

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2022-2023)

B. Tech. Computer Science and Engineering



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.



B.Tech. Computer Science and Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- 1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.
- 2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.
- 3. Graduates will function in their profession with social awareness and responsibility.
- 4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.
- 5. Graduates will be successful in pursuing higher studies in engineering or management.
- 6. Graduates will pursue career paths in teaching or research.



B.Tech. Computer Science and Engineering

PROGRAMME OUTCOMES (POs)

- PO_01: Having an ability to apply mathematics and science in engineering applications.
- PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems.
- PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment
- PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information
- PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice
- PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems
- PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development
- PO_08: Having a clear understanding of professional and ethical responsibility
- PO_09: Having cross cultural competency exhibited by working as a member or in teams
- PO_10: Having a good working knowledge of communicating in English communication with engineering community and society
- PO_11: Having a good cognitive load management skills related to project management and finance
- PO_12: Having interest and recognise the need for independent and lifelong learning



B.Tech. Computer Science and Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- 1. Apply computing theory, languages and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analysis.
- 2. Apply the principles and techniques of database design, administration, and implementation to enhance data collection capabilities and decision-support systems. Ability to critique the role of information and analytics in supporting business processes and functions.
- 3. Invent and use appropriate models of data analysis, assess the quality of input, derive insight from results, and investigate potential issues. Also to organize big data sets into meaningful structures, incorporating data profiling and quality standards.

	Category Credit Detail									
SI.No.	Description	Credits	Maximum Credit							
1	FC - Foundation Core	53	53							
2	DLES - Discipline-linked Engineering Sciences	12	12							
3	DC - Discipline Core	47	47							
4	DE - Discipline Elective	9	15							
5	PI - Projects and Internship	9	9							
6	OE - Open Elective	0	15							
7	BC - Bridge Course	0	0							
8	NGCR - Non-graded Core Requirement	11	11							
9	ME - Multidisciplinary Elective	0	21							
	Total Credits	162								
	Combined Category	DE + OE + ME Max.: 30	Credit Min.: 30 Credit							

Foundation Core											
sl.no	Course Code	Course Title	Course Type	Ver sio n	L	Т	Р	J	Credits		
1	BCHY101L	Engineering Chemistry	Theory Only	1.0	3	0	0	0	3.0		
2	BCHY101P	Engineering Chemistry Lab	Lab Only	1.0	0	0	2	0	1.0		
3	BCSE101E	Computer Programming: Python	Embedded Theory and Lab	1.0	1	0	4	0	3.0		
4	BCSE102L	Structured and Object-Oriented Programming	Theory Only	1.0	2	0	0	0	2.0		
5	BCSE102P	Structured and Object-Oriented Programming Lab	Lab Only	1.0	0	0	4	0	2.0		
6	BCSE103E	Computer Programming: Java	Embedded Theory and Lab	1.0	1	0	4	0	3.0		
7	BEEE102L	Basic Electrical and Electronics Engineering	Theory Only	1.0	3	0	0	0	3.0		
8	BEEE102P	Basic Electrical and Electronics Engineering Lab	Lab Only	1.0	0	0	2	0	1.0		
9	BENG101L	Technical English Communication	Theory Only	1.0	2	0	0	0	2.0		
10	BENG101P	Technical English Communication Lab	Lab Only	1.0	0	0	2	0	1.0		
11	BENG102P	Technical Report Writing	Lab Only	1.0	0	0	2	0	1.0		
12	BFLE200L	B.Tech. Foreign Language - 2021onwards	Basket	1.0	0	0	0	0	2.0		
13	BHSM200L	B.Tech. HSM Elective - 2021 onwards	Basket	1.0	0	0	0	0	3.0		
14	BMAT101L	Calculus	Theory Only	1.0	3	0	0	0	3.0		
15	BMAT101P	Calculus Lab	Lab Only	1.0	0	0	2	0	1.0		
16	BMAT102L	Differential Equations and Transforms	Theory Only	1.0	3	1	0	0	4.0		
17	BMAT201L	Complex Variables and Linear Algebra	Theory Only	1.0	3	1	0	0	4.0		
18	BMAT202L	Probability and Statistics	Theory Only	1.0	3	0	0	0	3.0		
19	BMAT202P	Probability and Statistics Lab	Lab Only	1.0	0	0	2	0	1.0		
20	BPHY101L	Engineering Physics	Theory Only	1.0	3	0	0	0	3.0		
21	BPHY101P	Engineering Physics Lab	Lab Only	1.0	0	0	2	0	1.0		
22	BSTS101P	Quantitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5		
23	BSTS102P	Quantitative Skills Practice II	Soft Skill	1.0	0	0	3	0	1.5		

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Foundation Core												
24	BSTS201P	Qualitative Skills Practice I	Soft Skill	1.0	0	0	3	0	1.5			
25	BSTS202P	Qualitative Skills Practice II	Soft Skill	1.0	0	0	3	0	1.5			

	Discipline-linked Engineering Sciences											
sl.no	Course Code	Course Title	Course Type	Ver sio	L	Т	Р	J	Credits			
1	BECE102L	Digital Systems Design	Theory Only	n 1.0	3	0	0	0	3.0			
2	BECE102P	Digital Systems Design Lab	Lab Only	1.0	0	0	2	0	1.0			
3	BECE204L	Microprocessors and Microcontrollers	Theory Only	1.0	3	0	0	0	3.0			
4	BECE204P	Microprocessors and Microcontrollers Lab	Lab Only	1.0	0	0	2	0	1.0			
5	BMAT205L	Discrete Mathematics and Graph Theory	Theory Only	1.0	3	1	0	0	4.0			

Discipline Core											
sl.no	Course Code	Course Title	Course Type	Ver	L	Т	Р	J	Credits		
				sio							
				n							
1	BCSE202L	Data Structures and Algorithms	Theory Only	1.0	3	0	0	0	3.0		
2	BCSE202P	Data Structures and Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0		
3	BCSE203E	Web Programming	Embedded Theory and Lab	1.0	1	0	4	0	3.0		
4	BCSE204L	Design and Analysis of Algorithms	Theory Only	1.0	3	0	0	0	3.0		
5	BCSE204P	Design and Analysis of Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0		
6	BCSE205L	Computer Architecture and Organization	Theory Only	1.0	3	0	0	0	3.0		
7	BCSE301L	Software Engineering	Theory Only	1.0	3	0	0	0	3.0		
8	BCSE301P	Software Engineering Lab	Lab Only	1.0	0	0	2	0	1.0		
9	BCSE302L	Database Systems	Theory Only	1.0	3	0	0	0	3.0		
10	BCSE302P	Database Systems Lab	Lab Only	1.0	0	0	2	0	1.0		
11	BCSE303L	Operating Systems	Theory Only	1.0	3	0	0	0	3.0		
12	BCSE303P	Operating Systems Lab	Lab Only	1.0	0	0	2	0	1.0		
13	BCSE304L	Theory of Computation	Theory Only	1.0	3	0	0	0	3.0		
14	BCSE305L	Embedded Systems	Theory Only	1.0	3	0	0	0	3.0		
15	BCSE306L	Artificial Intelligence	Theory Only	1.0	3	0	0	0	3.0		
16	BCSE307L	Compiler Design	Theory Only	1.0	3	0	0	0	3.0		
17	BCSE307P	Compiler Design Lab	Lab Only	1.0	0	0	2	0	1.0		
18	BCSE308L	Computer Networks	Theory Only	1.0	3	0	0	0	3.0		
19	BCSE308P	Computer Networks Lab	Lab Only	1.0	0	0	2	0	1.0		
20	BCSE309L	Cryptography and Network Security	Theory Only	1.0	3	0	0	0	3.0		
21	BCSE309P	Cryptography and Network Security Lab	Lab Only	1.0	0	0	2	0	1.0		

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Discipline Elective											
sl.no	Course Code	Course Title	Course Type	Ver sio n	L	Т	Р	J	Credits		
1	BCSE206L	Foundations of Data Science	Theory Only	1.0	3	0	0	0	3.0		
2	BCSE207L	Programming for Data Science	Theory Only	1.0	2	0	0	0	2.0		
3	BCSE207P	Programming for Data Science Lab	Lab Only	1.0	0	0	2	0	1.0		
4	BCSE208L	Data Mining	Theory Only	1.0	2	0	0	0	2.0		
5	BCSE208P	Data Mining Lab	Lab Only	1.0	0	0	2	0	1.0		
6	BCSE209L	Machine Learning	Theory Only	1.0	3	0	0	0	3.0		
7	BCSE209P	Machine Learning Lab	Lab Only	1.0	0	0	2	0	1.0		
8	BCSE310L	IoT Architectures and Protocols	Theory Only	1.0	3	0	0	0	3.0		
9	BCSE311L	Sensors and Actuator Devices	Theory Only	1.0	2	0	0	0	2.0		
10	BCSE311P	Sensors and Actuator Devices Lab	Lab Only	1.0	0	0	2	0	1.0		
11	BCSE312L	Programming for IoT Boards	Theory Only	1.0	2	0	0	0	2.0		
12	BCSE312P	Programming for IoT Boards Lab	Lab Only	1.0	0	0	2	0	1.0		
13	BCSE313L	Fundamentals of Fog and Edge Computing	Theory Only	1.0	3	0	0	0	3.0		
14	BCSE314L	Privacy and Security in IoT	Theory Only	1.0	3	0	0	0	3.0		
15	BCSE315L	Wearable Computing	Theory Only	1.0	3	0	0	0	3.0		
16	BCSE316L	Design of Smart Cities	Theory Only	1.0	3	0	0	0	3.0		
17	BCSE317L	Information Security	Theory Only	1.0	3	0	0	0	3.0		
18	BCSE318L	Data Privacy	Theory Only	1.0	3	0	0	0	3.0		
19	BCSE319L	Penetration Testing and Vulnerability Analysis	Theory Only	1.0	2	0	0	0	2.0		
20	BCSE319P	Penetration Testing and Vulnerability Analysis Lab	Lab Only	1.0	0	0	2	0	1.0		
21	BCSE320L	Web Application Security	Theory Only	1.0	3	0	0	0	3.0		
22	BCSE321L	Malware Analysis	Theory Only	1.0	2	0	0	0	2.0		
23	BCSE321P	Malware Analysis Lab	Lab Only	1.0	0	0	2	0	1.0		
24	BCSE322L	Digital Forensics	Theory Only	1.0	2	0	0	0	2.0		
25	BCSE322P	Digital Forensics Lab	Lab Only	1.0	0	0	2	0	1.0		
26	BCSE323L	Digital Watermarking and Steganography	Theory Only	1.0	3	0	0	0	3.0		
27	BCSE324L	Foundations of Blockchain Technology	Theory Only	1.0	3	0	0	0	3.0		
28	BCSE325L	Introduction to Bitcoin	Theory Only	1.0	3	0	0	0	3.0		
29	BCSE326L	Blockchain Architecture Design	Theory Only	1.0	3	0	0	0	3.0		
30	BCSE327L	Smart Contracts	Theory Only	1.0	2	0	0	0	2.0		
31	BCSE327P	Smart Contracts Lab	Lab Only	1.0	0	0	2	0	1.0		
32	BCSE328L	Cryptocurrency Technologies	Theory Only	1.0	3	0	0	0	3.0		
33	BCSE329L	Blockchain and Distributed Ledger Technology	Theory Only	1.0	2	0	0	0	2.0		
34	BCSE329P	Blockchain and Distributed Ledger Technology Lab	Lab Only	1.0	0	0	2	0	1.0		
35	BCSE330L	Public Key Infrastructure and Trust Management	Theory Only	1.0	3	0	0	0	3.0		
36	BCSE331L	Exploratory Data Analysis	Theory Only	1.0	2	0	0	0	2.0		
37	BCSE331P	Exploratory Data Analysis Lab	Lab Only	1.0	0	0	2	0	1.0		
38	BCSE332L	Deep Learning	Theory Only	1.0	3	0	0	0	3.0		
39	BCSE332P	Deep Learning Lab	Lab Only	1.0	0	0	2	0	1.0		
40	BCSE333L	Statistical Inference	Theory Only	1.0	2	0	0	0	2.0		

Discipline Elective											
41	BCSE333P	Statistical Inference Lab	Lab Only	1.0	0	0	2	0	1.0		
42	BCSE334L	Predictive Analytics	Theory Only	1.0	3	0	0	0	3.0		
43	BCSE335L	Healthcare Data Analytics	Theory Only	1.0	3	0	0	0	3.0		
44	BCSE336L	Financial Data Analytics	Theory Only	1.0	2	0	0	0	2.0		
45	BCSE336P	Financial Data Analytics Lab	Lab Only	1.0	0	0	2	0	1.0		
46	BCSE391J	Technical Answers to Real Problems Project	Project	1.0	0	0	0	0	3.0		
47	BCSE392J	Design Project	Project	1.0	0	0	0	0	3.0		
48	BCSE393J	Laboratory Project	Project	1.0	0	0	0	0	3.0		
49	BCSE394J	Product Development Project	Project	1.0	0	0	0	0	3.0		
50	BCSE396J	Reading Course	Project	1.0	0	0	0	0	3.0		
51	BCSE397J	Special Project	Project	1.0	0	0	0	0	3.0		
52	BCSE398J	Simulation Project	Project	1.0	0	0	0	0	3.0		
53	BCSE401L	Internet of Things	Theory Only	1.0	3	0	0	0	3.0		
54	BCSE402L	Big Data Analytics	Theory Only	1.0	3	0	0	0	3.0		
55	BCSE403L	Digital Image Processing	Theory Only	1.0	3	0	0	0	3.0		
56	BCSE404L	Internet and Web Programming	Theory Only	1.0	3	0	0	0	3.0		
57	BCSE405L	Advanced Java Programming	Theory Only	1.0	3	0	0	0	3.0		
58	BCSE406L	NoSQL Databases	Theory Only	1.0	3	0	0	0	3.0		
59	BCSE407L	Computer Vision	Theory Only	1.0	3	0	0	0	3.0		
60	BCSE408L	Cloud Computing	Theory Only	1.0	3	0	0	0	3.0		
61	BCSE409L	Natural Language Processing	Theory Only	1.0	3	0	0	0	3.0		
62	BCSE410L	Cyber Security	Theory Only	1.0	3	0	0	0	3.0		
63	BCSE411L	Robotics and Automation	Theory Only	1.0	3	0	0	0	3.0		
64	BCSE412L	Parallel Computing	Theory Only	1.0	3	0	0	0	3.0		
65	BCSE413L	Soft Computing	Theory Only	1.0	3	0	0	0	3.0		
66	BCSE414L	High Performance Computing	Theory Only	1.0	3	0	0	0	3.0		
67	BCSE431L	Fundamentals of Quantum Computing	Theory Only	1.0	3	0	0	0	3.0		
68	BEEE303L	Control Systems	Theory Only	1.0	3	0	0	0	3.0		
69	BEEE303P	Control Systems Lab	Lab Only	1.0	0	0	2	0	1.0		

	Projects and Internship											
sl.no	Course Code	Course Title	Course Type		L	Т	Р	J	Credits			
				sio								
				n								
1	BCSE399J	Summer Industrial Internship	Project	1.0	0	0	0	0	1.0			
2	BCSE497J	Project - I	Project	1.0	0	0	0	0	3.0			
3	BCSE498J	Project - II / Internship	Project	1.0	0	0	0	0	5.0			
4	BCSE499J	One Semester Internship	Project	1.0	0	0	0	0	14.0			

		Open Elective							
sl.no	Course Code	Course Title	Course Type	Ver sio	L	Т	Р	J	Credits
1	BCSE355L	AWS Solutions Architect	Theory Only	n	3	0	0	0	3.0
2	BEEE202L	Electromagnetic Theory	Theory Only	1.0	2	1	0	0	3.0
 3	BHUM201L	Mass Communication	Theory Only	1.0	3	0	0	0	3.0
1	BHUM202L	Rural Development	Theory Only	1.0	3	0	0	0	3.0
5	BHUM203L	Introduction to Psychology	Theory Only	1.0	3	0	0	0	3.0
3	BHUM204L	Industrial Psychology	Theory Only	1.0	3	0	0	0	3.0
,	BHUM205L	Development Economics	Theory Only	1.0	3	0	0	0	3.0
3	BHUM206L	International Economics	Theory Only	1.0	3	0	0	0	3.0
)	BHUM207L	Engineering Economics	Theory Only	1.0	3	0	0	0	3.0
10	BHUM208L	Economics of Strategy	Theory Only	1.0	3	0	0	0	3.0
11	BHUM209L	Game Theory	Theory Only	1.0	3	0	0	0	3.0
12	BHUM210E	Econometrics	Embedded Theory and Lab	1.0	2	0	2	0	3.0
3	BHUM211L	Behavioral Economics	Theory Only	1.0	3	0	0	0	3.0
4	BHUM212L	Mathematics for Economic Analysis	Theory Only	1.0	3	0	0	0	3.0
5	BHUM213L	Corporate Social Responsibility	Theory Only	1.0	3	0	0	0	3.0
16	BHUM214L	Political Science	Theory Only	1.0	3	0	0	0	3.0
17	BHUM215L	International Relations	Theory Only	1.0	3	0	0	0	3.0
18	BHUM216L	Indian Culture and Heritage	Theory Only	1.0	3	0	0	0	3.0
19	BHUM217L	Contemporary India	Theory Only	1.0	3	0	0	0	3.0
20	BHUM218L	Financial Management	Theory Only	1.0	3	0	0	0	3.0
21	BHUM219L	Principles of Accounting	Theory Only	1.0	3	0	0	0	3.0
22	BHUM220L	Financial Markets and Institutions	Theory Only	1.0	3	0	0	0	3.0
23	BHUM221L	Economics of Money, Banking and Financial Markets	Theory Only	1.0	3	0	0	0	3.0
24	BHUM222L	Security Analysis and Portfolio Management	Theory Only	1.0	3	0	0	0	3.0
25	BHUM223L	Options , Futures and other Derivatives	Theory Only	1.0	3	0	0	0	3.0
26	BHUM224L	Fixed Income Securities	Theory Only	1.0	3	0	0	0	3.0
27	BHUM225L	Personal Finance	Theory Only	1.0	3	0	0	0	3.0
28	BHUM226L	Corporate Finance	Theory Only	1.0	3	0	0	0	3.0
29	BHUM227L	Financial Statement Analysis	Theory Only	1.0	3	0	0	0	3.0
30	BHUM228L	Cost and Management Accounting	Theory Only	1.0	3	0	0	0	3.0
31	BHUM229L	Mind, Embodiment and Technology	Theory Only	1.0	3	0	0	0	3.0
32	BHUM230L	Health Humanities in Biotechnological Era	Theory Only	1.0	3	0	0	0	3.0
33	BHUM231L	Reproductive Choices for a Sustainable Society	Theory Only	1.0	3	0	0	0	3.0
34	BHUM232L	Introduction to Sustainable Aging	Theory Only	1.0	3	0	0	0	3.0
35	BHUM233L	Environmental Psychology	Theory Only	1.0	3	0	0	0	3.0
36	BHUM234L	Indian Psychology	Theory Only	1.0	3	0	0	0	3.0
37	BHUM235E	Psychology of Wellness	Embedded Theory and Lab	1.0	2	0	2	0	3.0
88	BHUM236L	Taxation	Theory Only	1.0	3	0	0	0	3.0
39	BMGT108L	Entrepreneurship	Theory Only	1.0	3	0	0	0	3.0

Open Elective											
40	BMGT109L	Introduction to Intellectual Property	Theory Only	1.0	3	0	0	0	3.0		
41	BPHY201L	Optics	Theory Only	1.0	3	0	0	0	3.0		
42	BPHY202L	Classical Mechanics	Theory Only	1.0	3	0	0	0	3.0		
43	BPHY203L	Quantum Mechanics	Theory Only	1.0	3	0	0	0	3.0		
44	BPHY301E	Computational Physics	Embedded Theory and Lab	1.0	2	0	2	0	3.0		
45	BPHY302P	Physics Lab	Lab Only	1.0	0	0	2	0	1.0		
46	BPHY401L	Solid State Physics	Theory Only	1.0	3	0	0	0	3.0		
47	BPHY402L	Electromagnetic Theory	Theory Only	1.0	3	0	0	0	3.0		
48	BPHY403L	Atomic and Nuclear Physics	Theory Only	1.0	3	0	0	0	3.0		
49	BPHY404L	Statistical Mechanics	Theory Only	1.0	3	0	0	0	3.0		
50	BSTS301P	Advanced Competitive Coding - I	Soft Skill	1.0	0	0	3	0	1.5		
51	BSTS302P	Advanced Competitive Coding - II	Soft Skill	1.0	0	0	3	0	1.5		
52	CFOC102M	Introduction to Cognitive Psychology	Online Course	1.0	0	0	0	0	3.0		
53	CFOC103M	Introduction to Political Theory	Online Course	1.0	0	0	0	0	3.0		
54	CFOC104M	Six Sigma	Online Course	1.0	0	0	0	0	3.0		
55	CFOC105M	Emotional Intelligence	Online Course	1.0	0	0	0	0	2.0		
56	CFOC109M	Design Thinking - A Primer	Online Course	1.0	0	0	0	0	1.0		
57	CFOC112M	Sociology of Science	Online Course	1.0	0	0	0	0	1.0		
58	CFOC118M	Practical Machine Learning with Tensorflow	Online Course	1.0	0	0	0	0	2.0		
59	CFOC119M	Training of Trainers	Online Course	1.0	0	0	0	0	3.0		
60	CFOC120M	Knowledge Management	Online Course	1.0	0	0	0	0	2.0		
61	CFOC121M	Leadership	Online Course	1.0	0	0	0	0	1.0		
62	CFOC122M	Educational Leadership	Online Course	1.0	0	0	0	0	2.0		
63	CFOC125M	Decision-Making Under Uncertainty	Online Course	1.0	0	0	0	0	1.0		
64	CFOC132M	Corporate Social Responsibility	Online Course	1.0	0	0	0	0	2.0		
65	CFOC133M	E-Business	Online Course	1.0	0	0	0	0	3.0		
66	CFOC134M	Innovation, Business Models and Entrepreneurship	Online Course	1.0	0	0	0	0	2.0		
67	CFOC137M	Intellectual Property Rights and Competition Law	Online Course	1.0	0	0	0	0	2.0		
68	CFOC138M	Patent Search for Engineers and Lawyers	Online Course	1.0	0	0	0	0	2.0		
69	CFOC150M	Microelectronics: Devices To Circuits	Online Course	1.0	0	0	0	0	3.0		
70	CFOC152M	Pattern Recognition and Application	Online Course	1.0	0	0	0	0	3.0		
71	CFOC165M	Software testing	Online Course	1.0	0	0	0	0	3.0		
72	CFOC171M	Introduction to Haskell Programming	Online Course	2.0	0	0	0	0	3.0		
73	CFOC174M	Introduction to Biostatistics	Online Course	1.0	0	0	0	0	2.0		
74	CFOC176M	Computer Aided Drug Design	Online Course	1.0	0	0	0	0	2.0		
75	CFOC177M	Drug Delivery: Principles and Engineering	Online Course	1.0	0	0	0	0	3.0		
76	CFOC178M	Functional Genomics	Online Course	1.0	0	0	0	0	1.0		
77	CFOC181M	WildLife Conservation	Online Course	1.0	0	0	0	0	2.0		
78	CFOC182M	Organic Chemistry in Biology and Drug Development	Online Course	1.0	0	0	0	0	3.0		
79	CFOC188M	Ethical Hacking	Online Course	1.0	0	0	0	0	3.0		
80	CFOC190M	Positive Psychology	Online Course	1.0	0	0	0	0	2.0		
81	CFOC191M	Forests and their Management	Online Course	1.0	0	0	0	0	3.0		

