
5. Generate the generative models for unsupervised learning task.

Module:1	Basics of Machine Learning	5 hours

Learning Algorithms, Building machine learning algorithm, Biological Neuron, Neural Network, Linear separability, Linear perceptron, Stochastic Gradient Descent, Multilayer Perceptron, Back-propagation algorithm, Curse of Dimensionality.

Module:2	Introduction to Deep Learning	7 hours

Historical context and motivation of Deep Learning, Gradient-Based Learning, Multi-layer perceptron, Back-propagation, Vanishing Gradient Problem, Capacity, Overfitting and Underfitting, Activation Functions: RELU, LRELU, ERELU, Regularization-dropout, drop connect, optimization methods for neural networks- Adagrad, adadelta, rmsprop, adam, NAG.

Module:3	Convolutional Neural Networks	6 hours

Overview of Convolutional Neural Networks Architecture-Motivation, Layers, Kernels, Convolution operation, Padding, Stride, Pooling, Non-linear layer, Stacking Layers, Popular CNN Architectures: LeNet, AlexNet, ZFNet, VggNet..

Module:4	Transfer Learning	6 hours

Data Pre-processing, Data Augmentation, batch normalization, Transfer Learning, Deep Transfer Learning Strategies, variants of CNN: DenseNet, PixelNet, ResNet, GoogleNet, Xception.

Module:5	Deep Recurrent Neural Network	7 hours

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures, Deep Recurrent Networks, Recursive Neural Networks, Long Short Term Memory Networks.

Module:6	Auto Encoders	6 hours

Autoencoders, Regulraized Autoencoders, Denoising Autoencoders, Representational Power, Layer, Size, and Depth of Autoencoders, Stochastic Encoders and Decoders, Contractive Encoders.

Module:7	**Deep Generative Models**	**6 hours**
Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief networks, Deep Boltzmann Machine - Directed Generative Nets, Generative Adversial Networks.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Ian Goodfellow, YoshuaBengio and Aaron Courville**, " Deep Learning"**, MIT Press, 2017.
Reference Books	
1.	Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2.	Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
3.	Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Mode of evaluation: Project/Activity	11-02-2021		
Recommended by Board of Studies	No. 61	Date	18.02.2021
Approved by Academic Council			

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:

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

Expected Course Outcome:

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

Module:1	DATA STRUCTURES	4 Hours

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

Module:2	CLASSES AND OBJECTS	4 Hours

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

Module:3	MULTITHREADING IN PYTHON	4 Hours

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

Module:4	DATA PROCESSING	5 Hours

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

Module:5	DATA SCIENCE PERSPECTIVES	4 Hours

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

Module:6	DATA HANDLING TECHNIQUES	3 Hours

Data wrangling ,Merging and joining,- Loan Prediction Problem, Data Mugging using Pandas

Module:7	WEB APPLICATIONS	4 Hours

Web Applications With Python – Django / Flask / Web2Py – Database Programming – NoSQL databases - Embedded Application using IOT Devices - Building a Predictive Model for IOT and Web programming

Module: 8	RECENT TRENDS	2 Hours

	Total Hours	**30 Hours**
Text Book(s)		
1	Doug Farrell, The Well Grounded Python Developer; Manning Publications, 2021	
2	Paul Barry, Head-First Python, O-Reilly Media, 2016	
Reference Book(s)		
1	Zed A Shaw, Learn Python the Hard Way - A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Addison Wesley Press, 2013	
2	Eric Mathews, Python Crash Course, Second Edition, No Starch Press, 2019	
3	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

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