Open Elective											
82	CFOC193M	Bioengineering: An Interface with Biology and Medicine	Online Course	1.0	0	0	0	0	2.0		
83	CFOC196M	Computational Systems Biology	Online Course	1.0	0	0	0	0	3.0		
84	CFOC197M	Bio-Informatics: Algorithms and Applications	Online Course	1.0	0	0	0	0	3.0		
85	CFOC203M	Natural Hazards	Online Course	1.0	0	0	0	0	2.0		
86	CFOC207M	Electronic Waste Management - Issues And Challenges	Online Course	1.0	0	0	0	0	1.0		
87	CFOC227M	GPU Architectures and Programming	Online Course	1.0	0	0	0	0	3.0		
88	CFOC232M	Consumer Behaviour	Online Course	1.0	0	0	0	0	2.0		
89	CFOC234M	Introduction to Airplane Performance	Online Course	1.0	0	0	0	0	2.0		
90	CFOC235M	Rocket Propulsion	Online Course	1.0	0	0	0	0	3.0		
91	CFOC236M	Aircraft Maintenance	Online Course	1.0	0	0	0	0	1.0		
92	CFOC237M	Sustainable Architecture	Online Course	1.0	0	0	0	0	3.0		
93	CFOC253M	Plastic Waste Management	Online Course	1.0	0	0	0	0	2.0		
94	CFOC258M	Introduction to Geographic Information Systems	Online Course	1.0	0	0	0	0	1.0		
95	CFOC264M	Thermodynamics	Online Course	1.0	0	0	0	0	3.0		
96	CFOC273M	Transport phenomena	Online Course	1.0	0	0	0	0	3.0		
97	CFOC282M	Waste to Energy Conversion	Online Course	1.0	0	0	0	0	2.0		
98	CFOC323M	Advanced Chemical Thermodynamics and Kinetics	Online Course	1.0	0	0	0	0	3.0		
99	CFOC329M	Design, Technology and Innovation	Online Course	1.0	0	0	0	0	2.0		
100	CFOC330M	Geographic Information System	Online Course	1.0	0	0	0	0	3.0		
101	CFOC332M	Fundamentals of Automotive Systems	Online Course	1.0	0	0	0	0	3.0		
102	CFOC335M	Fuzzy Sets, Logic and Systems and Applications	Online Course	1.0	0	0	0	0	3.0		
103	CFOC356M	Analog Circuits	Online Course	1.0	0	0	0	0	3.0		
104	CFOC365M	Evolution of Air Interface towards 5G	Online Course	1.0	0	0	0	0	2.0		
105	CFOC381M	Introduction to Research	Online Course	1.0	0	0	0	0	2.0		
106	CFOC384M	Entrepreneurship Essentials	Online Course	1.0	0	0	0	0	3.0		
107	CFOC387M	Introduction to Environmental Economics	Online Course	1.0	0	0	0	0	3.0		
108	CFOC388M	Energy Resources, Economics and Environment	Online Course	1.0	0	0	0	0	3.0		
109	CFOC391M	Effective Writing	Online Course	1.0	0	0	0	0	1.0		
110	CFOC395M	Speaking Effectively	Online Course	1.0	0	0	0	0	2.0		
111	CFOC397M	Intellectual Property	Online Course	1.0	0	0	0	0	3.0		
112	CFOC400M	Language and Mind	Online Course	1.0	0	0	0	0	2.0		
113	CFOC401M	The Nineteenth - Century English Novel	Online Course	1.0	0	0	0	0	3.0		
114	CFOC402M	Introduction to World Literature	Online Course	1.0	0	0	0	0	3.0		
115	CFOC404M	Patent Law for Engineers and Scientists	Online Course	1.0	0	0	0	0	3.0		
116	CFOC405M	Economic Growth & Development	Online Course	1.0	0	0	0	0	2.0		
117	CFOC407M	Introduction to Modern Indian Political Thought	Online Course	1.0	0	0	0	0	3.0		
118	CFOC408M	English Literature of the Romantic Period, 1798 -	Online Course	1.0	0	0	0	0	2.0		
119	CFOC416M	Feminism : Concepts and Theories	Online Course	1.0	0	0	0	0	3.0		
120	CFOC418M	Measure Theory	Online Course	1.0	0	0	0	0	3.0		
121	CFOC419M	Basic Real Analysis	Online Course	1.0	0	0	0	0	3.0		
122	CFOC442M	Robotics and Control : Theory and Practice	Online Course	1.0	0	0	0	0	2.0		

Open Elective											
123	CFOC469M	Financial Mathematics	Online Course	1.0	0	0	0	0	3.0		
124	CFOC475M	IC Engines and Gas Turbines	Online Course	1.0	0	0	0	0	3.0		
125	CFOC488M	Business Analytics For Management Decision	Online Course	1.0	0	0	0	0	3.0		
126	CFOC490M	Sales and Distribution Management	Online Course	1.0	0	0	0	0	2.0		
127	CFOC493M	Management of Inventory Systems	Online Course	1.0	0	0	0	0	3.0		
128	CFOC494M	Quality Design And Control	Online Course	1.0	0	0	0	0	3.0		
129	CFOC495M	Foundation Course in Managerial Economics	Online Course	1.0	0	0	0	0	2.0		
130	CFOC496M	Engineering Econometrics	Online Course	1.0	0	0	0	0	3.0		
131	CFOC497M	Financial Statement Analysis and Reporting	Online Course	1.0	0	0	0	0	3.0		
132	CFOC498M	Business Statistics	Online Course	1.0	0	0	0	0	3.0		
133	CFOC499M	Global Marketing Management	Online Course	1.0	0	0	0	0	2.0		
134	CFOC500M	Marketing Research and Analysis - II	Online Course	1.0	0	0	0	0	3.0		
135	CFOC503M	Marketing Analytics	Online Course	1.0	0	0	0	0	3.0		
136	CFOC505M	Management of Commercial Banking	Online Course	1.0	0	0	0	0	3.0		
137	CFOC508M	Entrepreneurship	Online Course	1.0	0	0	0	0	3.0		
138	CFOC549M	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	Online Course	1.0	0	0	0	0	1.0		
139	CFOC550M	Numerical Analysis	Online Course	1.0	0	0	0	0	4.0		
140	CFOC565M	Technologies for Clean and Renewable Energy Production	Online Course	1.0	0	0	0	0	2.0		
141	CFOC570M	Public Speaking	Online Course	1.0	0	0	0	0	3.0		
142	CFOC572M	Dairy And Food Process And Products Technology	Online Course	1.0	0	0	0	0	3.0		
143	CFOC575M	Wildlife Ecology	Online Course	1.0	0	0	0	0	3.0		
144	CFOC576M	Integrated Waste Management For A Smart City	Online Course	1.0	0	0	0	0	3.0		
145	CFOC578M	Wastewater Treatment And Recycling	Online Course	1.0	0	0	0	0	3.0		
146	CFOC584M	Accreditation And Outcome Based Learning	Online Course	1.0	0	0	0	0	2.0		
147	CFOC587M	Economics of Banking and Finance Markets	Online Course	1.0	0	0	0	0	3.0		
148	CFOC588M	Concepts Of Thermodynamics	Online Course	1.0	0	0	0	0	3.0		
149	CFOC590M	Management Information System	Online Course	1.0	0	0	0	0	3.0		
150	CFOC591M	Principles Of Management	Online Course	1.0	0	0	0	0	3.0		
151	CFOC592M	Stress Management	Online Course	1.0	0	0	0	0	1.0		
152	CFOC594M	Customer Relationship Management	Online Course	1.0	0	0	0	0	2.0		
153	CFOC597M	Globalization And Culture	Online Course	1.0	0	0	0	0	2.0		
154	CFOC599M	Leadership and Team Effectiveness	Online Course	1.0	0	0	0	0	3.0		
155	CFOC619M	Corporate Finance_2	Online Course	1.0	0	0	0	0	2.0		
156	CFOC642M	Conservation Economics	Online Course	1.0	0	0	0	0	3.0		
157	CFOC647M	Air pollution and Control	Online Course	1.0	0	0	0	0	3.0		
158	CFOC648M	Centre-State Relations in India	Online Course	1.0	0	0	0	0	2.0		
159	CFOC649M	Energy Resources, Economics, and Sustainability	Online Course	1.0	0	0	0	0	2.0		
160	CFOC650M	Human Physiology	Online Course	1.0	0	0	0	0	3.0		
161	CFOC651M	Psychology of Stress, Health and Well-being	Online Course	1.0	0	0	0	0	3.0		
162	CFOC652M	Signal Processing Techniques and its Applications	Online Course	1.0	0	0	0	0	3.0		
163	CFOC653M	Strength & Conditioning for the Indian Population	Online Course	1.0	0	0	0	0	3.0		
164 Report On	CFOC654M : 29-07-2024 12:58:	The Evolution of the Earth and Life	Online Course	1.0	0	0	0	0 Page 8	3.0 3 of 10		

		Open Elective							
165	CFOC655M	United Nations Sustainable Development Goals (UN	Online Course	1.0	0	0	0	0	3.0
		SDGs)							

		Bridge Course							
sl.no	Course Code	Course Title	Course Type	Ver sio n	L	Т	Р	J	Credits
1	BBIT100N	Biology	Theory Only	1.0	3	0	0	0	3.0
2	BENG101N	Effective English Communication	Lab Only	1.0	0	0	4	0	2.0
3	BMAT100N	Mathematics	Theory Only	1.0	3	1	0	0	4.0

	Non-graded Core Requirement									
sl.no	Course Code	Course Title	Course Type	Ver sio n	L	Т	Р	J	Credits	
1	BCHY102N	Environmental Sciences	Online Course	1.0	0	0	0	0	2.0	
2	BCSE101N	Introduction to Engineering	Project	1.0	0	0	0	0	1.0	
3	BEXC100N	Extracurricular Activities / Co-Curricular Activities - B.Tech. Programmes	Basket	1.0	0	0	0	0	2.0	
4	BHUM101N	Ethics and Values	Online Course	1.0	0	0	0	0	2.0	
5	BSSC101N	Essence of Traditional Knowledge	Online Course	1.0	0	0	0	0	2.0	
6	BSSC102N	Indian Constitution	Online Course	1.0	0	0	0	0	2.0	

Report On: 29-07-2024 12:58:06 PM Page 9 of 10

Fountation Core

BCSE101E	Computer Programming: Python		_	T	Р	C
	L NIII		_	0	4	3
Pre-requisite	NIL	Sylla			ersi	on
Course Objecti			1	.0		
Course Objecti	ves posure to basic problem-solving techniques using comput	ore				
	ne art of logical thinking abilities and propose novel solution		r re:	al w	orlo	1
	ugh programming language constructs.	113 10	/I I C	ai w	OHC	ı
probleme and	agn programming language concauses.					
Course Outcon	ne					
1. Classify vari	ous algorithmic approaches, categorize the appropriate d	ata re	epre	sen	tatio	on,
	trate various control constructs.					
	ropriate programming paradigms, interpret and handle					
	ution through reusable modules; idealize the importanc	e of	mod	dule	es a	ınd
packages.						
Mandalana Isaa	destant Parking Ockary				4 1	
	oduction to Problem Solving	nina			1 ho	
Flowchart and P	g: Definition and Steps, Problem Analysis Chart, Develo	ping	an <i>i</i>	Aigo	oritri	ım,
	non Programming Fundamentals			2	hou	ırc
	python – Interactive and Script Mode – Indentation – Con	mon	tc			
	ds – Data Types – Operators and their precedence – Exp					
	orting from Packages.	10331	3113	_ D	unt-	,,,
	trol Structures			2	hou	ırs
	and Branching: if, if-else, nested if, multi-way if-elif stat	emer	nts -			
	loop – else clauses in loops, nested loops – break, o					
statements.						
Module:4 Col	lections			3	hou	ırs
Lists: Create, Ad	cess, Slicing, Negative indices, List methods, List compre	hens	ions	; –		
Tuples: Create,	Indexing and slicing, Operations on tuples – Dictionary: C	reate	, add	d, a	nd	
replace values,	Operations on dictionaries – Sets: Creation and operations	s.				
	ngs and Regular Expressions				hοι	
	arison, Formatting, Slicing, Splitting, Stripping – Reg	gular	Exp	ores	ssio	ns:
Matching,						
Search and repl						
	ctions and Files				hou	
	arameters and Arguments: Positional arguments, Ke	ywor	d a	rgui	mer	ıts,
Parameters	use I and Clabel acome of veriables. Functi		:41=	۸.,	مائدا ما	
	ues – Local and Global scope of variables – Functi ecursive Functions – Lambda Function. Files: Create, C					
	se – tell and seek methods.	pen,	Rea	au,	VVI	пe,
	dules and Packages			2	hou	ıre
	 User-Defined modules – Overview of Numpy and Pand 	as na	ncka			113
Bailt in modules	Osci Benned modules - everview of Hampy and Fand	ao pe	iona	gco	•	
	Total Lecture h	ours	:	15	hou	urs
Text Book(s)						
	s, Python Crash Course: A Hands-On, Project-Based	Intro	oduo	tion	ı to	
	ig, 2nd Edition, No starch Press, 2019					
Reference Boo						
	own, Python: The Complete Reference, 4th Edition, McGra	aw Hi	ll Pu	ıblis	her	s,
2018.						
	uttag, Introduction to computation and programming ι	using	pyt	hon	ı: w	/ith
applications	to understanding data. 2nd Edition, MIT Press, 2016.					

Мо	de of Evaluation: No separate eval	uation for th	neory componer	nt.			
Ind	licative Experiments						
1.	Problem Analysis Chart, Flowcha	rt and Pseu	idocode Practice	es.			
2.	Sequential Constructs using Pyth						
3.	Branching (if, if-else, nested if, multi-way if-elif statements) and Looping (for, while,						
	nested						
	looping, break, continue, else in loops).						
4.	4. List, Tuples, Dictionaries & Sets.						
5.	5. Strings, Regular Expressions.						
6.	Functions, Lambda, Recursive Fu	inctions and	d Files.				
7.	Modules and Packages (NumPy	and Pandas	s)				
	Total Labora	tory Hours			60 hours		
Tex	kt Book(s)						
1.	Mariano Anaya, Clean Code in F		elop maintainab	le and ef	ficient code, 2 nd		
	Edition, Packt Publishing Limited,	2021.					
Ref	ference Books						
1.	Harsh Bhasin, Python for beginne			ernationa	II (P) Ltd., 2019,		
	Mode of assessment: Continuous	assessmei	nts and FAT				
Re	commended by Board of Studies	03 07 202	1				
App	proved by Academic Council	No. 63	Date	23.09.2	021		

BCSE102L	Structured and Object-Oriented Programming		L	Т	Р	С
			2	0	0	2
Pre-requisite	NIL	Syl	labı	ıs v	ersi	on
				1.0		

Course Objectives

- 1. To impart the basic constructs in structured programming and object-oriented programming paradigms.
- 2. To inculcate the insights and benefits in accessing memory locations by implementing real world problems.
- 3. To help solving real world problems through appropriate programming paradigms.

Course Outcome

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

- 1. Understand different programming language constructs and decision-making statements; manipulate data as a group.
- 2. Recognize the application of modular programming approach; create user defined data types and idealize the role of pointers.
- 3. Comprehend various elements of object-oriented programing paradigm; propose solutions through inheritance and polymorphism; identify the appropriate data structure for the given problem and devise solution using generic programming techniques.

Module:1 C Programming Fundamentals

2 hours

Variables - Reserved words - Data Types - Operators - Operator Precedence - Expressions - Type Conversions - I/O statements - Branching and Looping: if, if-else, nested if, if-else ladder, switch statement, goto statement - Loops: for, while and do...while - break and continue statements.

Module:2 | Arrays and Functions

4 hours

Arrays: One Dimensional array - Two-Dimensional Array - Strings and its operations. User Defined Functions: Declaration - Definition - call by value and call by reference - Types of Functions - Recursive functions - Storage Classes - Scope, Visibility and Lifetime of Variables.

Module:3 | Pointers

4 hours

Declaration and Access of Pointer Variables, Pointer arithmetic – Dynamic memory allocation – Pointers and arrays - Pointers and functions.

Module:4 | Structure and Union

2 hours

Declaration, Initialization, Access of Structure Variables - Arrays of Structure - Arrays within Structure - Structure within Structures - Structures and Functions - Pointers to Structure -

Module:5 Overview of Object-Oriented Programming

5 hours

Features of OOP - Classes and Objects - "this" pointer - Constructors and Destructors - Static Data Members, Static Member Functions and Objects - Inline Functions — Call by reference - Functions with default Arguments - Functions with Objects as Arguments - Friend Functions and Friend Classes.

Module:6 Inheritance

5 hours

Inheritance - Types of Inheritance: Single inheritance, Multiple Inheritance, Multi-level

Inheritance, Hierarchical Inheritance - Multipath Inheritance - Inheritance and constructors.								
Мо	dule:7	Polymorphism			4 hours			
Fur	nction O	verloading - Operator Overlo	ading – Dynam	nic Poly	morphism - Virtual Functions -			
Pur	e virtual	Functions - Abstract Classe	s.	-	·			
Мо	dule:8	Generic Programming			4 hours			
Fur	Function templates and class templates, Standard Template Library.							
		Tot	al Lecture hou	ırs:	30 hours			
Tex	t Book	(s)						
1.		t Schildt, C: The Complete	Reference, 4	th Editi	on, McGraw Hill Education,			
	2017			41-				
2.		t Schildt, C++: The Complet	te Reference, 4	4" Edit	tion, McGraw Hill Education,			
	2017.	Daala						
	ference							
1.		/ant Kanetkar, Let Us C: 17 th						
2.		/ Lippman and Josee Lajoie,	C++ Primer, 5	ⁱⁿ Editio	on, Addison-Wesley publishers,			
	2012.							
Mo	de of Ev	raluation: CAT / Written Assiឲ្	gnment / Quiz /	FAT /	Project.			
Red	commer	ided by Board of Studies	03.07.2021					
		y Academic Council	No. 63	Date	23.09.2021			

BCSE102P Structured and Object-Oriented Programming Lab		L	. T	Р	С
		(0	4	2
Pre-requisite	NIL	Syllabus version			sion
		1.0			

Course Objectives

- 1. To impart the basic constructs in structured programming and object-oriented programming paradigms.
- 2. To inculcate the insights and benefits in accessing memory locations by implementing real world problems.
- 3. To solve real world problems through appropriate programming paradigms.

Course Outcome

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

- 1. Understand different programming language constructs and decision-making statements; manipulate data as a group.
- 2. Recognize the application of modular programming approach; create user defined data types and idealize the role of pointers.
- 3. Comprehend various elements of object-oriented programing paradigm; propose solutions through inheritance and polymorphism; identify the appropriate data structure for the given problem and devise solution using generic programming techniques.

Indicative Experiments

- 1. Programs using basic control structures, branching and looping
- 2. Experiment the use of 1-D, 2-D arrays and strings and Functions
- 3. Demonstrate the application of pointers
- 4. Experiment structures and unions
- 5. Programs on basic Object-Oriented Programming constructs.
- 6. Demonstrate various categories of inheritance
- 7. Program to apply kinds of polymorphism.
- 8. Develop generic templates and Standard Template Libraries.

Total Laboratory Hours | 60 hours

Text Book(s)

1. Robert C. Seacord, Effective C: An Introduction to Professional C Programming, 1st Edition, No Starch Press, 2020.

Reference Book(s)

1. Vardan Grigoryan and Shunguang Wu, Expert C++: Become a proficient programmer by learning coding best practices with C++17 and C++20's latest features, 1st Edition, Packt Publishing Limited, 2020.

Mode of assessment: Continuous assessments and FAT.

Recommended by Board of Studies	03.07.202	21	
Approved by Academic Council	No. 63	Date	23.09.2021

BCSE10	3E	Computer Programming : Java		L	T	Р	С
		Alli		1	0	4	3
Pre-requisi	te	NIL	Sy	llab	us v	ers	on
Course Ohi	iootivo				1.0		
Course Obj			ho fi	ındı	2000	ntale	of
		e the core language features of Java and understand tented programming in Java.	пеп	JIIU	ame	man	5 OI
		the ability of using Java to solve real world problems.					
2. 10 d	CVCIOP	the ability of asing bava to solve real world problems.					
Course Out	tcome						
		ourse, students should be able to:					
1. Unde	erstand	d basic programming constructs; realize the funda	men	tals	of	Obj	ect
Orie	ntated	Programming in Java; apply inheritance and inte	rface	e co	once	pts	for
		code reusability.					
		e exception handling mechanism; process data within				ıse	the
		ures in the collection framework for solving real world p	roble	ms.			
Module:1		a Basics				ho	
		Features of Java Language - JVM - Bytecode - Java r					
	rammir	ng constructs - data types - variables – Java nam	ning	cor	iven	tions	; –
operators							
Module:2		pping Constructs and Arrays	14.			ho	
		oing constructs - Arrays - one dimensional and m	nulti-	aim	ensi	onai	_
		- Strings - Wrapper classes.					
Module:3		ses and Objects				ho	
		als – Access and non-access specifiers - Declaring obj					
		ariables – array of objects – constructors and destructo	rs –	usa	ge c	ot tr	IS
and "static" Module:4		eritance and Polymorphism			3	ho	ıre
		s — use of "super" – final keyword - Polymorphism -	- Ov	orlo			
		ct class – Interfaces.	- Ov	CHO	auii	y a	Iu
Module:5		kages and Exception Handling			2	ho	urs
		ng and Accessing - Sub packages.					4.0
		ng - Types of Exception - Control Flow in Exceptions - I	Jse d	of tr	v, ca	ıtch,	
		ws in Exception Handling - User defined exceptions.			•		
Module:6	IO St	reams and Files			2	ho	urs
		s – FileInputStream & FileOutputStream – FileRe					
		& DataOutputStream - BufferedInputStream & Buffe	redC)utp	utSt	rean	1 –
		- Serialization and Deserialization.					
Module:7		ction Framework			2	ho	urs
Generic clas	sses ar	nd methods - Collection framework: List and Map.					
		Total Lecture hours:			15	ho	urs
Text Book(e)						
		ang, "Introduction to Java programming" - compreh	anci	ve '	/erc	ion i	1 1 th
		son publisher, 2017.	G1191	v C	v C I S	- I	
Reference		on publication, 2011.					
		t , The Complete Reference -Java, Tata McGraw-Hill բ	oublis	sher	. 10	th	
Edition					,		
		nn,"Big Java", 4th edition, John Wiley & Sons publisher	, 5 th	edi	tion.	201	5
3 E.Balag	gurusa	my, "Programming with Java", Tata McGraw-Hill publis	hers	, 6 th	edi	tion.	
2019	-						

Mode	of Evaluation: No separate evaluation for theory component.					
Indica	ative Experiments					
1.	Programs using sequential and branching structures.					
2.	Experiment the use of looping, arrays and strings.					
3.	Demonstrate basic Object-Oriented programming elements.					
4.	Experiment the use of inheritance, polymorphism and abstract classes.					
5.	Designing packages and demonstrate exception handling.					
6.	Demonstrate the use of IO streams, file handling and serialization.					
7.	Program to discover application of collections.					
	Total Laboratory Hours 60 hours					
Text E	Book(s)					
1.	Marc Loy, Patrick Niemeyer and Daniel Leuck, Learning Java, O'Reilly Media, Inc.,					
	5 th Edition, 2020.					
Refer	ence Books					
1.	Dhruti Shah, 100+ Solutions in Java: A Hands-On Introduction to Programming in					
	Java, BPB Publications, 1 st Edition, 2020.					
Mode	of assessment: Continuous assessments and FAT					
Recor	mmended by Board of Studies 03.07.2021					
Appro	ved by Academic Council No. 63 Date 23.09.2021					

Discipline-linked Engineering Sciences

Course Code	Course Title		L	Т	Р	С
BECE102L	Digital Systems Design	3		0	0	3
Pre-requisite	Nil	Syllabus version				on
		1.0				

Course Objectives

- 1. Provide an understanding of Boolean algebra and logic functions.
- 2. Develop the knowledge of combinational and sequential logic circuit design.
- 3. Design and model the data path circuits for digital systems.
- 4. Establish a strong understanding of programmable logic.
- 5. Enable the student to design and model the logic circuits using Verilog HDL.

Course Outcome

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

- 1. Optimize the logic functions using and Boolean principles and K-map.
- 2. Model the Combinational and Sequential logic circuits using Verilog HDL.
- 3. Design the various combinational logic circuits and data path circuits.
- 4. Analyze and apply the design aspects of sequential logic circuits.
- 5. Analyze and apply the design aspects of Finite state machines.
- 6. Examine the basic architectures of programmable logic devices.

Module:1 | Digital Logic

8 hours

Boolean Algebra: Basic definitions, Axiomatic definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Simplification of Boolean functions. Gate-Level Minimization: The Map Method (K-map up to 4 variable), Product of Sums and Sum of Products Simplification, NAND and NOR Implementation. Logic Families: Digital Logic Gates, TTL and CMOS logic families.

Module:2 | Verilog HDL

5 hours

Lexical Conventions, Ports and Modules, Operators, Dataflow Modelling, Gate Level Modelling, Behavioural Modeling, Test Bench.

Module:3 Design of Combinational Logic Circuits

8 hours

Design Procedure, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Decoders, Encoders, Multiplexers, De-multiplexers, Parity generator and checker, Applications of Decoder, Multiplexer and De-multiplexer. Modeling of Combinational logic circuits using Verilog HDL.

Module:4 Design of data path circuits

6 hours

N-bit Parallel Adder/Subtractor, Carry Look Ahead Adder, Unsigned Array Multiplier, Booth Multiplier, 4-Bit Magnitude comparator. Modeling of data path circuits using Verilog HDL.

Module:5 Design of Sequential Logic Circuits

8 hours

Latches, Flip-Flops - SR, D, JK & T, Buffer Registers, Shift Registers - SISO, SIPO, PISO, PIPO, Design of synchronous sequential circuits: state table and state diagrams, Design of counters: Modulo-n, Johnson, Ring, Up/Down, Asynchronous counter. Modeling of sequential logic circuits using Verilog HDL.

Module:6 Design of FSM

1 hours

Finite state Machine(FSM):Mealy FSM and Moore FSM, Design Example: Sequence detection, Modeling of FSM using Verilog HDL.

Module:7 | Programmable Logic Devices

4 hours

Types of Programmable Logic Devices: PLA, PAL, CPLD, FPGA Generic Architecture.

Мо	dule:8 Contemporary issues				2 hours	
		Total	Lecture	hours:	45 hours	
Tex	(tbook(s)					
1.	1. M. Morris Mano and Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL and System Verilog, 2018, 6 th Edition, Pearson Pvt. Ltd.					
Ref	erence Books					
1.	Ming-Bo Lin, Digital Systems De 2015, 2nd Edition, Create Space I				HDL and FPGAs,	
2.	Samir Palnitkar, Verilog HDL: A edition, Prentice Hall of India Pvt.	•	ital Desi	gn and Sy	nthesis, 2009, 2nd	
3.	,					
Mod	de of Evaluation: Continuous Ass	essment Test	, Digital	Assignmer	nt, Quiz and Final	
Ass	sessment Test		_	J		
Red	commended by Board of Studies	14-05-2022				
App	proved by Academic Council	No. 66	Date	16-06-202	22	

Course Code	ourse Code Course Title				Р	С
BECE102P	Digital Systems Design Lab				2	1
Pre-requisite	quisite Nil			ous	vers	ion
				1.0		

Course Objective

• To apply theoretical knowledge gained in the theory course and get hands-on experience of the topics.

Course Outcome

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

- 1. Design, simulate and synthesize combinational logic circuits, data path circuits and sequential logic circuits using Verilog HDL.
- 2. Design and implement FSM on FPGA.
- 3. Design and implement small digital systems on FPGA.

Indicative Experiments 1. Characteristics of Digital ICs, Realization of Boolean expressions 2 hours 2. Design and Verilog modeling of Combinational Logic circuits 4 hours 3. Design and Verilog modeling of various data path elements - Adders 2 hours 4. Design and Verilog modeling of various data path elements - Multipliers 2 hours 5. Implementation of combinational circuits – (FPGA / Trainer Kit) 2 hours 6. Implementation of data path circuit - (FPGA / Trainer Kit) 2 hours 7. Design and Verilog modeling of simple sequential circuits like Counters and Shift registers 8. Design and Verilog modeling of complex sequential circuits 2 hours 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 2 hours 10. Design and Verilog modeling of FSM based design – Serial Adder 2 hours 11. Design and Verilog modeling of FSM based design – Traffic Light 4 hours Controller / Vending Machine 12. Design of ALU 4 hours Total Laboratory Hours 30 hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022 Approved by Academic Council No. 66 Date 16-06-2022 16							
 Design and Verilog modeling of Combinational Logic circuits Design and Verilog modeling of various data path elements - Adders Design and Verilog modeling of various data path elements - Multipliers Implementation of combinational circuits - (FPGA / Trainer Kit) Implementation of data path circuit - (FPGA / Trainer Kit) Design and Verilog modeling of simple sequential circuits like Counters and Shift registers Design and Verilog modeling of complex sequential circuits Implementation of Sequential circuits - (FPGA / Trainer Kit) Design and Verilog modeling of FSM based design - Serial Adder Design and Verilog modeling of FSM based design - Traffic Light Controller / Vending Machine Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022 	Indi	cative Experiments					
 3. Design and Verilog modeling of various data path elements - Adders 4. Design and Verilog modeling of various data path elements - Multipliers 5. Implementation of combinational circuits – (FPGA / Trainer Kit) 6. Implementation of data path circuit - (FPGA / Trainer Kit) 7. Design and Verilog modeling of simple sequential circuits like Counters and Shift registers 8. Design and Verilog modeling of complex sequential circuits 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU 4 hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022 	1.	Characteristics of Digital ICs, Real	ization of Bo	olean exp	ressions	2 hours	
 4. Design and Verilog modeling of various data path elements - Multipliers 5. Implementation of combinational circuits – (FPGA / Trainer Kit) 6. Implementation of data path circuit - (FPGA / Trainer Kit) 7. Design and Verilog modeling of simple sequential circuits like Counters and Shift registers 8. Design and Verilog modeling of complex sequential circuits 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU 4 hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022 	2.	Design and Verilog modeling of Co	ombinational	Logic circ	cuits	4 hours	
5. Implementation of combinational circuits – (FPGA / Trainer Kit) 6. Implementation of data path circuit - (FPGA / Trainer Kit) 7. Design and Verilog modeling of simple sequential circuits like Counters and Shift registers 8. Design and Verilog modeling of complex sequential circuits 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	3.	Design and Verilog modeling of va	rious data pa	ath eleme	nts - Adders	2 hours	
 6. Implementation of data path circuit - (FPGA / Trainer Kit) 7. Design and Verilog modeling of simple sequential circuits like Counters and Shift registers 8. Design and Verilog modeling of complex sequential circuits 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU 4 hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022 	4.	Design and Verilog modeling of va	rious data pa	ath eleme	nts - Multipliers	2 hours	
7. Design and Verilog modeling of simple sequential circuits like Counters and Shift registers 8. Design and Verilog modeling of complex sequential circuits 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU 13. Total Laboratory Hours 14. Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	5.	Implementation of combinational c	ircuits – (FP	GA / Trair	ner Kit)	2 hours	
and Shift registers 8. Design and Verilog modeling of complex sequential circuits 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design - Serial Adder 11. Design and Verilog modeling of FSM based design - Traffic Light Controller / Vending Machine 12. Design of ALU 13. Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	6.	6. Implementation of data path circuit - (FPGA / Trainer Kit) 2 ho					
8. Design and Verilog modeling of complex sequential circuits 9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	7.	7. Design and Verilog modeling of simple sequential circuits like Counters					
9. Implementation of Sequential circuits - (FPGA / Trainer Kit) 10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022		and Shift registers					
10. Design and Verilog modeling of FSM based design – Serial Adder 11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	8.	Design and Verilog modeling of complex sequential circuits 2 hours					
11. Design and Verilog modeling of FSM based design – Traffic Light Controller / Vending Machine 12. Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	9.	Implementation of Sequential circu	its - (FPGA	Trainer l	<it)< td=""><td>2 hours</td></it)<>	2 hours	
Controller / Vending Machine 12. Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	10.	Design and Verilog modeling of FS	SM based de	sign – Se	rial Adder	2 hours	
12. Design of ALU Total Laboratory Hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	11.	Design and Verilog modeling of FS	SM based de	sign – Tra	affic Light	4 hours	
Total Laboratory Hours 30 hours Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022		Controller / Vending Machine					
Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022	12.	Design of ALU				4 hours	
Mode of Assessment: Continuous Assessment and Final Assessment Test Recommended by Board of Studies 14-05-2022							
Recommended by Board of Studies 14-05-2022		Total Laboratory Hours 30 hours					
,	Mod	e of Assessment: Continuous Asses	ssment and	Final Asse	essment Test		
Approved by Academic Council No. 66 Date 16-06-2022	Reco	ommended by Board of Studies	14-05-2022)			
	Appr	roved by Academic Council	No. 66	Date	16-06-2022		

Course Code	Course Title		L	Т	Р	С
BECE204L	Microprocessors and Microcontrollers				0	3
Pre-requisite	BECE102L		lab	us	vers	sion
				1.0		

Course Objectives:

- 1. To acquaint students with architectures of Intel microprocessors, microcontroller and ARM processors.
- 2. To familiarize the students with assembly language programming in 8051 microcontroller and ARM processor.
- 3. To interface peripherals and I/O devices with the 8051 microcontroller.

Course Outcome:

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

- 1. Comprehend the various microprocessors including Intel Pentium Processors
- 2. Infer the architecture and Programming of Intel 8086 Microprocessor.
- 3. Comprehend the architectures and programming of 8051 microcontroller.
- 4. Deploy the implementation of various peripherals such as general purpose input/output, timers, serial communication, LCD, keypad and ADC with 8051 microcontroller
- 5. Infer the architecture of ARM Processor
- 6. Develop the simple application using ARM processor.

Module:1 Overview of Microprocessors

3 hours

Introduction to Microprocessors, 8-bit/16-bit Microprocessor, Overview of Intel Pentium, I (i3, i5, i7) Series Processor.

Module:2 | Microprocessor Architecture and Interfacing: Intel x86

8 hours

16-bit Microprocessor: 8086 - Architecture and Addressing modes, Memory Segmentation, Instruction Set, Assembly Language Processing, Programming with DOS and BIOS function calls, minimum and maximum mode configuration, Programmable Peripheral Interface (8255), Programmable Timer Controller (8254), Memory Interface to 8086.

Module:3 | Microcontroller Architecture: Intel 8051

7 hours

Microcontroller 8051 - Organization and Architecture, RAM-ROM Organization, Machine Cycle, Instruction set: Addressing modes, Data Processing - Stack, Arithmetic, Logical; Branching – Unconditional and Conditional, Assembly programming.

Module:4 | Microcontroller 8051 Peripherals

5 hours

I/O Ports, Timers-Counters, Serial Communication and Interrupts.

Module:5 I/O interfacing with Microcontroller 8051

7 hours

LCD, LED, Keypad, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensor with Signal Conditioning Interface.

Module:6 ARM Processor Architecture

5 hours

ARM Design Philosophy; Overview of ARM architecture; States [ARM, Thumb, Jazelle]; Registers, Modes; Conditional Execution; Pipelining; Vector Tables; Exception handling.

Module:7 | ARM Instruction Set

8 hours

ARM Instruction- data processing instructions, branch instructions, load store instructions, SWI Instruction, Loading instructions, conditional Execution, Assembly Programming.

Module:8 | Contemporary issues

2 hours

						To	tal Lec	ture hours:	45 hours
Tex	xt Book	<u>. ,</u>							
1.			.M. Bhurch McGraw-F		nced	Micropro	ocessor	and Periphe	erals, 2012, 2 nd
2.	2. Mohammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2014, 2 nd Edition, Pearson, India.								
Re	Reference Books								
1.	1				•	/ Langua	ge Prog	ramming &	Architecture: 1,
<u> </u>				odigitaled.co				0047.0	
2.	_			licroprocess Pvt. Ltd., Ne		•	•	ns, 2017, Sec	cond Edition, Tata
3.	Joseph	ı Yiu, ⁻	The Definit	ve Guide to	ARI	/I® Corte	x®-M0 a	ind Cortex-M	0+ Processors,
	2015,	2 nd Edi	tion, Elsev	ier Science	& Te	chnology	, UK		·
Мо	de of E	Evalua	tion: Conti	nuous Asse	essm	ent Test	, Digital	Assignmen	t, Quiz and Final
I .	sessmer						. 0		-
Re	commer	nded b	y Board of	Studies	1	4-05-202	2		
App	proved b	y Aca	demic Cou	ncil	N	lo. 66	Date	16-06-202	22

Course Cod	e Code Course Title							L	T	Р	С
BECE204P		Microprocessors and Microcontrollers Lab)	0	0	2	1
Pre-requisite BECE102L				Sy	Syllabus version						
									1.0		
Course Obj	ectives										
1. To	familiarize	the	students	with	assembly	language	progr	amn	ning	u	sing

- microprocessor and microcontroller.
- 2. To familiarize the students with Embedded C language programming using microcontroller.
- 3. To interface peripherals and I/O devices with the microcontroller and microprocessor.

Course Outcome

Student will be able to

- 1. Showcase the skill, knowledge and ability of programming microcontroller and microprocessor using its instruction set.
- 2. Expertise with microcontroller and interfaces including general purpose input/ output, timers, serial communication, LCD, keypad and ADC

umers, senai communication, LCD, keypad and ADC.					
Indicative Experiments [Experiments using 8086/8051/ARM]					
1 Assembly language programming of Arithmetic/logical operations.	6 hours				
2 Assembly language programming of memory operations.	4 hours				
3 Assembly language programming/ Embedded C programming for interfacing the peripherals: General purpose input/ output, timers, serial communication, LCD, keypad and ADC.	10 hours				
4 Hardware implementation of peripheral interfacing: General purpose input/ output, timers, serial communication, LCD, keypad and ADC.	10 hours				
Total Laboratory Hours					
Mode of Assessment: Continuous Assessment and Final Assessment Test					
Recommended by Board of Studies 14-05-2022					
Approved by Academic Council No. 66 Date 16-06-2022					

BMAT205L	Discrete Mathematics and Graph Theory		-	Т	Р	С								
		3	3	1	0	4								
Pre-requisite	NIL	Sylla	bus	s V	ers/	ion								
			1	.0										
Course Objecti	ves:					To address the challenges of the relevance of lattice theoryand algebraic structures								
		d algebra	ic s	stru	ıctuı	es								

- 2. To use Counting techniques, in particular recurrence relations to computer science problems.
- 3. To understand the concepts of graph theory and related algorithm concepts.

Course Outcomes:

At the end of this course, students are expected to

- 1. Learn proof techniques and concepts of inference theory
- 2. Use algebraic structures in applications
- 3. Counting techniques in engineering problems.

4. Use lattice and Boolean algebra properties in Digital circuits. 5. Solve Science and Engineering problems using Graph theory. Module:1 | Mathematical Logic 7 hours Statements and Notation-Connectives-Tautologies-Equivalence - Implications-Normal forms - The Theory of Inference for the Statement Calculus - Predicate Calculus - Inference Theory of the Predicate Calculus Module:2 Algebraic Structures Semigroups and Monoids - Groups - Subgroups - Lagrange's Theorem Homomorphism -Properties-Group Codes. **Module:3** Counting Techniques Basics of counting - Pigeonhole principle - Permutations and combinations - Inclusionexclusion principle - Recurrence relations - Solving recurrence relations - Generating functions-Solution to recurrence relations. Module:4 | Lattices and Boolean algebra 6 hours Partially Ordered Relations -Lattices as Posets - Hasse Digram - Properties of Lattices -Boolean algebra-Properties of Boolean Algebra-Boolean functions. **Module:5** Fundamentals of Graphs 6hours Basic Concepts of Graph Theory - Planar and Complete graph - Matrix representation of

Path algorithms

Module:6 Trees, Fundamental circuits, Cut sets Trees – properties of trees – distance and centres in tree – Spanning trees – Spanning tree

Graphs - Graph Isomorphism - Connectivity-Cut sets-Euler and Hamilton Paths-Shortest

algorithms- Tree traversals- Fundamental circuits and cut-sets Module:7 | Graph colouring, covering, Partitioning

6 hours

15 hours

Bipartite graphs - Chromatic number - Chromatic partitioning - Chromatic polynomial matching – Covering– Four Colour problem.

wodule:8	Contemporary issues		2 nours
		Total Lecture hours:	45 hours

Total Tutorial hours:

Text Books:

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

Prentice Hall India 2016.

Reference Books:

- 1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill,
- 2019.
- 2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018.
- 3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.
- 4. Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017.
- 5. Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw

Hill, Special Indian Edition, 2017.

6.Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015.

2013.						
Mode of Evaluation: CAT, Quizzes, Digital Assignments, FAT						
Recommended by Board of Studies 15.02.2022						
Approved by Academic Council	No. 65	Date	17-03-2022			

Discipline Core

BCSE202L	Data Structures and Algorithms		LT	Р	С		
			3 0	0	3		
Pre-requisite	NIL	Syll	abus	vers	on		
			1.0)			
Course Objective	98						
1. To impart basi	c concepts of data structures and algorithms.						
To differentiate	e linear, non-linear data structures and their operations.						
3. To comprehen	d the necessity of time complexity in algorithms.						
Course Outcome	es						
On completion of	On completion of this course, students should be able to:						
1. Understand the	e fundamental analysis and time complexity for a given	proble	m.				
2. Articulate linea	r, non-linear data structures and legal operations perm	itted o	n ther	n.			
	ply suitable algorithms for searching and sorting.						
-	us tree and graph traversals.						
	ing, heaps and AVL trees and realize their applications						
z. <u>z</u> xpiioato ilaoi.	mig, medipe and the account realized their approaches						
Module:1 Algor	ithm Analysis			8 ho	urs		
	orithms and data structures - Fundamentals of algorit	hm ar	nalvsis	: Sp	ace		
	rity of an algorithm, Types of asymptotic notations and						
	cy – best case, worst case, average case - Analysis c						
	nms - Asymptotic analysis for recurrence relation						
_	od, Master Method and Recursive Tree Method.				,		
	r Data Structures			7 ho	urs		
Arrays: 1D and 2D array- Stack - Applications of stack: Expression Evaluation, Conversion							
	of Infix to postfix and prefix expression, Tower of Hanoi – Queue - Types of Queue:						
	Pouble Ended Queue (deQueue) - Applications - List:						
	, Circular linked lists- Applications: Polynomial Manipu				,		
	ching and Sorting			7 ho	urs		
	Search and binary search – Applications.						
	sort, Selection sort, Bubble sort, Counting sort, Quick	sort, l	Merge	sort	_		
Analysis of sorting		ŕ	J				
Module:4 Trees				6 ho	urs		
Introduction - Bin	ary Tree: Definition and Properties - Tree Traversals-	Expre					
	ees - Operations in BST: insertion, deletion, finding m						
the k th minimum e				,	J		
Module:5 Grap				6 ho	urs		
	epresentation of Graph - Graph Traversal: Breadth	First S					
	ch (DFS) - Minimum Spanning Tree: Prim's, Kruska						
Shortest Path: Dij			J				
Module:6 Hash				4 ho	urs		
	Separate chaining - Open hashing: Linear probing,	Quad	Iratic	prob	ng,		
	Closed hashing - Random probing – Rehashing - Exter				0,		
Double hashing -	Closed hashing transcent probling trondsming Exter				urs		
	s and AVL Trees			5 ho	4.0		
Module:7 Heap	s and AVL Trees	: Term					
Module:7 Heap Heaps - Heap sor		: Term					
Module:7 Heap Heaps - Heap sor operations (rotation	s and AVL Trees t- Applications -Priority Queue using Heaps. AVL trees	: Term	ninolo(sic		
Module:7 Heap Heaps - Heap sor operations (rotation	s and AVL Trees t- Applications -Priority Queue using Heaps. AVL trees on, insertion and deletion).	: Term	ninolo(gy, ba	sic		
Module:7 Heap Heaps - Heap sor operations (rotation	s and AVL Trees t- Applications -Priority Queue using Heaps. AVL trees on, insertion and deletion).	: Term	ninolog	gy, ba	asic urs		
Module:7 Heap Heaps - Heap sor operations (rotation Module:8 Conte	s and AVL Trees t- Applications -Priority Queue using Heaps. AVL trees on, insertion and deletion). emporary Issues	: Term	ninolog	gy, ba 2 ho	asic urs		
Module:7 Heap Heaps - Heap sor operations (rotation) Module:8 Conte	s and AVL Trees t- Applications -Priority Queue using Heaps. AVL trees on, insertion and deletion). emporary Issues		ninolog 4	gy, ba 2 ho 5 ho	urs urs		

Ref	Reference Books						
1.	Alfred V. Aho, Jeffrey D. Ullman	and John E. Hop	ocroft, Dat	ta Structures and Algorithms,			
	1983, Pearson Education.						
2.	2. Horowitz, Sahni and S. Anderson-Freed, Fundamentals of Data Structures in C, 2008, 2 nd Edition, Universities Press.						
3.	Thomas H. Cormen, C.E. Le Algorithms, 2009, 3 rd Edition, MI		Rivest an	d C. Stein, Introduction to			
Мо	Mode of Evaluation: CAT, Assignment, Quiz and FAT						
Re	Recommended by Board of Studies 04-03-2022						
App	proved by Academic Council	No. 65	Date	17-03-2022			

BCS	SE202P	Data Stru	ctures and A	lgorithm	s Lab	L	Т	Р	С	
						0	0	2	1	
Pre-	requisite	NIL				Syllabı		ersi	on	
							1.0			
	rse Objectiv									
		ic concepts of data st								
	 To differentiate linear, non-linear data structures and their operations. To comprehend the necessity of time complexity in algorithms. 									
3.	To comprehe	nd the necessity of tin	ne complexity	in algorith	nms.					
	rse Outcome									
		this course, students								
		ate data structures to			al problems	S.				
2. Id	entify suitable	e algorithms for solvir	ng the given pr	oblems.						
lo di	aatiya Eynar	imanta								
1.	cative Exper		atura and ita a	nalication						
		tion of stack data stru								
2.		tion of queue data stru		pplication	S					
3.		tion linked list and its								
4.		tion of searching algo								
5.		tion of sorting algorith								
6.		Traversal implement								
7.		ch Tree implementation		المالية التالية	Ossuela ele	!4				
8.		ersal – Depth First Se				orithm				
9.		panning Tree – Prim's								
10.	Single Sour	ce Shortest Path Algo			oratory H	01120 30) hai			
Toy	t Book	_		TOLAI LA	ooratory n	ours 30) ho	JIS .		
1		iss, Data Structures 8	2. Algorithm An	alveie in (C++ 2013	1 th Editio	n			
'	Pearson	133, Data Structures o	x Algoridiin An	aiyələ ili v	511, 2013,	4 Luitio	11,			
Ref	erence Book									
1.		o, Jeffrey D. Ullman a	and John F	longroft I	Data Structi	ires and				
۱۰ ۱		1983, Pearson Educa		ioporoit, i		aros aria				
2.		ahni and S. Anderson		amentals	of Data Stri	ictures in	C	2008	8	
		Universities Press.	100a, 1 and		o. Data off	. J. G. 100 11	. •, .	_550	-,	
3.	Thomas H	Cormen, C.E. Leisers	on, R.I. Rives	st and C	Stein, Intro	duction to)			
· ·		2009, 3 rd Edition, MIT					-			
Mod		ment: Continuous ass		d FAT.						
		y Board of Studies	04-03-2022							
		demic Council	No. 65	Date	17-03-202	22				

Course Code	course Code Course Title							
BCSE203E	E203E Web Programming							
Pre-requisite	Pre-requisite NIL Syllabus version							
			1.0					
Course Objecti	ves							
1. To convey the Internet and Its Application in Real world.								

- 2. To introduce the fundamentals of web programming through HTML and CSS.
- 3. To establish the application of Javascript in designing interactive web pages.
- 4. To investigate various elements of ReactJS and design user interfaces to deploy in the real time.

Course Outcomes

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

- 1. Apply various elements of HTML and CSS.
- 2. Design interactive web pages using JavaScript.
- 3. Create Dynamic Web Applications using ReactJS.
- 4. Deploy and host web applications in Local Servers or Cloud platforms.

Module:1	Introduction	2 hours					
World wide	World wide web and its evolution - E-mail, Telnet, FTP, E-commerce, Cloud Computing,						
Video confe	Video conferencing - Internet service providers, IP Address, URL, Domain Name Servers -						
Web Brows	Web Browsers, Search Engine -Web Server vs Application Server.						
Module:2	Hypertext Markup Language	2 hours					

HTML Tags, Structure, HTML Coding Conventions - Block Elements, Text Elements, Code-Related Elements, Character References - Lists, Images, section, article, and aside Elements - nav and a Elements - header and footer Elements.

Module:3 | Cascading Style Sheets

2 hours

CSS Overview - CSS Rules, CSS Syntax and Style - Class Selectors, ID Selectors, span and div Elements - Cascading, style Attribute, style Container, External CSS Files - CSS Properties: Color Properties, Font Properties, line-height Property, Text Properties, Border Properties. Element Box, padding Property, margin Property - Hosting a Website and GIT.

Module:4 JavaScript

3 hours

Hello World Web Page - Buttons, Functions, Variables, Identifiers - Assignment Statements and Objects - Document Object Model, Forms: form Element, Controls, Text Control Accessing a Form's Control Values, reset and focus Methods – Event Handler Attributes: onchange, onmouseover, onmouseout.

Module:5 Advanced JavaScript

2 hours

While Loop, External JavaScript Files, do Loop, Radio Buttons, Checkboxes, for Loop - fieldset and legend Elements- Manipulating CSS with JavaScript- Using z-index to Stack Elements-Textarea Controls - Pull-Down Menus- List Boxes- Canvas and Drawing - Event Handler and Listener.

Module:6 ReactJS 2 hours

React Environment Setup - ReactJS Basics - React JSX - React Components: React Component API - React Component Life Cycle - React Constructors - React Dev Tools - React Native vs ReactJS.

Module:7 | Advanced ReactJS

2 hours

React Dataflow: React State - React Props - React Props Validation - Styling React - Hooks and Routing - Deploying React - Case Studies for building dynamic web applications.

	Total Lecture hours:	15 hours
Tex	t Book(s)	
1.	Dean, J., Web Programming with HTML5, CSS, and JavaScript. Journal 2018	ones & Bartlett

2.		Minnick, C. Beginning ReactJS foundations building user interfaces with ReactJS: An Approachable Guide, OReillly, 2022.						
Refe	erence Books							
1.	Harvey M Deitel, Paul J Deitel and Program, Pearson, 6 th Edition, 202	0.						
2.	Rebah, H.B., Boukthir, H. and Che HTML5 and CSS3. John Wiley & S			Design and Development with				
Mod	Mode of Evaluation: Written Assignment, Quiz.							
Indicative Experiments								
1.	Explore various terminologies related to Internet (ISP, Email, Telnet, FTP, Web browsers, Search Engines)							
2.	Experiment the use of basic HTM	L element	S.					
3.	Demonstrate the applications of Lists, Tables, Images, Section, article and aside elements.							
4.	Investigate the various componen	its of CSS						
5.	Develop web pages using HTML	and variou	ıs elemen	ts of CSS.				
6	Designing simple dynamic webpa	ges using	Javascrip	t.				
7.	Build web pages using While Loo Checkboxes, for Loop - fieldset ar	•		•				
8.	Manipulating CSS with JavaScript Controls - Pull-Down Menus- List Listener.							
9.	React Environment Setup - React Component API.	JS Basics	- React J	SX - React Components: React				
10.	Understand React Component Lif Tools - React Native vs ReactJS.	e Cycle ar	nd apply F	React Constructors - React Dev				
11.	Envisage React Dataflow: React Styling React - Hooks and Routing		act Props	- React Props Validation -				
12.	Deploying React - Case Studies for	or building	dynamic	web applications.				
			Total	Laboratory Hours 60 hours				
Text	t Book							
1.								
Refe	erence Books							
1.	Alex Banks and Eve Porcello, L React and Redux, O'Reilly Publishe	earning F ers, 1 st Ed	React: Fui	nctional Web Development with 7.				
Mod	de of assessment: Continuous Asses	ssments, F	AT					
	Recommended by Board of Studies 26-07-2022							
	Approved by Academic Council No. 67 Date 08-08-2022							

BCSE204L	BCSE204L Design and Analysis of Algorithms						
		3	0	0	3		
Pre-requisite NIL Syllabus vers							
			1.0	0			
Course Object	ives						
•	knowledge on various design strategies that can help in solving the	ne rea	wor	ıa			
problems effect 3. To synthesiz	ively e efficient algorithms in various engineering design situations	ne rea	wor	IQ			
problems effect 3. To synthesiz Course Outcor	ively e efficient algorithms in various engineering design situations nes	ne rea	wor				
problems effect 3. To synthesiz Course Outcor On completion	nees of this course, student should be able to:						
Course Outcom On completion of Apply the m	ively e efficient algorithms in various engineering design situations nes			IG			

Module:1	Design Techniq	Paradigms: ues	Greedy,	Divide	and	Conquer	6 hours

5. Explain the hardness of real-world problems with respect to algorithmic efficiency and learning to

4. Articulating Randomized Algorithms.

cope with it.

Overview and Importance of Algorithms - Stages of algorithm development: Describing the problem, Identifying a suitable technique, Design of an algorithm, Derive Time Complexity, Proof of Correctness of the algorithm, Illustration of Design Stages - Greedy techniques: Fractional Knapsack Problem, and Huffman coding - Divide and Conquer: Maximum Subarray, Karatsuba faster integer multiplication algorithm.

Module:2 Design Paradigms: Dynamic Programming, Backtracking and Branch & Bound Techniques 10 hours

Dynamic programming: Assembly Line Scheduling, Matrix Chain Multiplication, Longest Common Subsequence, 0-1 Knapsack, TSP- Backtracking: N-Queens problem, Subset Sum, Graph Coloring-Branch & Bound: LIFO-BB and FIFO BB methods: Job Selection problem, 0-1 Knapsack Problem

Module:3	String Matching Algorithms	5 hours					
Naïve String-matching Algorithms, KMP algorithm, Rabin-Karp Algorithm, Suffix Trees.							
Module:4	Graph Algorithms	6 hours					
All pair sho	rtest path: Bellman Ford Algorithm, Floyd-Warshall Algorithm	- Network Flows: Flow					
Networks, Maximum Flows: Ford-Fulkerson, Edmond-Karp, Push Re-label Algorithm — Application of							
Max Flow to maximum matching problem							
Module:5	Geometric Algorithms	4 hours					
Line Segments: Properties, Intersection, sweeping lines - Convex Hull finding algorithms: Graham's							
Scan, Jarvis	' March Algorithm.						
Module:6	Randomized algorithms	5 hours					
Randomized	I quick sort - The hiring problem - Finding the global Minimum Cu	it.					
N/1 1 1 7	Classes of Complexity and Annuavimetica	7 1					
Module:7	Classes of Complexity and Approximation	7 hours					
wodule:7	Algorithms	/ nours					
The Class I	Algorithms	(Problem Definition and					
The Class I	Algorithms P - The Class NP - Reducibility and NP-completeness — SAT 3SAT, Independent Set, Clique, Approximation Algorithm — Ver	(Problem Definition and					
The Class I statement),	Algorithms P - The Class NP - Reducibility and NP-completeness — SAT 3SAT, Independent Set, Clique, Approximation Algorithm — Ver	(Problem Definition and					
The Class I statement), Travelling sa	Algorithms P - The Class NP - Reducibility and NP-completeness — SAT 3SAT, Independent Set, Clique, Approximation Algorithm — Veralesman	(Problem Definition and tex Cover, Set Cover and					
The Class I statement), Travelling sa	Algorithms P - The Class NP - Reducibility and NP-completeness — SAT 3SAT, Independent Set, Clique, Approximation Algorithm — Veralesman	(Problem Definition and tex Cover, Set Cover and					
The Class I statement), Travelling sa	Algorithms P - The Class NP - Reducibility and NP-completeness — SAT 3SAT, Independent Set, Clique, Approximation Algorithm — Ver alesman Contemporary Issues	(Problem Definition and tex Cover, Set Cover and					
The Class I statement), Travelling sa	Algorithms P - The Class NP - Reducibility and NP-completeness — SAT 3SAT, Independent Set, Clique, Approximation Algorithm — Ver alesman Contemporary Issues	(Problem Definition and tex Cover, Set Cover and					
The Class I statement), Travelling sa Module:8	Algorithms P - The Class NP - Reducibility and NP-completeness — SAT 3SAT, Independent Set, Clique, Approximation Algorithm — Ver alesman Contemporary Issues	(Problem Definition and tex Cover, Set Cover and 2 hours					

Ref	Reference Books						
1.	Jon Kleinberg and ÉvaTardos, Algo	orithm Desi	gn, Pears	son Education, 1 st Edition, 2014.			
2.	Rajeev Motwani, Prabhakar Raghavan; Randomized Algorithms, Cambridge University Press,						
	1995 (Online Print – 2013)						
3.	Ravindra K. Ahuja, Thomas L. Mag						
	Algorithms, and Applications, 1st Ed	dition, Pear	son Educ	ation, 2014.			
Мо	de of Evaluation: CAT, Written assi	ignments, (Quiz, FAT				
Red	Recommended by Board of Studies 04-03-2022						
App	proved by Academic Council	No. 65	Date	17-03-2022			

BCS	SE204P	Design and Analysis of Algorithms Lab	L	Т	Р	С			
		<u> </u>	0	0	2	1			
Pre-	requisite	Nil	Syllab	us \	/ersi	on			
	1.0								
Cou	rse Objective	es							
1. To	o provide matl	nematical foundations for analyzing the complexity of the	algorit	hms	3				
2. To	o İmpart the kı	nowledge on various design strategies that can help in so	lving t	he r	eal				
worl	d problems ef	fectively							
3. S	Synthesize effi	cient algorithms in various engineering design situations							
Cou	rse Outcome								
		his course, student should be able to:							
		e major algorithm design paradigms.							
		raph algorithms, string matching and geometric algorithm	s alon	g wi	th th	eir			
anal	ysis.								
	cative Experi								
1.		egy : Activity Selection & Huffman coding							
2.		gramming : ALS, Matrix Chain Multiplication , Longest Co	ommo	า					
	Subsequenc	e, 0-1 Knapsack							
3.		onquer : Maximum Subarray and Karatsuba faster intege	er mult	iplic	atior	1			
	algorithm								
4.	Backtracking								
5.		Bound: Job selection							
6		ing algorithms : Naïve, KMP and Rabin Karp,suffix trees							
7		pair shortest path algorithms							
8		vs : Ford –Fulkerson and Edmond - Karp							
9		of line segments &Finding Convexhull, Finding closest pa	ir of po	oints	3				
10		me algorithm for verification of NPC problems							
11	Approximation	on and Randomized algorithms							
		Total Laboratory Hour	s 30	Ηοι	ırs				
	Book								
1.		Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduc	ction to)					
		Third edition, MIT Press, 2009.							
	erence Books		4 et - :			4.4			
1.		g and ÉvaTardos, Algorithm Design, Pearson Education,							
2.		vani, Prabhakar Raghavan; Randomized Algorithms, Cam	nbridge	e Un	iver	sity			
		(Online Print – 2013)							
3.		Ahuja, Thomas L. Magnanti, and James B. Orlin, Network	(Flow	s: T	neor	у,			
	Algorithms, and Applications, 1 st Edition, Pearson Education, 2014.								
		nent: Continuous assessments, FAT.							
		Board of Studies 04-03-2022							
App	roved by Acac	lemic Council No. 65 Date 17-03-202	2						

BCSE205L	Computer Architecture and Organization		L	T	Р	С
			3	0	0	3
Pre-requisite	NIL	Syl	llab	us \	/ersi	on
				1.0)	

- 1. To acquaint students with the basic concepts of fundamental component, architecture, register organization and performance metrics of a computer and to impart the knowledge of data representation in binary and to understand the implementation of arithmetic algorithms in a typical computer.
- 2. To teach students how to describe machine capabilities and design an effective data path design for instruction execution. To introduce students to syntax and semantics of machine level programming.
- To make students understand the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer. And explore various alternate techniques for improving the performance of a processor.

Course Outcomes

On completion of this course, student should be able to:

- 1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machine with different capabilities. Recognize different instruction formats and addressing modes. Validate efficient algorithm for fixed point and floating point arithmetic operations.
- 2. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction.
- 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.
- 4. Assess the performance of IO and external storage systems. Classify parallel machine models. Analyze the pipeline hazards and solutions.

Module:1 Introduction To Computer Architecture and Organization 5 Hours

Overview of Organization and Architecture –Functional components of a computer:

Registers and register files - Interconnection of components - Overview of IAS computer function - Organization of the von Neumann machine - Harvard architecture - CISC & RISC Architectures.

Module:2 Data Representation and Computer Arithmetic

5 Hours

Algorithms for fixed point arithmetic operations: Multiplication (Booths, Modified Booths), Division (restoring and non-restoring) - Algorithms for floating point arithmetic operations - Representation of nonnumeric data (character codes).

Module:3 Instruction Sets and Control Unit

9 Hours

Computer Instructions: Instruction sets, Instruction Set Architecture, Instruction formats, Instruction set categories - Addressing modes - Phases of instruction cycle - ALU - Datapath and control unit: Hardwired control unit and Micro programmed control unit - Performance metrics: Execution time calculation, MIPS, MFLOPS.

Module:4 Memory System Organization and Architecture

7 Hours

Memory systems hierarchy: Characteristics, Byte Storage methods, Conceptual view of memory cell - Design of scalable memory using RAM's-ROM's chips - Construction of larger size memories - Memory Interleaving - Memory interface address map- Cache memory: principles, Cache memory management techniques, Types of caches, caches misses, Mean

memory access time evaluation of cache.

Module:5 Interfacing and Communication

5 Hours

I/O fundamentals: handshaking, buffering, I/O Modules - I/O techniques: Programmed I/O, Interrupt-driven I/O, Direct Memory Access, Direct Cache Access - Interrupt structures: Vectored and Prioritized-interrupt overhead - Buses: Synchronous and asynchronous - Arbitration.

Module:6 Subsystems

5 Hours

External storage systems: Solid state drivers - Organization and Structure of disk drives: Electronic- magnetic and optical technologies - Reliability of memory systems - Error detecting and error correcting systems - RAID Levels - I/O Performance

Module:7 High Performance Processors

7 Hours

Classification of models - Flynn's taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD) - Pipelining: Two stages, Multi stage pipelining, Basic performance issues in pipelining, Hazards, Methods to prevent and resolve hazards and their drawbacks - Approaches to deal branches - Superscalar architecture: Limitations of scalar pipelines, superscalar versus super pipeline architecture, superscalar techniques, performance evaluation of superscalar architecture - performance evaluation of parallel processors: Amdahl's law, speed-up and efficiency.

Module:8	Contemporary Issues	2 Ho	urs
	Tot	al Lecture Hours 45 He	ours
Taxt Back/o	1	•	

Text Book(s)

David A. Patterson and John L. Hennessy, Computer Organization and Design -The Hardware / Software Interface 6th Edition, Morgan Kaufmann, 2020

Reference Book(s)

- 1 Computer Architecture and Organization-Designing for Performance, William Stallings, Tenth edition, Pearson Education series, 2016
- 2 Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.

Mode of Evaluation: CAT, Written Assignments, Quiz and FAT.

Recommended by Board of Studies	04-03-2022			
Approved by Academic Council	No. 65	Date	17-03-2022	

BCSE301L	Software Engineering		L	Т	Р	С
			3	0	0	3
Pre-requisite	NIL	Syl	labı	JS V	ersi	on
				1.0		

- 1. To introduce the essential Software Engineering concepts.
- 2. To impart concepts and skills for performing analysis, design develop, test and evolve efficient software systems of various disciplines and applications
- 3. To make familiar about engineering practices, standards and metrics for developing software components and products

Course Outcomes

On completion of this course, student should be able to:

- 1. Apply and assess the principles of various process models for the software development.
- Demonstrate various software project management activities that include planning , Estimations, Risk assessment and Configuration Management
- 3. Perform Requirements modelling and apply appropriate design and testing heuristics to produce quality software systems.
- 4. Demonstrate the complete Software life cycle activities from requirements analysis to maintenance using the modern tools and techniques.
- 5. Escalate the use of various standards and metrics in evaluating the process and product.

Module:1 Overview Of Software Engineering

6 hours

Nature of Software, Software Engineering, Software process, project, product, Process Models

Classical Evolutionary models, Introduction to Agility - Agile Process-Extreme programming - XP Process - Principles of Agile Software Development framework - Overview of System Engineering

Module:2 Introduction To Software Project Management

6 hours

Planning, Scope, Work break-down structure, Milestones, Deliverables, Cost and Estimates - (Human Resources, Time-scale, Costs), Risk Management, RMMM Plan, CASE TOOLS, Agile Project Management, Managing team dynamics and communication, Metrics and Measurement

Module:3 | Modelling Requirements

8 hours

Software requirements and its types, Requirements Engineering process, Requirement Elicitation, System Modeling – Requirements Specification and Requirement Validation, Requirements Elicitation techniques, Requirements management in Agile.

Module:4 Software Design

8 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

Module:5 | Validation And Verification

7 hours

Strategic Approach to Software Testing, Testing Fundamentals Test Plan, Test Design, Test Execution, Reviews, Inspection and Auditing – Regression Testing – Mutation Testing - Object oriented testing - Testing Web based System - Mobile App testing – Mobile test Automation and tools – DevOps Testing – Cloud and Big Data Testing

Module:6 | Software Evolution

Software M	Software Maintenance, Types of Maintenance, - Software Configuration Management –							
Overview – SCM Tools. Re-Engineering, Reverse Engineering, Software Reuse								
Module:7 Quality Assurance 4 hours								
Product and Process Metrics, Quality Standards Models ISO, TQM, Six-Sigma, Process improvement Models: CMM & CMMI. Quality Control and Quality Assurance - Quality Management - Quality Factors - Methods of Quality Management								
Module:8	Contemporary Issues				2 hours			
		Т	otal Lecti	ıre hours:	45 hours			
Text Book	r(s)				<u> </u>			
1. Ian Sc	merville, Software Engine	ering, 10 th Editior	ı, Addison	-Wesley, 20)15			
Reference	Books							
	S. Pressman and Bruce F ach, 10 th edition, McGraw			ering: A Pra	actitioner's			
2. William E. Lewis, Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2017								
Mode of Evaluation: CAT, Written assignment, Quiz, FAT.								
Recomme	Recommended by Board of Studies 04-03-2022							
Approved I	Approved by Academic Council No. 65 Date 17-03-2022							

BCSE	301P	Software Engineering Lab		L	Т	Р	С
				0	0	2	1
Pre-re	quisite	NIL	Sv	llabu	s ve		on .
	•				1.0		
Cours	e Objective	2 8					
		ce the essential Software Engineering concepts.					
		concepts and skills for performing analysis, design ,de	evelop,	test	and	evo	olve
	efficient so	ftware systems of various disciplines and application	าร				
3.		amiliar about engineering practices, standards and	metric	s for	dev	elop	ing
	software co	omponents and products.					
	e Outcome						
		this course, student should be able to:					
1.		ate the complete Software life cycle activities from re		nents	6		
	analysis to	maintenance using the modern tools and technique	es.				
Indica	tive Experi						
1.		and Identification of the suitable process models					
2.		Break-down Structure (Process Based, Product	Based	, Ged	gra	phic	
		d Role Based) and Estimations					
3.		ent modelling using Entity Relationship Diagram(Stru					
4.		ent modelling using Context flow diagram, DFD (Fun					
5.		ent modelling using State Transition Diagram (Beha	vioral l	Mode	ling)	<u>) </u>	
6.		n – Use case Model, Class Model					
7.		n – Interaction Models					
8.		n – Package, Component and deployment models					
9.		d demonstration of test cases. Functional Testing a	nd Non	- Fur	ictio	nal	
1.5		sing any open source tools)					
10.	Story Boa	rding and User Interface design Modelling					
T- (-) I-(.)	Total Laboratory	Hours	30	nou	îS	
	Book(s)	mills Coffeen Francisco 10th Edition Addition 14	/ l - · ·	2045			
1.		rville, Software Engineering, 10 th Edition, Addison-W	resiey,	2015)		
	Poger S		na. ^ r)ro -t:1	ion -		
1.	Roger S.	Pressman and Bruce R. Maxim, Software Engineering, 10 th edition, McGraw Hill Education, 2019	ng: A F	ractii	lione	∌r S	
2.		, 10° edition, McGraw Hill Education, 2019 Lewis, Software Testing and Continuous Quality Imp	orovor:	ont .	Thir		
 	Edition,	Lewis, Software Testing and Continuous Quality Imp	proven	ıeril,	HIII	ı	
	1 '	Publications 2017					
Mode	Auerbach Publications, 2017 Mode of assessment: Continuous assessments, FAT.						
		Board of Studies 04-03-2022					
	Approved by Academic Council No. 65 Date 17-03-2022						
, ,bb, 0,	Approved by Academic Godiner 146. 66 Bate 17 66 2022						

BCSE302L	Database Systems		_	Т	Р	С
		3	3	0	0	3
Pre-requisite	NIL	Syll	ab	us	ver	sion
				1.	0	

- 1. To understand the concepts of File system and structure of the database; Designing an Entity-Relationship model for a real-life application and Mapping a database schema from the ER model.
- 2. To differentiate various normal forms, evaluate relational schemas for design qualities and optimize a query.
- 3. To impart the working methodologies of transaction management, understand concurrency control, recovery, indexing, access methods and fundamental view on unstructured data and its management.

Course Outcomes

On completion of this course, student should be able to:

- 1. Comprehend the role of database management system in an organization and design the structure and operation of the relational data model.
- 2. Develop a database project depending on the business requirements, considering various design issues.
- 3. List the concepts of indexing and accessing methods.
- 4. Explain the concept of a database transaction processing and comprehend the concept of database facilities including concurrency control, backup and recovery.
- 5. Review the fundamental view on unstructured data and describe other emerging database technologies.

Module:1 Database Systems Concepts and Architecture 4 hours

Need for database systems – Characteristics of Database Approach – Advantages of using DBMS approach - Actors on the Database Management Scene: Database Administrator - Classification of database management systems - Data Models - Schemas and Instances - Three-Schema Architecture - The Database System Environment - Centralized and Client/Server Architectures for DBMSs – Overall Architecture of Database Management Systems

Module:2 Relational Model and E-R Modeling

6 hours

Relational Model: Candidate Keys, Primary Keys, Foreign Keys - Integrity Constraints - Handling of Nulls - Entity Relationship Model: Types of Attributes, Relationships, Structural Constraints, Relational model Constraints – Mapping ER model to a relational schema – Extended ER Model - Generalization – Specialization – Aggregations.

Module:3 | Relational Database Design

6 hours

Database Design – Schema Refinement - Guidelines for Relational Schema - Functional dependencies - Axioms on Functional Dependencies- Normalization: First, Second and Third Normal Forms - Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form - Join dependency and Fifth Normal form

Module:4 Physical Database Design and Query Processing

8 hours

File Organization - Indexing: Single level indexing, multi-level indexing, dynamic multilevel Indexing - B+ Tree Indexing - Hashing Techniques: Static and Dynamic Hashing - Relational Algebra - Translating SQL Queries into Relational Algebra - Query Processing - Query Optimization: Algebraic Query Optimization, Heuristic query optimization Rules, Join Query Optimization using Indexing and Hashing - Tuple Relational Calculus.

Module:5 Transaction Processing and Recovery

Introduction to Transaction Processing - Transaction concepts: ACID Properties of Transactions, Transaction States - Serial and Serializable Schedules - Schedules based on recoverability - Schedules based on Serializability - Conflict Serializability - Recovery Concepts: Log Based Recovery Protocols, Recovery based on deferred update, Recovery techniques based on immediate update - Shadow Paging Algorithm Module:6 Concurrency Control In Transaction 8 hours **Processing** Concurrent Transactions - Lost Update Problem - Concurrency Control Techniques: Time Stamp Based Protocols, Thomas Write Rule, Lock Based Protocols, Lock Compatibility Matrix, - Two-Phase Locking Protocol - Lock Conversions - Graph Based Protocols for Concurrency Control - Tree Protocol for Concurrency Control - Deadlocks Based on Locks in Transactions - Deadlock Handling Techniques - Transaction Deadlock Detection Techniques - Transaction Deadlock Prevention Techniques - Multi-Granularity Locking for avoiding Transaction Deadlocks Module:7 NOSQL Database Management 3 hours Introduction, Need of NoSQL, CAP Theorem, different NoSQL data bases: Key-value data stores, Columnar families, Document databases, Graph databases Module:8 | Contemporary Issues 2 Hours **Total Lecture hours:** 45 hours **Text Book** R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7th Edition, 2016 **Reference Books** A. Silberschatz, H. F. Korth & S. Sudarshan, Database System Concepts, McGraw Hill, 7th Edition 2019. Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill, 4th Edition, 2018 C.J.Date, A.Kannan, S.Swamynathan," An Introduction to Database Systems", Pearson, Eighth Edition, 2006. 4. | Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021 Mode of Evaluation: CAT, Written assignments, Quiz and FAT. Recommended by Board of Studies 04-03-2022 Approved by Academic Council No. 65 17-03-2022 Date

BU	SE302P	Database Systems Lab		L	T	Р	С				
		<u>-</u>		0	0	2	1				
Pre	e-requisite		Syl	lab	us \	/ers	ion				
	1.0										
	urse Objectiv										
	Designing an database sche	o understand the concepts of File system and structu Entity-Relationship model for a real-life application of the ER model. Earious normal forms, evaluate relational schemas for	on ai	nd	Ma _l	ppin	g a				
	optimize a que		uoo.g	··· •	uun		unu				
3.	3. Explain the working methodologies of transaction management and give a solution during a transaction failure. Understand the basic concepts on concurrency control, recovery, indexing, access methods and fundamental view on unstructured data and its management.										
Co	urse Outcome										
		this course, student should be able to:									
1.	Design the str	ucture and operation of the relational data model. ata requirements of the real world and design a databa	ase m	nana	agei	men	t				
Inc	licative Experi										
<u>1.</u>		n and Data Manipulation Language									
2.	Constraints										
3.	Single row fu										
4.		d group functions									
5.	Sub query, vi										
6.	High Level La	nguage Extensions - Procedures, Functions, Cursors a									
		Total Laboratory Ho	urs	30	hοι	ırs					
Te	xt Book										
1.	. R. Elmasri & S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7 th Edition, 2016										
_	f D										
	ference Books										
1.	A. Silberscha 7 th Edition 20	tz, H. F. Korth & S. Sudarshan, Database System Cor 19.									
	A. Silberscha 7 th Edition 20 Raghu Rama	tz, H. F. Korth & S. Sudarshan, Database System Cor 19. krishnan, Database Management Systems, Mcgraw-Hi	II, 4 th	Ed	ition	, 20	18				
1.	A. Silberscha 7 th Edition 20 Raghu Rama	tz, H. F. Korth & S. Sudarshan, Database System Cor 19. krishnan, Database Management Systems, Mcgraw-Hi annan, S.Swamynathan," An Introduction to Database	II, 4 th	Ed	ition	, 20	18				

04-03-2022

Date

No. 65

17-03-2022

Mode of assessment: Continuous assessments, FAT

Recommended by Board of Studies

Approved by Academic Council

BCSE303L		L	Т	Р	С	
	·		3	0	0	3
Pre-requisite	NIL	Syl	labı	us v	ersi	on
				1.0		
Course Objective	es					
implement the	the operating system concepts, designs and provice services. ne trade-offs between conflicting objectives in large sca			·		

Course Outcomes

On completion of this course, student should be able to:

- 1. Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states.
- 2. Design scheduling algorithms to compute and compare various scheduling criteria.

3. To develop the knowledge for application of the various design issues and services.

- 3. Apply and analyze communication between inter process and synchronization techniques.
- 4. Implement page replacement algorithms, memory management problems and segmentation.
- 5. Differentiate the file systems for applying different allocation, access technique, representing virtualization and providing protection and security to OS.

Module:1 Introduction 3 hours Introduction to OS: Functionality of OS - OS design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, resources - Influence of security, networking, and multimedia. Module:2 OS Principles 4 hours

System calls, System/Application Call Interface – Protection: User/Kernel modes - Interrupts -Processes - Structures (Process Control Block, Ready List etc.), Process creation, management in Unix – Threads: User level, kernel level threads and thread models.

Module:3Scheduling9 hoursProcessesScheduling - CPU Scheduling: Pre-emptive, non-pre-emptive - Multiprocessor

scheduling – Deadlocks - Resource allocation and management - Deadlock handling mechanisms: prevention, avoidance, detection, recovery.

Module:4 Concurrency 8 hours

Inter-process communication, Synchronization - Implementing synchronization primitives (Peterson's solution, Bakery algorithm, synchronization hardware) - Semaphores - Classical synchronization problems, Monitors: Solution to Dining Philosophers problem - IPC in Unix, Multiprocessors and Locking - Scalable Locks - Lock-free coordination.

Module:5 Memory Management 7 hours

Main memory management, Memory allocation strategies, Virtual memory: Hardware support for virtual memory (caching, TLB) – Paging - Segmentation - Demand Paging - Page Faults - Page Replacement - Thrashing - Working Set.

Module:6 Virtualization and File System 6 hours Management

Virtual Machines - Virtualization (Hardware/Software, Server, Service, Network - Hypervisors - Container virtualization - Cost of virtualization - File system interface (access methods, directory structures) - File system implementation (directory implementation, file allocation methods) - File system recovery - Journaling - Soft updates - Log-structured file system - Distributed file system.

	··· y - · - · · ·	
Module:7	Storage Management, Protection and	6 hours
	Security	

Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based)- System threats and security – Policy vs mechanism - Access vs authentication -

Sys	System protection: Access matrix - Capability based systems - OS: performance, scaling,								
futu	future directions in mobile OS.								
Мо	dule:8	Contemporary Issues			2 hours				
			Total Lecture ho	ours:	45 hours				
Tex	xt Book								
1.	Abraha	am Silberschatz, Peter B.	Galvin, Greg Ga	gne, "Ope	erating System Concepts",				
	2018,	10 th Edition, Wiley, United	States.						
Re	ference	Books							
1.	Andrev	v S. Tanenbaum, "Mode	ern Operating S	ystems",	2016, 4 th Edition, Pearson,				
	United	Kingdom.							
2.	William	Stallings, "Operating S	Systems: Internal	ls and D	esign Principles", 2018, 9th				
	Edition, Pearson, United Kingdom.								
Мо	de of E	valuation: CAT, Written A	ssignment, Quiz,	FAT					
Re	commer	ided by Board of Studies	04-03-2022						
		y Academic Council	No. 65	Date	17-03-2022				

BCSE303P Operating Systems Lab			L	Т	Р	С	
			0	0	2	1	
Pre-requisite	Nil	Sy	llab	us v	vers	ion	
1.0							
Course Objective	es						
1. To introduce the operating system concepts, designs and provide skills required to implement the services.							
2. To describe the trade-offs between conflicting objectives in large scale system design.							

Course Outcome

On completion of this course, student should be able to:

- 1. Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states.
- 2. Design scheduling algorithms to compute and compare various scheduling criteria.

3. To develop the knowledge for application of the various design issues and services.

- 3. Apply and analyze communication between inter process and synchronization techniques.
- 4. Implement page replacement algorithms, memory management problems and segmentation.

 Differentiate the file systems for applying different allocation, access technique,

Differentiate the file systems for applying different allocation, access technique representing virtualization and providing protection and security to OS.

 2013, 2nd Edition, O'Reilly Media, Inc, United States. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 								
 Implement your own bootloader program that helps a computer to boot an OS. Shell Programming (I/O, Decision making, Looping, Multi-level branching) Creating child process using fork () system call, Orphan and Zombie process creation Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and Round Robin) Implement process synchronization using semaphores / monitors. Simulation of Banker s algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms Page Replacement Algorithms FIFO, LRU and Optimal Implement a file locking mechanism. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report) Total Laboratory Hours 30 hours Text Book Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK. Reference Books Love, Robert, "Linux System Programming: talking directly to the kernel and C library" 2013, 2nd Edition, O'Reilly Media, Inc, United States. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 	Indi	cative Experiments						
 Shell Programming (I/O, Decision making, Looping, Multi-level branching) Creating child process using fork () system call, Orphan and Zombie process creation Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and Round Robin) Implement process synchronization using semaphores / monitors. Simulation of Banker's algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms Page Replacement Algorithms FIFO, LRU and Optimal Implement a file locking mechanism. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report) Total Laboratory Hours 30 hours Text Book Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK. Reference Books Love, Robert, "Linux System Programming: talking directly to the kernel and C library" 2013, 2nd Edition, O'Reilly Media, Inc, United States. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 	1.	Study of Basic Linux Commands						
 Creating child process using fork () system call, Orphan and Zombie process creation Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and Round Robin) Implement process synchronization using semaphores / monitors. Simulation of Banker's algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms Page Replacement Algorithms FIFO, LRU and Optimal Implement a file locking mechanism. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report) Total Laboratory Hours 30 hours Text Book Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK. Reference Books Love, Robert, "Linux System Programming: talking directly to the kernel and C library" 2013, 2nd Edition, O'Reilly Media, Inc, United States. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 	2.	2. Implement your own bootloader program that helps a computer to boot an OS.						
 Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and Round Robin) Implement process synchronization using semaphores / monitors. Simulation of Banker s algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms Page Replacement Algorithms FIFO, LRU and Optimal Implement a file locking mechanism. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report) Total Laboratory Hours 30 hours Text Book Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK. Reference Books Love, Robert, "Linux System Programming: talking directly to the kernel and C library" 2013, 2nd Edition, O'Reilly Media, Inc, United States. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 	3.	3. Shell Programming (I/O, Decision making, Looping, Multi-level branching)						
 Implement process synchronization using semaphores / monitors. Simulation of Banker s algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms Page Replacement Algorithms FIFO, LRU and Optimal Implement a file locking mechanism. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report) Total Laboratory Hours 30 hours Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK. Reference Books Love, Robert, "Linux System Programming: talking directly to the kernel and C library" 2013, 2nd Edition, O'Reilly Media, Inc, United States. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 		Creating child process using fork () system call, Orphan and Zombie process creation						
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 not. Also check whether addition resource requested can be granted immediately 8. Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading 9. Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms 10. Page Replacement Algorithms FIFO, LRU and Optimal 11. Implement a file locking mechanism. 12. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report) Total Laboratory Hours 30 hours Text Book 1. Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK. Reference Books 1. Love, Robert, "Linux System Programming: talking directly to the kernel and C library" 2013, 2nd Edition, O'Reilly Media, Inc, United States. 2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 								
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 9. Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms 10. Page Replacement Algorithms FIFO, LRU and Optimal 11. Implement a file locking mechanism. 12. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report) Total Laboratory Hours 30 hours Text Book 1. Fox, Richard, "Linux with Operating System Concepts", 2022, 2nd Edition, Chapman and Hall/CRC, UK. Reference Books 1. Love, Robert, "Linux System Programming: talking directly to the kernel and C library" 2013, 2nd Edition, O'Reilly Media, Inc, United States. 2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 	8.	· · · · · · · · · · · · · · · · · · ·						
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 2013, 2nd Edition, O'Reilly Media, Inc, United States. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts" 2018, 10th Edition, Wiley, United States. 	Ref							
2018, 10 th Edition, Wiley, United States.	1.							
	2.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts",						
Mode of Assessment: Continuous Assessments EAT								
wode of Assessment. Continuous Assessments, FAT	Mod	de of Assessment: Continuous Assessments, FAT						
Recommended by Board of Studies 04-03-2022	Rec	ommended by Board of Studies 04-03-2022						
Approved by Academic Council No. 65 Date 17-03-2022	Арр	roved by Academic Council No. 65 Date 17-03-2022						

BCSE304L	Theory of Computation		L 1	. Ь (
DC3L304L	Theory or computation		3 0						
Pre-requisite	Nil		Syllabus v						
7 10 10 quilono			1.0	0.0.0.					
Course Object	ives	-							
	mmars and models of automata.								
	computation: What can be and what cannot be co	omputed	d.						
3. Establishing	connections among grammars, automata and for	mal lang	guages.						
Course Outco	me								
	On completion of this course, student should be able to:								
	d analyse different computational models								
	usly formal mathematical methods to prove proper	rties of I	anguages,						
grammars and									
	ations of some computational models and possible		ds of proving	g them.					
4. Represent tr	e abstract concepts mathematically with notations	S							
Modulo:1 Int	roduction to Languages and Grammars			4 hour					
	of techniques in Mathematics - Overview of	a Com	nutational N						
	d Grammars - Alphabets - Strings - Operations of								
Automata	Totalimate Appliabete Samge Sporations	on Lang	jaagoo, ovo	111011 0					
	ite State Automata			8 hour					
	ta (FA) - Deterministic Finite Automata (DFA)) - Non	n-determinist						
	λ) - NFA with epsilon transitions – NFA without e								
	Equivalence of NFA and DFA - minimization of [
Module:3 Re	gular Expressions and Languages			7 hour					
Regular Expre	ssion - FA and Regular Expressions: FA to reg	ular exp	oression and	l regula					
	A - Pattern matching and regular expressions -			and FA					
	a for regular languages - Closure properties of reg	gular lar	nguages						
	ntext Free Grammars			7 hour					
	Grammar (CFG) - Derivations - Parse Trees -								
	nplification of CFG – Elimination of Useless sym								
•	lormal forms for CFG: CNF and GNF - Pumpinຸ ⊑ເ	g Lemm	ia for CFL -	Closur					
Properties of C	r∟ shdown Automata			5 hour					
	e Pushdown automata - Languages of a Push	down a	utomata — F						
	stic Pushdown Automata and Deterministic pushdo			OWEI					
Module:6 Tu		own aat	tomata	6 hour					
	es as acceptor and transducer - Multi head and M	/lulti tap	e Turing Ma						
	g Machine - The Halting problem - Turing-Church		g						
l Universal Lurin	<u> </u>								
	cursive and Recursively Enumerable			6 hour					
Module:7 Re				6 hour					
Module:7 Re	cursive and Recursively Enumerable		is not Re						
Module:7 Re La Recursive and Enumerable (F	cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Language) E) – computable functions – Chomsky Hierarchy	ge that		cursive					
Recursive and Enumerable (Fost's Corresponder)	cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Language) – computable functions – Chomsky Hierarchyondence Problem	ge that		cursive oblems					
Recursive and Enumerable (Fost's Corresponder)	cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Language) E) – computable functions – Chomsky Hierarchy	ge that		cursive					
Recursive and Enumerable (Fost's Corresponder)	cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Language) – computable functions – Chomsky Hierarchyondence Problem Intemporary Issues	ge that	decidable pro	cursive oblems 2 hour					
Recursive and Enumerable (Fost's Corresponder)	cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Language) – computable functions – Chomsky Hierarchyondence Problem	ge that	decidable pro	cursive oblems					
Recursive and Enumerable (Fost's Corresponder)	cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Language) – computable functions – Chomsky Hierarchyondence Problem Intemporary Issues	ge that	decidable pro	cursive oblems 2 hour					
Recursive and Enumerable (FPost's CorrespModule:8 CorrespModule:8 CorrespModule:8 Logon Enumerable (FPost's Corres	cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Language) — computable functions — Chomsky Hierarchy and ence Problem ntemporary Issues Total Lecture hours:	ge that y - Unc	decidable pro	cursiveloblems 2 hour 5 hour neory,					
Recursive and Enumerable (Fost's Corresp Module:8 Co	Cursive and Recursively Enumerable Inguages Recursively Enumerable Languages, Languages, E) – computable functions – Chomsky Hierarchy Indence Problem Intemporary Issues Total Lecture hours: Toft, R. Motwani and J.D. Ullman, "Introduction and Computation", Third Edition, Pearson Educ	ge that y - Unc	decidable pro	cursiveloblems 2 hour 5 hour neory,					
Recursive and Enumerable (FPost's CorrespModule:8 CorrespModule:8 CorrespModule:8 Logon Enumerable (FPost's Corres	Cursive and Recursively Enumerable nguages Recursively Enumerable Languages, Languages, E) – computable functions – Chomsky Hierarchy and ence Problem Intemporary Issues Total Lecture hours: Total Computation, Third Edition, Pearson Education, Pearson Educ	ge that y - Unc	decidable pro	cursiveloblems 2 hour 5 hour neory,					

1.	Peter Linz, "An Introduction to Formal Languages and Automata", Sixth Edition, Jones &
	Bartlett, 2016. ISBN: 978-9384323219
2.	K. Krithivasan and R. Rama, "Introduction to Formal Languages, Automata and

Computation", Pearson Education, 2009. ISBN: 978-8131723562

Mode of Evaluation: CAT, Assignment, Quiz, FAT.						
Recommended by Board of Studies	04-03-2022					
Approved by Academic Council	No. 65	Date	17-03-2022			

BCSE305L	Embedded Systems		L	Т	Р	С
			3	0	0	3
Pre-requisite	NIL	Sylla	abu	s ve	ersio	on
			•	1.0		

- 1. To expose students to various challenges and constraints of special purpose computing systems in terms of resources and functional requirements.
- 2. To introduce students to various components of typical embedded systems viz., sensors and actuators, data converters, UART etc., their interfacing, programming environment for developing any smart systems and various serial communication protocols for optimal components interfacing and communication.
- 3. To make students understand the importance of program modeling, optimization techniques and debugging tools for product development and explore various solutions for real time scheduling issues in terms of resources and deadline.

Course Outcomes

On completion of this course, students should be able to:

- 1. Identify the challenges in designing an embedded system using various microcontrollers and interfaces.
- 2. To summaries the functionality of any special purpose computing system, and to propose smart solutions to engineering challenges at the prototype level.
- 3. To examine the working principle and interface of typical embedded system components, create programme models, apply various optimization approaches including simulation environment and demonstration using debugging tools.
- 4. To evaluate the working principle of serial communication protocols and their proper use, as well as to analyze the benefits and drawbacks of real-time scheduling algorithms and to recommend acceptable solutions for specific challenges.

Module:1	Introduction	5 hours				
Overview	of Embedded Systems, Design challenges, Embed	lded processor technology,				
Hardware I	Design, Micro-controller architecture -8051, PIC, and A	ARM.				
Module:2	I/O Interfacing Techniques	8 hours				
Memory in	Memory interfacing, A/D, D/A, Timers, Watch-dog timer, Counters, Encoder & Decoder,					
UART, Ser	nsors and actuators interfacing.					
Module:3	Architecture of Special Purpose Computing	6 hours				
	System					
ATM, Han	dheld devices, Data Compressor, Image Capturing	Devices–Architecture and				
Requireme	nts, Challenges & Constraints of special purpose com	puting system.				
Module:4	Programming Tools	7 hours				
Evolution of	of embedded programming tools, Modelling program	s, Code optimization, Logic				
analyzers,	Programming environment.	-				
Module:5	Real Time Operating System	8 hours				
Classificat	on of Real time system, Issues & challenges in I	RTS, Real time scheduling				
schemes- I	EDF-RMS & Hybrid techniques, eCOS, POSIX, Proto	threads.				
Module:6	Embedded Networking Protocols	5 hours				
Inter Integ	rated Circuits (I2C), Controller Area Network, Emb	edded Ethernet Controller,				
RS232, Blu	RS232, Bluetooth, Zigbee, Wifi.					
Module:7	Applications of Embedded Systems	4 hours				
Introduction	n to embedded system applications using case stu	udies – Role in Agriculture				
sector, A	utomotive electronics, Consumer Electronics, In	dustrial controls, Medical				
Electronics						
Module:8	Contemporary Issues	2 hours				

			Total Lectu	ıre hours	: 45 hours				
Tex	Text Book								
1.	. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Fourth Edition, Morgan Kaufman Publishers, 2016.								
	System	n Design, Fourth Edition, M	lorgan Kautmar	Publishe	rs, 2016.				
Ref	ference	Books							
1.			, Programming	and Desig	gn, by Raj Kamal, McGraw				
	Hill Ed	ucation, 3e, 2015.							
2.				Sofware Ir	ntroduction, by Vahid G Frank				
	and Gi	vargis Tony, John Wiley &	Sons, 2009.						
Мо	Mode of Evaluation: CAT, written assignment, Quiz, FAT.								
Red	Recommended by Board of Studies 04-03-2022								
App	oroved b	y Academic Council	No. 65	Date	17-03-2022				

BCSE306L	Artificial Intelligence	1	Т	Р	С
DOGLJUGE	Aitinolal intelligence	3	0	0	3
Pre-requisite	NIL	Syllabi	_	_	
1 To Toquisite		Cynabl	1.0	C1 31	<u> </u>
Course Objective	L PS		1.0		
	artificial intelligence principles, techniques and its history	<u> </u>			
	s the applicability, strengths, and weaknesses of the		kno	wle	dae
	ation, problem solving, and learning methods in so				
problems	, I	J	Ŭ		Ū
	p intelligent systems by assembling solutions to conc	rete co	mpu	ıtatic	nal
problems					
Course Outcome	es				
On completion of	this course, student should be able to:				
 Évaluate A 	Artificial Intelligence (AI) methods and describe their foun	dations	i.		
Apply bas	sic principles of AI in solutions that require problem-	solving	, inf	erer	ıce,
	n, knowledge representation and learning.				
	ate knowledge of reasoning, uncertainty, and knowledge	repres	enta	ation	for
	al-world problems				
4. Analyse a	nd illustrate how search algorithms play a vital role in pro	blem-s	olvir	ng	
Module:1 Intro	dustion			6 ho	
	olution of Al, State of Art -Different Types of Art	ificial I			
	Al-Subfields of Al-Intelligent Agents- Structure of				
Environments	Al-Subileids of Al-Intelligent Agents- Structure of	intellige	1111	~yei	113-
	lem Solving based on Searching		- 6	6 ho	urs
	Problem Solving by searching Methods-State Space s	earch.			
	 Uniform Cost Search, Breadth First Search- Depth F 				
	erative deepening depth-first, Informed Search Methods-				
A* Search					
	al Search and Adversarial Search			5 ho	urs
	orithms – Hill-climbing search, Simulated annealing, Gen				
	ch: Game Trees and Minimax Evaluation, Elementary two	o-player	s ga	ames	3:
	ax with Alpha-Beta Pruning.				
	c and Reasoning				urs
	gic and Reasoning -Propositional Logic-First Order Logic		nce	in Fi	rst
	ication, Forward Chaining, Backward Chaining, Resolution	on.		_	
	ertain Knowledge and Reasoning			hou	
	ertainty- Bayes Rule -Bayesian Belief Network- Approx	imate I	nfer	ence	e in
Bayesian network					
Module:6 Plan		l l			urs
	g, Planning as State-space search, Forward search,				
	Hierarchical Planning, Planning and acting in Nondeter	minisuc	uoi	паш	S –
	ning, Multiagent planning municating, Perceiving and Acting			3 ho	urs
	undamentals of Language -Probabilistic Language Proc	 pesing			
	ation Extraction-Perception-Image Formation- Object Rec			iiiia	uon
	emporary Issues			2 ho	urs
					<u></u>
	Total Lecture hou	rs:	4!	5 ho	urs
Taxt Back	. 544. 254410 1104				
Text Book					

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd Edition,

Prentice Hall.

Re	Reference Books						
1.	K. R. Chowdhary, Fundamentals of Artificial Intelligence, Springer, 2020.						
2	Alpaydin, E. 2010. Introduction to Machine Learning. 2 nd Edition, MIT Press.						
Мо	de of Evaluation: CAT, Assignme	nt, Quiz, FAT					
Re	Recommended by Board of Studies 04-03-2022						
Apı	Approved by Academic Council No. 65 Date 17-03-2022						

BCSE307L	Compiler Design	L	T	Р	С
		3	0	0	3
Pre-requisite	NIL	Sylla	bus	vers	ion
			1.	0	

- 1. To provide fundamental knowledge of various language translators.
- 2. To make students familiar with lexical analysis and parsing techniques.
- 3. To understand the various actions carried out in semantic analysis.
- 4. To make the students get familiar with how the intermediate code is generated.
- 5. To understand the principles of code optimization techniques and code generation.
- 6. To provide foundation for study of high-performance compiler design.

Course Outcomes

- 1. Apply the skills on devising, selecting, and using tools and techniques towards compiler design
- 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. Constructing symbol tables and generating intermediate code.
- 5. Obtain insights on compiler optimization and code generation.

Module:1 INTRODUCTION TO COMPILATION AND LEXICAL ANALYSIS 7 hours

Introduction to LLVM - 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) - Lex - A Lexical Analyzer Generator.

Module:2 | SYNTAX ANALYSIS

8 hours

Role of Parser- Parse Tree - Elimination of Ambiguity - Top Down Parsing - Recursive Descent Parsing - LL (1) Grammars - Shift Reduce Parsers- Operator Precedence Parsing - LR Parsers, Construction of SLR Parser Tables and Parsing- CLR Parsing- LALR Parsing.

Module:3 | SEMANTICS ANALYSIS

5 hours

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

Module:4 INTERMEDIATE CODE GENERATION

5 hours

Variants of Syntax trees - Three Address Code- Types – Declarations - Procedures - Assignment Statements - Translation of Expressions - Control Flow - Back Patching- Switch Case Statements.

Module:5 | CODE OPTIMIZATION

6 hours

Loop optimizations- Principal Sources of Optimization -Introduction to Data Flow Analysis - Basic Blocks - Optimization of Basic Blocks - Peephole Optimization- The DAG Representation of Basic Blocks -Loops in Flow Graphs - Machine Independent Optimization-Implementation of a naïve code generator for a virtual Machine- Security checking of virtual machine code.

Module:6 CODE GENERATION

5 hours

Issues in the design of a code generator- Target Machine- Next-Use Information - Register Allocation and Assignment- Runtime Organization- Activation Records.

Module:7 | PARALLELISM

7 hours

Parallelization- Automatic Parallelization- Optimizations for Cache Locality and Vectorization- Domain Specific Languages-Compilation- Instruction Scheduling and Software Pipelining- Impact of Language Design and Architecture Evolution on Compilers-Static Single Assignment

Module:8 | Contemporary Issues

				Total L	ecture hours:	45 hours			
Tex	xt Book	(s)							
1.	1. A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles,								
	techniques, & tools, 2007, Second Edition, Pearson Education, Boston.								
Ref	ference	Books							
1.	Watso	n, Des. A Practical Approa	ach to Compiler C	Construction	on. Germany, Sp	oringer			
	Interna	tional Publishing, 2017.							
Мо	Mode of Evaluation: CAT, Quiz, Written assignment and FAT								
Re	Recommended by Board of Studies 04-03-2022								
Apı	Approved by Academic Council No. 65 Date 17-03-2022								

		Agenda Kem o	J/ U J - /	~,,,,	IICA (ui C	00
BCSE	307P	Compiler Design Lab		L	Т	Р	С
		i		0	0	2	1
Pre-re	quisite		Sylla	abı	us v	ers	ion
					1.0		
Cours	e Objectives						
		ental knowledge of various language translators.					
		amiliar with phases of compiler.					
3. To p	orovide foundat	ion for study of high-performance compiler design.					
	e Outcome						
	•	devising, selecting and using tools and techniques to	owards	s c	om	oiler	
design							
		specifications using context free grammars (CFG).			_		
		e techniques, and the knowledge acquired for the pu	ırpose	ot			
		e systems.					
		ol tables and generating intermediate code.					
5. Obl	am insignts on	compiler optimization and code generation.					
Indica	itive Experime	nts					
1.		on of LEXR using LLVM.					
2.	Implementation	on of handwritten parser using LLVM					
3.		ode with the LLVM backend.					
4.		Il programming language.					
5.		rsive descent parser for the CFG language and	impler	me	nt i	t us	sina
	LLVM.		•				0
6.	Write a LR pa	rser for the CFG language and implement it in the u	sing L	LV	′Μ.		
7.	Intro to Flex a						
	Modify the sc	anner and parser so that terminating a statement wit	h "; b"	' in	stea	ad o	f ";"
		output being printed in binary.					
8.	Using LLVM-s	style RTTI for the AST and Generating IR from the A	ST.				

10.	Emitting assembler text and object coc	Total Laboratory Hours	20 haura
10.	Emitting assembler text and object cod		
40		1 -	

Converting types from an AST description to LLVM types.

Mode of assessment: CAT, FAT

Text Book(s)

1 Learn LLVM 12: A beginner's guide to learning LLVM compiler tools and core libraries with C++

Reference Books

1. Watson, Des. A Practical Approach to Compiler Construction. Germany, Springer International Publishing, 2017.

Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE308L	Computer Networks		L	Т	Р	С
			3	0	0	3
Pre-requisite	NIL	Syllabus version				on
		1.0				

- 1. To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications.
- 2. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures.
- 3. To identify the suitable application layer protocols for specific applications and its respective security mechanisms.

Course Outcomes

On completion of this course, student should be able to:

- 1. Interpret the different building blocks of Communication network and its architecture.
- 2. Contrast different types of switching networks and analyze the performance of network
- 3. Identify and analyze error and flow control mechanisms in data link layer.
- 4. Design sub-netting and analyze the performance of network layer with various routing protocols.
- 5. Compare various congestion control mechanisms and identify appropriate transport layer protocol for real time applications with appropriate security mechanism.

Module:1	Networking Principles and Layered	6 hours
	Architecture	
	nunications and Networking: A Communications Mo	
	f network, Requirements , Applications, Network To	
	, Protocols and Standards, Network Models (OSI, T	
	Circuit and Packet Switching	7 hours
	communications Networks – Circuit Switching – Pac	
	witching and Packet Switching – Implementing Netv	
	s(Transmission Impairment, Data Rate and Perform	
	Data Link Layer	8 hours
	ction and Correction – Hamming Code , CRC, Check	
	ı – Sliding Window Protocol - GoBack - N - Selective	
	tted Aloha - CSMA, CSMA/CD – IEEE Standards(IE	EEE802.3 (Ethernet),
	1(WLAN))- RFID- Bluetooth Standards	
	Network Layer	8 hours
	ess Space – Notations – Classful Addressing – Clas	
	anslation – IPv6 Address Structure – IPv4 and IPv6	
	Routing Protocols	6 hours
	k State and Distance Vector Routing Protocols- Imp	olementation-Performance
	acket Tracer	
	Transport Layer	5 hours
	DP-Congestion Control-Effects of Congestion-Traffi	
	Control-Congestion Avoidance Mechanisms-Queui	ing Mechanisms-QoS
Parameters		
	Application layer	3 hours
	layer-Domain Name System-Case Study : FTP-HT	
Module:8	Contemporary Issues	2 hours
	Total Lecture hours:	45 hours
Text Book		
1. Behrou	ız A. Forouzan, Data communication and Netw	orking, 5th Edition, 2017,

	McGraw Hill Education.							
Ref	Reference Books							
1.	1. James F. Kurose and Keith W.Ross, Computer Networking: A Top-Down Approach, 6th							
	Edition, 2017, Pearson Educatio	n.						
2.	William Stallings, "Data and Co	mputer Commur	nication",	10th Edition, 2017, Pearson,				
	United Kingdom.							
Мо	de of Evaluation: CAT, Written A	ssignment, Quiz,	FAT					
Red	Recommended by Board of Studies 04-03-2022							
Approved by Academic Council No. 65 Date 17-03-2022				17-03-2022				

BCSE308P	Computer Networks Lab		L	Т	Р	С
			0	0	2	1
Pre-requisite	NIL	Syllabus version			n	
		1.0				

- 1. To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications.
- 2. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures.
- 3. To identify the suitable application layer protocols for specific applications and its respective security mechanisms

Course Outcome

On completion of this course, student should be able to:

- 1. Interpret the different building blocks of Communication network and its architecture.
- 2. Contrast different types of switching networks and analyze the performance of network
- 3. Identify and analyze error and flow control mechanisms in data link layer.
- 4. Design sub-netting and analyze the performance of network layer with various routing protocols.
- 5. Compare various congestion control mechanisms and identify appropriate transport layer protocol for real time applications with appropriate security mechanism.

Indi	cative Experiments					
1.	1. Study of Basic Network Commands, Demo session of all networking hardware and					
	Functionalities					
2.	Error detection and correction n	nechanisms				
3.	Flow control mechanisms					
4.	IP addressing Classless addres	ssing				
5.	Observing Packets across the r					
6.	Socket programming(TCP and	UDP) - Some cha	allenging e	experiments c	an be given on	
	Socket programming					
7.	Simulation of unicast routing pro	otocols				
8.	Simulation of Transport layer Pr	rotocols and anal	ysis of co	ngestion contr	ol techniques	
	in network					
9.	Develop a DNS client server to	resolve the giver	n host nam	ne or IP addre	SS	
		То	tal Labor	atory Hours	30 hours	
Text	t book					
1 \	W.Richard Stevens, Uix Network	Programming, 2	2ndEdition	, Pearson Edι	ıcation, 2015.	
Mod	le of assessment: Continuous a	ssessment, FAT				
Reco	ommended by Board of Studies	04-03-2022		·		
Appı	roved by Academic Council	No. 65	Date	17-03-2022		

BCSE309L	Cryptography and Network Security	L	T	Р	С
		3	0	0	3
Pre-requisite	NIL	Sylla			on
Course Objective			1.0	,	
	e concepts of basic number theory and cryptographic te	chniau	ies		
	cept of Hash and Message Authentication, Digital Signa				
authentication		itai oo	aria		
	basics of transport layer security, Web Security and var	ious ty	pes o	of	
System Secur	· · · · · · · · · · · · · · · · · · ·		<u> </u>		
Course Outcome					
	this course, students should be able to:				
	undamental mathematical concepts related to security.				
	d concept of various cryptographic techniques.		ممنامم	tiono	
	the authentication and integrity process of data for vari				
4. To know fundation Security	amentals of Transport layer security, web security, E-Ma	all 5 00	urity	and I	_
Security					
Module:1 Fund	amentals of Number Theory			5 ho	urs
Finite Fields and I	Number Theory: Modular arithmetic, Euclidian Algorithm	n, Prim	ality	Testii	ng:
	rs theorem, Chinese Reminder theorem, Discrete Loga	<u>rithms</u>	•		
	metric Encryption Algorithms			7 ho	
	yptographic techniques: Introduction to Stream cipher, E	Block o	cipher	:: DE	3,
	Cipher Operation, Random Bit Generation and RC4			•	
	mmetric Encryption Algorithm and Key Exchange	- ti - O:		8 ho	urs
	ryptographic techniques: principles, RSA, ElGamal, Elli momorphic Encryption and Secret Sharing, Key distribu			.,	
	ols, Diffie-Hellman Key Exchange, Man-in-the-Meddle A		iu ive	у	
Module:4 Mess	age Digest and Hash Functions			5 ho	urs
	Hash Functions, Security of Hash Functions, Message	Diges	t (MD	5),	
Secure Hash Fun	ction (SHA),Birthday Attack, HMAC				
	al Signature and Authentication Protocols			7 ho	urs
	quirements, Authentication Functions, Message Auther				
	Authentication, Authentication Protocols, Digital Signatu				
	Elgamal based Digital Signature, Authentication Application	ations:	Kerb	eros,	
	tion Service, Public Key Infrastructure (PKI)				
	sport Layer Security and IP Security			4 ho	
	Security, Secure Socket Layer(SSL),TLS, IP Security: O	vervie	w: IP	Secu	ırity
Architecture, Enca	apsulating Payload Security				
Module:7 E-ma	il, Web and System Security			7 ho	urs
	ecurity, Pretty Good Privacy (PGP), S/MIME, Web Secu	rity: W	eb S		
Considerations, S	ecure Electronic Transaction Protocol	•			-
	n Detection, Password Management, Firewalls: Firewal	l Desig	gn Pri	inciple	эs,
Trusted Systems.				2 L -	
Module:8 Cont	emporary Issues	1		2 ho	urs
	Total Lecture hours:		4	l5 ho	urs
Text Book					
	and Network Security-Principles and Practice, 8 th Edi	tion h	v Sta	allings	
	Enter the country throughout and tradado, or Edi		,		

	William, published by Pearson, 2	2020							
	Reference Books								
1.	1. Cryptography and Network Security, 3 rd Edition, by Behrouz A Forouzan and Depdeep								
	Mukhopadhyay, published by Mo	GrawHill, 2015							
Мо	de of Evaluation: CAT, written as	ssignment, Quiz,	and FAT						
Re	commended by Board of Studies	04-03-2022							
Apı	proved by Academic Council	No. 65	Date	17-03-2022					

ВС	SE309P	Cryptography and Network Security Lab	IL	Т	Р	С		
			0	0	2	1		
Pre	-requisite	NIL	Syllabu	is v	ersi	on		
				1.0				
	urse Objective							
		rious Private and Public Key cryptographic algorithms.						
		hash functions and digital signature algorithms						
3.	Acquire knowle	edge in various network security models						
Cal	urse Outcome							
		his course, students should be able to:						
		ous cipher techniques without using standard cryptogra	nhic lihr	arv				
	functions	ous diprior toorninques without using standard dryptogra	ipino libi	ai y				
		rious hash functions and digital signature algorithms for	r differei	nt				
	applications							
		s secured networking-based application						
	·							
	icative Experir							
1.		nder and receiver who need to exchange data confiden						
		cryption. Write program that implements DES encryption	n and de	ecry	ptior	1		
_		key size and 64 bit block size						
2.		nder and receiver who need to exchange data confiden						
		cryption. Write program that implements AES encryption	n and de	ecry	ptior	1		
2		28/256 bits key size and 64 bit block size.						
3		nipper scheme by using RSA	- C- d-	/ N / A A	<u> </u>			
4. 5		5 hash algorithm that finds the Message Authentication						
5		ge Authentication Code (MAC) for given variable size m SHA-256 Hash algorithm	iessage	bу	usin	J		
		Fime consumptions for varying message size for both S	HΔ_128	and	1 2 H	Δ_		
	256.	Time consumptions for varying message size for both of	11/4-120	and	. 011	Λ-		
6		igital Siganture standard(DSS)for verifying the legal co	mmunic	atin	a			
	parties				3			
7		e Hellman multiparty key exchange protocol and perforn	n Man-	in-th	ne-			
	Middle Attack							
8		ple client and server application using SSL socket com						
9	Develop a sim	ple client server model using telnet and capture the pa	ickets tr	ans	mitte	∌d		
		nalyze the pcap file and get the transmitted data (plain	text) us	ing	any			
		packet capturing library.						
		above scenario using SSH and observe the data						
10	Develop a we	b application that implements JSON web token	1					
n -		Total Laboratory Hou	ırs 30	hοι	ırs			
		ent: Continuous Assessment, FAT						
		Board of Studies 04-03-2022	200					
App	proved by Acad	emic Council No. 65 Date 17-03-20	122					

Discipline Elective

Course code	Course code Course Title		L	T	Р	С
BCSE206L Foundations of Data Science		3	0	0	3	
Pre-requisite	NIL	Syllabus version				ion
		1.0				

Course Objectives

- 1. To provide fundamental knowledge on data science with querying and analytics required for the field of data science.
- 2. To understand the process of handling heterogeneous data, pre-process and visualize them for better understanding.
- 3. To gain the fundamental knowledge on data science tools and gain basic skill set to solve real-time data science problems.

Course Outcome

Upon completion of the course the student will be able to

- 1. Ability to obtain fundamental knowledge on data science.
- 2. Demonstrate proficiency in data analytics.
- 3. Apply advanced tools to work on dimensionality reduction and mathematical 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 Data Science Context

5 hours

Need for Data Science – What is Data Science - Data Science Process – Business Intelligence and Data Science – Prerequisites for a Data Scientist – Tools and Skills required.

Module:2 Databases for Data Science

7 hours

Structured Query Language (SQL): Basic Statistics, Data Munging, Filtering, Joins, Aggregation, Window Functions, Ordered Data, preparing No-SQL: Document Databases, Wide-column Databases and Graphical Databases.

Module:3 | Data Science Methodology

8 hours

Analytics for Data Science – Examples of Data Analytics – Data Analytics Lifecycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results.

Module:4 Data Analytics on Text

7 hours

Major Text Mining Areas – Information Retrieval – Data Mining – Natural Language Processing NLP) – Text analytics tasks: Cleaning and Parsing, Searching, Retrieval, Text Mining, Part-of-Speech Tagging, Stemming, Text Analytics Pipeline. NLP: Major components of NLP, stages of NLP, and NLP applications.

Module:5 | Platform for Data Science

6 hours

Python for Data Science –Python Libraries – Data Frame Manipulation with numpy and pandas – Exploration Data Analysis – Time Series Dataset – Clustering with Python – Dimensionality Reduction. Python integrated Development Environments (IDE) for Data Science.

Module:6 | GNU Octave for Mathematical Operations

6 hours

Handling Vectors and Matrices: Multiplication, Transpose, Random Matrix creation, Eigen Vectors and Eigen Values, Determinants. Arithmetic Operations – Set Operations – Plotting Data.

Module:7 | Tableau

4 hours

Tableau Introduction – Dimensions, Measures, Descriptive Statistics, Basic Charts, Dashboard Design Principles, Special Chart Types, Integrate Tableau with Google Sheets.

Module:8 | Contemporary Issues

			Total Lecture ho	ours:		45 hours			
Tox	Text Book(s)								
167		,		. ,_		<u> </u>			
1	Sanjee	v Wagh, Manisha Bhend	e, Anuradha Tha	ıkare, 'Fui	ndamentals o	of Data Science,			
1.	CRC P	ress, 1 st Edition, 2022.							
Re	ference	Books							
1	Avrim	Blum, John Hopcroft,	Ravindran Kann	an, "Foui	ndations of	Data Science",			
1.	Cambr	Cambridge University Press, First Edition, 2020.							
	Joel G	rus, "Data Science from S	Scratch: First Prin	ciples with	n Pvthon". O'	Reilly Media, 1st			
2.	Edition			о. р .оо	, . ,				
	Ani A	dhikari and John DeN	ero. 'Computati	onal and	Inferential	Thinking: The			
3.	Foundations of Data Science', GitBook, 2019.								
Мо	Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final								
Ass	Assessment Test								
Re	Recommended by Board of Studies 12-05-2022								
App	Approved by Academic Council No. 66 Date 16-06-2022								

Course code	Course Title		L	Т	Р	С	
BCSE207L	Programming for Data Science	ence	2	0	0	2	
Pre-requisite	NIL		llab	us v	ers	ion	
•				1.0			
Course Objecti	ves	•					
1. To prov	ide necessary knowledge on data manipula	tion and to perforr	n an	alys	is o	n	
the prac	ctical problems using a programming approa	ich.		-			
2. To gene	erate report and visualize the results in grap	hical form using p	rogra	amm	ning		
tools.							
3. To learn	and implement R programs for data science	e					
<u> </u>							
Course Outcom							
	of the course, the student will be able to						
	and use R language to solve problems.	to					
	suitable form for analysis from real-time da e insights from the data through statistical in						
	and visualize the results, analyze the perfo		عاماه				
4. Lvaluate	and visualize the results, analyze the peno	illiance of the mo	ucis.	•			
Module:1 Fun	ctions in R			2	ho	urs	
	vith R- Running R Code - Including C	omments - Defi	nina				
	in R Functions - Loading Functions - Writi						
Statements.	ŭ	3	3				
Module:2 Vec	tors and Lists			3	ho	urs	
Vector - Vectoria	zed Operations - Vector Indices - Vector Fil	tering - Modifying	Vec	tors,	, Lis	ts -	
	Accessing List Elements - Modifying Lists-						
lapply().							
Module:3 Data						urs	
	Data - The Data Generation Process - F						
	a - Using Data to Answer Questions - Da	ata Frames - Wo	rking	wit	h D	ata	
	g with CSV Data.	l					
•	ipulating Data with dplyr and tidyr					urs	
	on - Core dplyr Functions- Performing S						
	Group - Joining Data Frames Together -						
	g Data with tidyr -From Columns to R	,	Fron	n K	ows	to	
•	d() - tidyr in Action: Exploring Educational S	tatistics.			' la a		
	essing Databases and Web APIs	Naccasing a Date	hoo		ho		
	FRelational Databases -A Taste of SQL-APIs -RESTful Requests -Accessing Web	•					
•	tion: Finding Cuban Food in Seattle.	AFIS HOIH K -FI	oces	Siriy	JJ	OIN	
Module:6 Data				6	ho	ure	
•		tion - Selecting V	/ieua				
Designing Data Visualizations - The Purpose of Visualization - Selecting Visual Layouts - Choosing Effective Graphical Encodings - Expressive Data Displays - Enhancing Aesthetics							
	lizations with ggplot2- A Grammar of Graph						
•	s and Customization - Building Maps- ggplo		•	•	٠.		
	ractive Visualization in R					urs	
	age - The Rbokeh Package - The Leaflet P	ackage - Interacti	ve V				
	ing Changes to the City of Seattle.						
	temporary Issues			2	ho	urs	
	Total Lecture hours:			30	ho	urs	
		İ					

Michael Freeman and Joel Ross, Programming Skills for Data Science: Start Writing

Text Book(s)

	Code to Wrangle, Analyze, and Visualize Data with R, Addison-Wesley, 2018.						
Re	Reference Books						
1.	Benjamin S. Baumer, Daniel T. Kaplan and Nicholas J. Horton, Modern Data Science						
١.	with R, Chapman and Hall/CRC, 2021.						
2.	2. John Mount and Nina Zumel, Practical Data Science with R, 2 nd edition, Wiley, 2019.						
Мо	de of Evaluation : Continuous Ass	essment Tests, C	Quizzes, A	ssignment, Final			
Ass	Assessment Test						
Re	Recommended by Board of Studies 12-05-2022						
App	proved by Academic Council	No. 66	Date	16-06-2022			

Course code	Course Title		L	T	Р	С
BCSE207P	Programming for Data Science Lab	Programming for Data Science Lab			2	1
Pre-requisite	ite NIL Syl		llab	us v	ers/	ion
				1.0		

- 1. To provide necessary knowledge on data manipulation and to perform analysis on the practical problems using statistical and machine learning approach.
- 2. To generate report and visualize the results in graphical form using programming tools.
- 3. To learn and implement R programs for data science.

Course Outcome

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

- 1. Program and use R language to solve problems.
- 2. Design a suitable form for analysis from real-time data.
- 3. Formulate insights from the data through statistical inferences.
- 4. Evaluate and visualize the results, analyze the performance of the models.

Indi						
1.	Functions in R				4 hours	
2.	Vectors and Lists				2 hours	
3.	Data Frames				4 hours	
4.	Handling Missing Data				4 hours	
5. Manipulating Data with dplyr and tidyr					2 hours	
6. Processing JSON Data					2 hours	
7. APIs					3 hours	
8	Data Visualization				3 hours	
9.	Interactive Visualization in R				3 hours	
10.	Case Study				3 hours	
Total Laboratory Hours					30 hours	
Mode of assessment: Continuous assessment / FAT / Oral examination and others						
Recommended by Board of Studies 12-05-2022						
App						

Course code	Course Title		L	Т	Р	С
BCSE208L	Data Mining		2	0	0	2
Pre-requisite	NIL	Sy	llab	us v	ers	ion
				1.0		

- 1. To introduce the fundamental processes data warehousing and major issues in data mining.
- 2. To impart the knowledge on various data mining concepts and techniques that can be applied to text mining, web mining etc.
- 3. To develop the knowledge for application of data mining and social impacts of data mining.

Course Outcome

Upon completion of the course the student will be able to

- 1. Interpret the contribution of data warehousing and data mining to the decisionsupport systems.
- 2. Construct the data needed for data mining using preprocessing techniques.
- 3. Discover interesting patterns from large amounts of data using Association Rule Mining.
- 4. Extract useful information from the labeled data using various classifiers and Compile unlabeled data into clusters applying various clustering algorithms.
- 5. Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.

Module:1 Data Warehousing

4 hours

Introduction to Data warehouse - Data Warehouse models- Data warehouse architecture: Three-tier data warehouse architecture - Data warehouse modeling: Data cube and OLAP - Star and Snowflake Schema.

Module:2 Introduction to Data Mining

3 hours

Introduction to data mining - Data mining functionalities - Steps in data mining process-Classification of data mining systems - Major issues in data mining.

Module:3 Data Preprocessing

3 hours

Data Preprocessing: An overview - Data cleaning - Data integration -Data reduction - Data transformation.

Module:4 | Frequent Pattern Mining

4 hours

Frequent Pattern Mining: Basic Concepts and a Road Map - Efficient and scalable frequent item set mining methods: Apriori algorithm, FP-Growth algorithm - Mining frequent item sets using vertical data format.

Module:5 Classification Techniques

5 hours

General approach to classification - Classification by decision tree induction - Bayes classification methods - Model evaluation and selection - Techniques to improve classification accuracy - advanced classification methods: Bayesian belief networks- Lazy learners.

Module:6 | Cluster Analysis

5 hours

Types of data in cluster analysis - Partitioning methods - K Medoid Clustering - Density based methods - Grid based methods - Outlier analysis.

Module:7 Data Mining Trends and Research Frontiers

4 hours

Overview of Web mining-Temporal and Spatial mining-Other methodologies of data mining: Statistical data mining- Data mining applications.

Module:8 | Contemporary Issues

			Total Lecture ho	ours:	30 hours			
Tex	Text Book(s)							
4	Jiawei	Han and Micheline Kam	ber, Data Mining	g: Concep	ts and Techniques, Morgan			
1.	Kaufma	ann Publishers, third edition	on, 2013.					
Re	ference	Books						
1.				rehousing	g: Principles and Practical			
1.	Techni	Techniques, Cambridge University Press, 2019.						
2.	Pang-N	ling Tan, Michael Steinb	ach, Anuj Karpat	ne, Vipin	Kumar, Introduction to Data			
۷.	Mining	, Pearson, 2 nd Edition, 201	19.					
Мо	Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final							
Assessment Test								
Re	Recommended by Board of Studies 12-05-2022							
App	Approved by Academic Council No. 66 Date 16-06-2022							

Course code	Course Title		L	Т	Р	С
BCSE208P	Data Mining Lab		0	0	2	1
Pre-requisite	NIL	Syll	labı	ıs v	ersi	ion
			1	.0		

- 1. To introduce the fundamental processes data warehousing and major issues in data mining.
- 2. To impart the knowledge on various data mining concepts and techniques that can be applied to text mining, web mining etc.
- 3. To develop the knowledge for application of data mining and social impacts of data mining.

Course Outcome

- 1. Interpret the contribution of data warehousing and data mining to the decision-support systems.
- 2. Construct the data needed for data mining using preprocessing techniques.
- 3. Discover interesting patterns from large amounts of data using Association Rule Mining.
- 4. Extract useful information from the labeled data using various classifiers and Compile unlabeled data into clusters applying various clustering algorithms.
- 5. Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.

Indi	cative Experiments					
1.	. Introduction to exploratory data analysis using R.					
2.	Demonstrate the Descriptive Statistics for a sample data like mean, median,					
	variance and correlation etc.,					
3.	Demonstrate Missing value analysis using sample data.					
4.	Demo of Apriori algorithm on various data sets with varying confidence and					
	support.					
5.	Demo of FP Growth algorithm on various data sets with varying confidence and					
	support.					
6	Demo on Classification Techniques such as Decision Tree (ID3 / CART),					
	Bayesian etc., and using sample data.					
7.	Demonstration of Clustering Techniques K-Medoid and Hierarchical.					
8.	Demonstration on Document Similarity Techniques and measurements.					
9.	Simulation of Page Rank Algorithm.					
10.	Demonstration on Hubs and Authorities.					
	Total Laboratory Hours 30 hours					
Text	: Book(s)					
Jiaw	ei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan					
	Kaufmann Publishers, third edition, 2013.					
Refe	Reference Books					
	Parteek Bhatia, Data Mining and Data Warehousing: Principles and Practical					
	Techniques, Cambridge University Press, 2019.					
	Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data					
Mini	Mining, Pearson, 2 nd Edition, 2019.					

Mode of Assessment: Continuous Assessment / FAT / Oral examination and others

No. 66

12-05-2022

Date

16-06-2022

Recommended by Board of Studies

Approved by Academic Council

Course code	Course Title		L	T	Р	С
BCSE209L Machine Learning				0	0	3
Pre-requisite	NIL	Syl	lab	us v	ers/	ion
				1.0		

- 1. To teach the theoretical foundations of various learning algorithms.
- 2. To train the students better understand the context of supervised and unsupervised learning through real-life examples.
- 3. To understand the need for Reinforcement learning in real time problems.
- 4. Apply all learning algorithms over appropriate real-time dataset.
- 5. Evaluate the algorithms based on corresponding metrics identified.

Course Outcome

Third Edition 2014.

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

- 1. Understand, visualize, analyze and preprocess the data from a real-time source.
- 2. Apply appropriate algorithm to the data.
- 3. Analyze the results of algorithm and convert to appropriate information required for the real time application.
- 4. Evaluate the performance of various algorithms that could be applied to the data and to suggest most relevant algorithm according to the environment.

Module:1	Introduction to Machine Learning and Pre-	4 hours					
	requisites						
Introductio	Introduction to Machine Learning – Learning Paradigms – PAC learning – Version Spaces –						
Role of Ma	chine Learning in Artificial Intelligence application	ns.					
	Supervised Learning – I	7 hours					
	d Non-Linear examples – Multi–Class & Mu						
	n – Multiple Linear Regression – Naïve Bayes Cl	assifier – Decision Trees – ID3 –					
	ror bounds.						
	Supervised Learning – II	8 hours					
K-NN class	sifier – Logistic regression – Perceptron – Sing	le layer & Multi-layer – Support					
Vector Mad	chines – Linear & Non-linear – Metrics & Error Co						
Module:4	Unsupervised Learning	9 hours					
	basics (Partitioned, Hierarchical and Density basics)						
	ering – Self organizing maps – Expectation max						
	Kernel PCA – tSNE (t-distributed stochastic new	eighbor embedding) - Metrics &					
Error Corre							
	Ensemble Learning	5 hours					
	riance Tradeoff – Bagging and Boosting (Rande	om forests, Adaboost, XG boost					
	- Metrics & Error Correction.						
	Machine Learning in Practice	3 hours					
	lance – SMOTE – One Class SVM – Optimizatio	, · ·					
	Reinforcement Learning (RL)	8 hours					
	RL – RL Framework – Markov Decision Proces						
Polices, Value Functions and Bellman Equations – Solution Methods – Q-learning.							
Module:8	Contemporary Issues	1 hour					
	Total Lecture hours:	45 hours					
Text Book	(s)						
Ethem	Alpaydin, Introduction to Machine Learning, M	IT Press, Prentice Hall of India,					
1							

	Richard S. Sutton and Andrew	·		•					
2.	(Adaptive Computation and Ma	icnine Learning	series) Z	edition, A Bradford Book;					
	2018.								
Ref	Reference Books								
1	Mehryar Mohri, Afshin Rostan	nizadeh, Ameet	Talwalka	r, Foundations of Machine					
1.	Learning, MIT Press, 2012.	Learning, MIT Press, 2012.							
2.	Tom Mitchell, Machine Learning,	McGraw Hill, 3rd	d Edition,	1997.					
3.	Charu C. Aggarwal, Data Classif	ication Algorithm	s and App	lications, CRC Press, 2014					
Мо	de of Evaluation : Continuous Ass	essment Tests, (Quizzes, A	ssignment, Final					
Ass	Assessment Test								
Red	Recommended by Board of Studies 09-05-2022								
App	Approved by Academic Council No. 66 Date 16-06-2022								

Course code Course Title		L	Т	Р	С	
BCSE209P Machine Learning Lab			0	0	2	1
Pre-requisite	Nil	Syllabus version			on	
		1.0				

- 1. To teach the theoretical foundations of various learning algorithms.
- 2. To train the students better understand the context of supervised and unsupervised learning through real-life examples.
- 3. To understand the need for Reinforcement learning in real time problems.
- 4. Apply all learning algorithms over appropriate real-time dataset.
- 5. Evaluate the algorithms based on corresponding metrics identified.

Course Outcome

- 1. At the end of this course, student will be able to:
- 2. Understand, visualize, analyze and preprocess the data from a real-time source.
- 3. Apply appropriate algorithm to the data.
- 4. Analyze the results of algorithm and convert to appropriate information required for the real time application.
- 5. Evaluate the performance of various algorithms that could be applied to the data and to suggest most relevant algorithm according to the environment.

	data and to suggest most relevant algorithm according to the environment.							
Indi	Indicative Experiments							
1.	Linear & Multiple Linear Regression							
2.	Naïve Bayes classifier							
3.	Decision trees – ID3 & CART							
4.	Logistic regression							
5.	Support Vector Machines – Linea	r & Non-l	inear					
6.	Single & Multilayer Perceptron							
7.	K-NN, K-Means & K-mode cluste	ring						
8.	Random – forest							
9.	Adaboost, XGboost							
10.	Principal component analysis							
11.	Self – Organizing maps							
12.	Q-Learning							
		To	tal Labo	ratory Hours	30 hours			
Mod	Mode of Evaluation: CAT / Mid-Term Lab/ FAT							
Rec	ommended by Board of Studies	09-05-2	022					
Approved by Academic Council No. 66 Date 16-06-2022								

Course code	Course Title		L	Т	Р	С
BCSE331L Exploratory Data Analysis		2	0	0	2	
Pre-requisite	NIL	Syllabus ve		vers	ion	
		1.0				

- 1. The course introduces the methods for data preparation and data understanding.
- 2. It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical and graphical methods.
- **3.** Supports to summarize use of predictive analytics, data science and data visualization.

Course Outcomes

At the end of the course, the student will be able to

- 1. Handle missing data in the real world data sets by choosing appropriate methods
- 2. Summarize the data using basic statistics. Visualize the data using basic graphs and plots.
- 3. Identify the outliers if any in the data set.
- 4. Choose appropriate feature selection and dimensionality reduction.
- 5. Apply Techniques for handling multi-dimensional data.

Module:1 Introduction to Exploratory Data Analysis

4 hours

Introduction to Exploratory Data Analysis (EDA) –Steps in EDA, Data Types: Numerical Data – Discrete data, continuous data – Categorical data – Measurement Scales: Nominal, Ordinal, Interval, Ratio – Comparing EDA with classical and Bayesian Analysis – Software tools for EDA.

Module:2 Data Transformation

4 hours

Transformation Techniques: Performing data deduplication - replacing values – Discretization and binning. Introduction to Missing data, handling missing data: Traditional methods - Maximum Likelihood Estimation.

Module:3 Correlation Analysis and Time Series Analysis

4 hours

Types of analysis: Univariate analysis - bivariate analysis - multivariate analysis. Time Series Analysis (TSA): Fundamentals of TSA - characteristics of TSA - Time based indexing - visualizing time series - grouping time series data - resampling time series data.

Module:4 Data Summarization and Visualization

4 hours

Statistical summary measures, data elaboration, 1-D Statistical data analysis, 2-D Statistical data Analysis, contingency tables, n-D Statistical data analysis. Visualization: Scatter plots – Dot charts - Bar plots.

Module:5 | Clustering Algorithms

4 hours

Introduction to Spectral clustering – Document clustering – Minimum Spanning Tree clustering. Overview of Model-based clustering – Expectation-Maximization algorithm – Hierarchical Agglomerative model-based clustering. Outlier detection using Clustering.

Module:6 | Dimensionality Reduction

4 hours

Linear Methods: Principal Component Analysis (PCA) – Singular Value Decomposition – Factor Analysis -Intrinsic Dimensionality. Non Linear methods: Multidimensional Scaling – Manifold Learning – Self-Organizing Maps.

Module:7 | Model Development and Evaluation

4 hours

Constructing linear regression model – evaluation – computing accuracy – understanding accuracy. Understanding reinforcement learning: Difference between supervised and reinforcement learning – Applications of reinforcement learning.

Module:8 | Contemporary Issues

			Total Lecture ho	ours:	30hours		
_							
Tex	<u>kt Book</u>	(s)					
1.	Suresh	n Kumar Mukhiya, Usma	n Ahmed, "Hand	ds-On Ex	ploratory Data Analysis with		
	Python	" 1 st Edition, 2020, Packt	Publishing.				
2.	Martine	ez, W,Martinez A & J.L.	Solka: Explorat	ory Data	Analysis with MATLAB, CRC		
	Press,	A Chapman & Hall Book,	3 rd Edition, 2017		•		
Re	ference	Books					
1.	Michae	el Jambu, "Exploratory and	d multivariate data	a analysis	s", 1991, 1 st Edition,		
	Acade	mic Press Inc.					
2.	Charu	C. Aggarwal, "Data Mining	The Text book".	2015, Sp	oringer.		
3.	Craig k	K. Enders, "Applied Missin	g Data Analysis"	2010, 1 ^s	^t Edition, The Guilford Press.		
Мо	Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project						
	÷ ,						
Re	Recommended by Board of Studies 12-05-2022						
Apı	Approved by Academic Council No. 66 Date 16-06-2022						

Course code	Course Title		L	Т	Р	С	
BCSE331P	Exploratory Data Analysis Lab		0	0	2	1	
Pre-requisite	NIL	Sy	llab	us '	vers	ion	
				1.0			
Course Objective	es						
1. Emphasiz	e the importance of programming in EDA.						
2. Familiarize	e the student with R programming for various tasks.						
3. Explore data structures and file processing facilities in R language.							
Course Outcomes							

At the end of the course, the student will be able to

- 1. Engrave simple R programs.
- 2. Debug and execute R programs using R studio.
- 3. Implement several algorithms in R language.

Ind						
1.	1. Data transformation and pre-processing. Write R programs to read data from keyboard and transform it to various ranges like [-3,+3], [-1,+1], [0,1] etc.					
2.	Write R programs to read data from keyboard or text files and compute summary measures like arithmetic mean, median, mode, variance and standard deviation. Also read a set of X,Y values and find covariance and correlation, use statistical techniques to identify outlier data	6 hours				
3.	Estimation of missing data, global methods, class based methods, multiple imputation methods etc	6 hours				
4	Exploratory Data Analysis for Structured Data	4 hours				
4.	Write R programs to implement the k-means clustering algorithm by reading the data and user-specified value of k. Display the characteristics of the clusters found by the algorithm.	6 hours				
5.	Write R programs for nearest neighbour algorithms for classification	4 hours				
	Total Laboratory Hours					
Мо	thers					
Recommended by Board of Studies 12-05-2022						
App	proved by Academic Council No. 66 Date 16-06-2022					

Course Outcomes At the end of this course, stud 1. Understand the meth differentiate the learnin 2. Identify and apply suita 3. Design and develop cu 4. Design of test procedu 5. To understand the nee Module:1 Introduction to not the need of test procedu 5. To understand the need of test procedu 5. To understand the need of test procedu 6. To understand the need of test procedu 7. To understand the need of test procedu 8. Design of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the meth of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the meth of test procedu 9. To understand the meth of test procedu 9. To understand the meth of test procedu 9. To understand the meth of test procedu 9. To understand the meth of test procedu 9. To understand the meth of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand the need of test procedu 9. To understand develop cu 9. To understand	Course Title	L	T P	С
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Function approximation - Class Shallow neural networks — Act Deep Neural Networks — Forw Module:2 Improving deep Mini-batch Gradient Descent Momentum — RMSProp an Normalization — Softmax Regional Data Augmentation - Under-fit Module:3 Convolution neuron Foundations of Convolution neuron Foundations of Convolution Network — Deep others. Module:4 Recurrent networks — Recurrent Neural Networks — Representations from Transform Representations from Transform Module:5 Recursive neural Long-Term Dependencies — Gated RNNs — Optimization form Module:6 Advanced Neural Transfer Learning — Transfer Learning — Transfer Learning — Transfer Learning — Region based CNN Module:7 Deep reinforcem Deep Reinforcement Learning Advantage Actor Critic (A2C) based Reinforcement Learning	ctions in Neural networks – Activation function			
Shallow neural networks — Ac Deep Neural Networks — Forw Module:2 Improving deep Mini-batch Gradient Descent Momentum — RMSProp an Normalization — Softmax Reg Data Augmentation - Under-fit Module:3 Convolution neural Neural Network — Deep others. Module:4 Recurrent networks — Architectures, Deep Recurrent Neural Networks — Architectures, Deep Recurrent Representations from Transform Transform Dependencies — Gated RNNs — Optimization form Module:6 Advanced Neural Transfer Learning — Transfer Learning — Transfer Learning — Transfer Learning — Deep Reinforcement Learning Advantage Actor Critic (A2C) based Reinforcement Learning	ssification and Clustering problems - Deep			
Module:2 Improving deep Mini-batch Gradient Descent Momentum – RMSProp an Normalization – Softmax Reg Data Augmentation - Under-fit Module:3 Convolution neu Foundations of Convolutional Convolution Network – Deep others. Module:4 Recurrent netwo Recurrent Neural Networks - E Architectures, Deep Recurrent Representations from Transfo Module:5 Recursive neura Long-Term Dependencies - Gated RNNs - Optimization fo Module:6 Advanced Neura Transfer Learning – Transfer L variants – Region based CNN Module:7 Deep reinforcem Deep Reinforcement Learnin Advantage Actor Critic (A2C) based Reinforcement Learnin	ctivation Functions – Gradient Descent – Ba			
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variants – Region based CNN Module:7 Deep reinforcem Deep Reinforcement Learnin Advantage Actor Critic (A2C) based Reinforcement Learnin	earning Models – Generative Adversarial Ne	twork :		
Module:7 Deep reinforcem Deep Reinforcement Learnin Advantage Actor Critic (A2C) based Reinforcement Learnin	- Fast RCNN - You Only Look Once - Single			
Deep Reinforcement Learnin Advantage Actor Critic (A2C) based Reinforcement Learnin			5 h	
Advantage Actor Critic (A2C) based Reinforcement Learning	ng – Q-Learning – Deep Q-Learning – P	olicy		
based Reinforcement Learning	and Asynchronous Advantage Actor Critic			
		,	,	
			1 ł	noui
	Total Lecture ho	ours:	45 H	ours
Text Book(s)				

1.	Ian Goodfellow Yoshua Bengio Aaron Courville, Deep Learning, MIT Press, 2017.						
2	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, first						
	Edition, 2013.						
Ref	ference Books						
1.	N D Lewis, Deep Learning Step by	Step with Pytl	non, 2016	S.			
2.	Josh Patterson, Adam Gibson, [Deep Learning	g: A Pra	ctitioner's Approach, O'Reilly			
	Media, 2017.						
3	Umberto Michelucci, Applied Deep	Learning. A C	Case-base	ed Approach to Understanding			
	Deep Neural Networks, Apress, 20	18.		-			
4	Giancarlo Zaccone, Md. Rezau						
	TensorFlow: Explore neural networ	ks with Pythor	n, Packt P	Publisher, 2017.			
Мо	de of Evaluation: CAT / Written Assi	gnment / Quiz	/ FAT				
	Recommended by Board of Studies 09-05-2022						
App	proved by Academic Council	No. 66	Date	16-06-2022			

Course code	Course Title		L	T	Р	С
BCSE332P Deep Learning Lab			0	0	2	1
Pre-requisite	NIL	Syllabus version				on
		1.0				

- 1. Introduce major deep neural network frameworks and issues in basic neural networks.
- 2. To solve real world applications using Deep learning.

Course Outcomes

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

- 1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
- 2. Identify and apply suitable deep learning approaches for given application.
- 3. Design and develop custom Deep-nets for human intuitive applications.
- 4. Design of test procedures to assess the efficiency of the developed model.
- **5.** Understand the need for Reinforcement learning in real time problems.

	5. Orderstand the need for Reinforcement learning in real – time problems icative Experiments) .					
1.	 Demonstration and implementation of Shallow architecture, using Python, Tensorflow and Keras. Google Colaboratory - Cloning GitHub repository, Upload Data, Importing Kaggle's dataset, Basic File operations Implementing Perceptron, Digit Classification : Neural network to classify MNIST dataset 						
2.	Hyper parameter tuning and regularization practice - • Multilayer Perceptron (BPN) • Mini-batch gradient descent,	4 hours					
3.	Convolution Neural Network application using Tensorflow and Keras,	4 hours					
4.	Object detection using Transfer Learning of CNN architectures	2 hours					
5.	Image denoising (Fashion dataset) using Auto Encoders • Handling Color Image in Neural Network aka Stacked Auto Encoders (Denoising)	2 hours					
6.	Text processing, Language Modeling using RNN	2 hours					
7.	Transfer Learning models for classification problems	2 hours					
8.	Sentiment Analysis using LSTM	2 hours					
9.	Image generation using GAN	2 hours					
Mod	Total Laboratory Hours de of Evaluation: CAT / Mid-Term Lab/ FAT	30 hours					
Red	commended by Board of Studies 09-05-2022						
App	proved by Academic Council No. 66 Date 16-06-2022						

Course code Course Title		L	Т	Р	С	
BCSE333L Statistical Inference		2	0	0	2	
Pre-requisite	NIL	Syl		us	vers	ion
		1.0				

- 1. To study statistical methods for hypotheses testing and solving inference problems.
- 2. To interpret the results in a way that draws evidence-based and well-informed decisions from data.
- **3.** To derive conclusions from data and analyze its implications.

Course Outcomes

At the end of the course, the student will be able to

- 1. Understand the notion of a parametric model, point estimation of the parameters and properties of a good estimator.
- 2. Learn the concept of interval estimation and confidence intervals.
- 3. Understand and perform large-sample tests of hypotheses.
- 4. Discuss nonparametric tests of hypotheses.
- 5. Translate and correlate the statistical analysis into Statistical inference

Module:1 Introduction to Estimator

4 hours

Population, sample, parameter and statistic- Estimator, Estimate-characteristics of a good estimator — Unbiasedness- Consistency-Invariance property of Consistent estimator-Sufficient condition for consistency- Sufficiency- Factorization Theorem- Minimal sufficiency-Efficiency- Applications of Lehmann-Scheffe's theorem, Rao - Blackwell Theorem and applications. Bayesian Estimation.

Module:2 | Point Estimation

5 hours

Methods of point estimation- Maximum likelihood method (the asymptotic properties of ML estimators are not included), Large sample properties of ML estimator (without proof)-applications of MLE, Method of Minimum variance, method of moments, method of least squares, method of minimum chi-square.

Module:3 Interval Estimation

3 hours

Confidence limits and confidence coefficient; Duality between acceptance region of a test and a confidence interval; Construction of confidence intervals for population proportion (small and large samples) and between two population proportions(large samples); Confidence intervals for mean and variance of a normal population; Difference between the mean and ratio of two normal populations.

Module:4 | Testing of hypotheses

4 hours

Types of errors, power of a test, most powerful tests; Neyman-Pearson Fundamental Lemmaand its applications; Notion of Uniformly most powerful tests; Likelihood Ratio tests: Description and property of LR tests - Application to standard distributions.

Module:5 | Large sample tests

4 hours

Large sample properties; Tests of significance (under normality assumption)- Test for a single population mean, proportion; Test for equality of two means, proportions; Test for variance, Test for correlation and Test for Regression.

Module:6 | Small sample tests

4 hours

Student's t-test, test for a population mean, equality of two population means, paired t-test, F-test for equality of two population variances; Chi-square test for goodness of fit, independence of attributes.

Module:7 Non-parametric tests

4 hours

Sign test, Wilcoxon Signed rank test, Median test, Wilcoxon-Mann-Whitney test, Run test and One sample Kolmogorov Smirnov test, Kruskal Wallis-H-test: Description, properties and applications.

Мо	dule:8	Contemporary Issues	2 hours				
		Total hours	30 hours				
Tex	t Book	i(s)					
1.		t V Hogg, Elliot A Tannis and Dale L.Zimmerman, Probability ance, 9 th Edition, Pearson publishers, 2015.	and Statistical				
2.	,	Kumar Srivastava and Namita Srivastava, Statistical Inferenceses, Prentice Hall of India, Kindle Edition, 2014.	ce Testing of				
Re	ference	Books					
1.	Marc 9 2018.	S. Paolella, Fundamental statistical inference: A computational a	approach, Wiley,				
2.	B. K. K	Kale and K. Muralidharan, Parametric Inference, Narosa Publishin	g House, 2016.				
3.	•	I and Miller, M, John E. Freund's Mathematical statistics won Education, 2002.	rith Applications,				
4.	, , , , , , , , , , , , , , , , , , ,						
Мо	Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar						
Re	Recommended by Board of Studies 12-05-2022						
App	oroved b	by Academic Council No. 66 Date 16-06-2022					

Course code	Course Title		L	Т	Р	С
BCSE333P	Statistical Inference Lab		0	0	2	1
Pre-requisite	Pre-requisite NIL Sy		llab	us	vers	ion
				1.0		

- 1. To study statistical methods for hypotheses testing and solving inference problems.
- 2. To interpret the results in a way that draws evidence-based and well-informed decisions from data.
- 3. To derive conclusions from data and analyze its implications.

Course Outcomes

At the end of the course, the student will be able to

- 1. Understand the notion of a parametric model, point estimation of the parameters and properties of a good estimator.
- 2. Conquer the concept of interval estimation and confidence intervals.
- 3. Analyze and perform large-sample tests of hypotheses.
- 4. Discuss nonparametric tests of hypotheses.
- 5. Translate and correlate the statistical analysis into Statistical inference

Indi	Indicative Experiments					
1 Methods of Estimation – MLE and Method of Moments					2 hours	
2	Estimation of Confidence interv	als			4 hours	
3	<i>P</i> - value and Power of the test				2 hours	
4	Large Sample Tests- Test for P	opulation mean	& Populati	on	4 hours	
	proportions					
5 Small Sample Tests – t – test for population mean, Paired t-test			t-test	4 hours		
6 F- test for population variances					2 hour	
7 Chi-square test for goodness of fit and test for attributes					4 hours	
8	Test for correlation and test for	regression			6 hours	
9	Non-parametric tests				4 hours	
		To	tal Labor	atory Hours	30 hours	
Mode of assessment: Continuous assessment / FAT / Oral examination and others						
Rec	Recommended by Board of Studies 12-05-2022					
Approved by Academic Council No. 66 Date 16-06-2022						
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Course Code	Course Title		L	Т	Р	С
BCSE334L	Predictive Analytics		3	0	0	3
Pre-requisite	puisite NIL Syll		abı	IS V	ersi	ion
				1.0		

- 1. Learn the fundamental principles of analytics for business and learn how to Visualize and explore data to better understand relationships among variables.
- **2.** To understand the techniques of modeling and examine how predictive analytics can be used in decision making.
- **3.** Apply predictive models to generate predictions for new data.

Expected Course Outcome

Upon completion of the course the student will be able to

- 1. Understand the importance of predictive analytics and processing of data for analysis.
- 2. Describe different types of predictive models.
- 3. Apply regression and classification model on applications for decision making and evaluate the performance.
- 4. Analyze the impact of class imbalance on performance measure for model predictions and models that can mitigate the issue during training.
- 5. Define and apply time series forecasting models in a variety of business contexts.

Module:1 | Introduction to Analytics 5 hours Introduction to predictive analytics - Business analytics: types, applications- Models: predictive models - descriptive models - decision models - applications - analytical techniques. Module:2 Data Pre-processing and Model Tuning 6 hours Data transformations: Individual predictors, Multiple predictors, Dealing with missing values, Removing. Adding, Binning Predictors, Computing, Model Tuning, Data Splitting, Resampling. Module:3 | Predictive Modeling 6 hours Propensity models, cluster models, collaborative filtering, applications and fundamental limitations. Statistical Modeling- Formal Definition, Model Comparison, Classification. Module:4 | Comparison of Regression Models 7 hours

Module:4 | Comparison of Regression Models | 7 hours Measuring Performance in Regression Models - Linear Regression and Its Cousins - NonLinear Regression Models - Regression Trees and Rule-Based Models Case Study: Compressive Strength of Concrete Mixtures. Module:5 | Comparison of Classification Models | 7 hours

Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models - Classification Trees and Rule-Based Models - Model Evaluation Techniques.

Module:6 Remedies for Severe Class Imbalance	6 hours
The Effect of Class Imbalance - Model Tuning - Alte	ernate Cutoffs - Adjusting Prior
Probabilities - Unequal Case Weights - Sampling Met	hods - Cost-Sensitive Training.
Measuring Predictor Importance - Factors that can affect N	Model Performance.
Module:7 Time Series Analysis	6 hours

Methods for time series analyses – Analysis: Motivation – Exploratory analysis – Prediction and forecasting – Classification – Regression analysis – Signal estimation – Segmentation. Models – Autoregressive model - Partial autocorrelation function.

Module:8	Contemporary Issues	2 hours
	-	
	Total Lecture Hours:	45 hours

Text Book(s) Kuhn, Max, and Kjell Johnson. Applied Predictive Modeling, 3rd Edition, Springer, 2019. Jeffrey Strickland, Predictive analytics using R, Simulation educators, Colorado Springs, 2015. Reference Books Anasse Bari, Mohamed Chaouchi, Tommy Jung, Predictive Analytics for dummies, 2nd edition Wiley, 2016. Daniel T.Larose and Chantal D.Larose, Data Mining and Predictive Analytics, 2nd edition Wiley, 2015. Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Widde of Evaluation: CAT / Assignment / Quiz / FAT / Froject / Seminal						
Recommended by Board of Studies	12-05-2022			,		
Approved by Academic Council	No. 66	Date	16-06-2022			

Course code Course Title			L	T	Р	С
BCSE335L Healthcare Data Analytics		3	0	0	3	
Pre-requisite NIL Sy		Syl	lab	us '	vers	ion
				1.0		

- 1. Describe how data-based healthcare can help in improving outcomes for patient health.
- 2. To design data models that combine patient records from multiple sources to form a patient centric view of data.
- 3. To use data analytics to find health concerns and solutions to the problem faced by a patient.
- 4. To find meaningful patterns and trends in healthcare data to help the overall population.

Course Outcomes

At the end of the course, the student will be able to

- 1. Explain the concepts of Healthcare Data Analytics and healthcare foundations.
- 2. Apply machine learning techniques on healthcare data analytics.
- 3. Measure and analyse the quality of health-care systems.
- 4. Develop models for effective predictions in healthcare applications.
- 5. Use modern day emerging technologies in healthcare data analytics process.

Module:1Introduction to Healthcare Data Analytics3 hoursIntroduction - Need for Healthcare Analytics - Foundations of Healthcare Analytics - Examples of Healthcare Analytics.

Module:2 | **Healthcare Foundations**

5 hours

Healthcare delivery - Healthcare financing - Healthcare policy - Handling Patient data: the journey from patient to computer - Standardized clinical codesets - Breaking down healthcare analytics: population, medical task, data format, disease.

Module:3 | Machine Learning Foundations for Healthcare

8 hours

Model frameworks for medical decision making: Tree-like reasoning, Probabilistic reasoning and Bayes theorem, Criterion tables and the weighted sum approach, Pattern association and neural networks - Machine learning pipeline: Loading the data, Cleaning and preprocessing the data, Exploring and visualizing the data, Selecting features, Training the model parameters, Evaluating model performance.

Module:4 | Measuring Healthcare Quality

8 hours

Introduction to healthcare measures, Medicare value-based programs: The Hospital Value-Based Purchasing (HVBP) program, The Hospital Readmission Reduction (HRR) program, The Hospital-Acquired Conditions (HAC) program, The End-Stage Renal Disease (ESRD) quality incentive program, The Skilled Nursing Facility Value-Based Program (SNFVBP), The Home Health Value-Based Program (HHVBP), The Merit-Based Incentive Payment System (MIPS).

Module:5 | Making Predictive Models in Healthcare

8 hours

Introduction to Predictive Analytics – Obtaining and Importing the NHAMCS Dataset – Making the Response Variable - Splitting the Data into Train and Test Sets - Preprocessing the Predictor Variables – Building the Models – Using the Models to Make Predictions – Improving our Models.

Module:6 | Healthcare Analytics Applications

6 hours

Introduction - Descriptive Analytics Applications - Predictive Analytics Applications - Prescriptive Analytics Application.

Module:7 | Healthcare and Emerging Technologies

5 hours

Healthcare analytics and the internet - Healthcare and the Internet of Things - Healthcare

	analytics and social media - Healthcare and deep learning - Obstacles, ethical issues, and limitations.						
Мо	dule:8	Contemporary Issues				2 hours	
			Total Lecture h	ours		45 hours	
	kt Book	\ <i>\</i>					
1.		, Vikas Vik. Healthcare					
		ting using machine learnir	<u> </u>				
2.	El Mo	rr, Christo, and Hossan	n Ali-Hassan. A	nalytics i	n healthcare:	a practical	
	introdu	ction. Springer, 2019.					
Ref	ference	Books					
1.		Ivo D. "Data Science and doi. org/10 1007 (2018): 9		alytics." S	pringer, Ann A	rbor, MI, USA	
2.	Yang,	Hui, and Eva K. Lee, e	ds. Healthcare	analytics:	from data to	knowledge to	
	_	care improvement. John W		-		· ·	
	,						
Mo	de of Ev	aluation: CAT / written as	signment / Quiz /	FAT / Pro	oject / Seminar	/ group	
disc	discussion						
Red	Recommended by Board of Studies 12-05-2022						
App	proved b	y Academic Council	No. 66	Date	16-06-2022		

Course code	Course Title		L	Т	Р	С
BCSE336L	Financial Data Analytic	s	2	0	0	2
Pre-requisite	NIL	,	Syllab	us v	ers	ion
				1.	0	
Course Objecti						
	to model financial time series using liner AF					
	and analyze to test and model heterosceda	astic effects usin	g ARC	CH/		
	type time series.					
	how to test for unit root and construct ARM	A models.				
Course Outcon						
	course, the student will be able to					
Approach and analyze any financial data.						
	ate between various time series models.					
	cross-validation of various financial models	developed.				
4. Forecast	future observations on financial data.					
Modulaid Fire	annial data and their properties	1			b -	
	ancial data and their properties	/ [vaman]== =::	ا الم		ho	
	- Bond Yields and Prices – Implied Volatility Multivariate returns.	y – ⊏xampies ar	iu visu	ıalıZâ	auor	ı OT
	ear models for financial time series			1	ho	
	ear models for imancial time series essive models – Simple moving average r	nadala Simpla	ADM		ho	
	ationarity – Exponential smoothing.	nodels – Simple	: AKIVI/	A IIIC	Juei	5 –
	isonal and Long memory models				ho	urc
	s – Regression models with time series erro	ore Long mom	ory mo			uis
	set Volatility and Volatility models	ors – Long mem	ory mic		ho	urc
	of Volatility – Structure of a model – Testing	I for ADCH Effo	ot A			
	el – GARCH-M Model – Exponential Ga					
	stic volatility model – alternative approaches		1163110	iu C	י וייינ	CH
	olications of Volatility Models	5. 			ho	ure
	Term structure – Option pricing and hedge	l ring – Time Vai	wing C			
	imum Variance Portfolios – Prediction.	ging – Time vai	ying C	JUITE	riau	JI 13
	h Frequency Financial Data			1	ho	ure
	s trading – Bid ask spread of trading pric	l es – Empirical	charac			
	odels for price changes.	es – Lilipilicai	Cilaia	J.C.III	Stics	, 01
Module:7 Value				4	ho	ure
	nd Coherence – Risk metrics –Extreme valu	ıe annroach to \	/alue a			
Peak over thres		ao approach to t	dido c	10 1 (10	J1 (
	Itemporary Issues			2	ho	urs
		I				
	Total Lecture hours:			30	ho	urs
Text Book(s)) () (D) () ()	004	^		
	ay An Introduction to Analysis of Financial D	Data with R, Wile	ey, 201	3.		
Reference Boo		0	\	. 0-		
	Financial Time Series, by Ruey S. Tsa	ay, 3rd edition,	vviiey	/ Se	ries	ın
	and Statistics, 2010.	Dractice Manuel	- ما ا	. D	204	0
	Foote, Financial Engineering Analytics: A I					
	nalysis of Time-Series Data in SPlus, by Re	en e Carmona, S	pringe	∍r, IVI	iarci	1
4, 2004.	ion: CAT / written againment / Ovie / CAT	/ Draigat / Carain	or			
	ion: CAT / written assignment / Quiz / FAT	/ Project / Semir	ıaı			

Date

16-06-2022

No. 66

Recommended by Board of Studies | 12-05-2022

Approved by Academic Council

Course code Course Title			L	T	Р	С
BCSE336P Financial Data Analytics Lab			0	0	2	1
Pre-requisite	NIL	Sy	llab	us	vers	ion
				1.0		

- 1. Learn how to model financial time series using liner ARMA type time series.
- 2. Study how to test and model heteroscedastic effects using ARCH / GARCH type time series.
- 3. Acquire how to test for unit root and construct ARMA models.

Course Outcome

At the end of the course, the student will be able to

- 1. Approach and analyze any financial data.
- 2. Differentiate between various time series models.
- 3. Perform cross-validation of various financial models developed.
- 4. Forecast future observations on financial data.

Ind	icative Experiments				
1.	Given a simple daily return of a concern as data, implement and	8 hours			
	execute a R program to compute the sample mean, standard deviation,				
	skewness, excess kurtosis, minimum and maximum of each simple				
	return series.				
2.	Consider the daily range (daily high–daily low) of Apple stock from	8 hours			
	January 2, 2007 to December 23, 2011. One can obtain the data by the				
	package quantmod from Yahoo. Compute the first 100 lags of ACF of				
	the series. Is there evidence of long-range dependence? Why? If the				
	range series has long memory, build an ARMA model for the data.				
3.	Consider the 30-year conventional mortgage rates from April	8 hours			
	1971 to November 2011. Build a pure time series model for the monthly				
	mortgage rate. Perform model checking and find the fitted model.				
4.	Use the quantmod package to obtain the daily prices of Apple stock	6 hours			
	from				
	January 2, 2007, to November 30, 2011.				
	Use an ARMA–GARCH model to obtain the daily volatility of the stock.				
	Compare the three volatility series.				
	Total Laboratory Hours				
	Mode of assessment: Continuous assessment / FAT / Oral examination and others				
	Recommended by Board of Studies 12-05-2022				
App	proved by Academic Council No. 66 Date 16-06-2022				

BCSE310L	IoT Architectures and Protocols		L	T P	
Due ne malelte	Alli	0		0 0	
Pre-requisite	NIL	Sylia	<u>abus</u> 1.	vers	ion
Course Objectiv	ine.		1.	<u>J</u>	
•	rt knowledge on the infrastructure, sensor technolog	ies ar	nd ne	-tworl	kina
	gies of Internet of Things.	ics ai	id IIC	,twoii	wig
	ze, design and develop solutions for Internet of Things.				
	re the real-life aspects of Internet of Things.				
Course Outcom					
At the end of this	course, student will be able to:				
 Identify t 	he hardware and software components, challenges of Ir	nternet	t of T	hings	; .
2. Assess of	different Internet of Things technologies and their applica	ations.			
	pasic circuits using sensors interfacing, data conversion	proce	ess a	nd sh	iield
	to interface with the real world.				
	d demonstrate the project successfully by sensor red	quirem	ents	, cod	ing,
emulatin	g and testing.				
Module:1 IoT F				5 ho	
	paracteristics of Internet of Things (IoT) - Challenges and	ı issue	es - F	'nysic	aı
Design of for - Lo	ogical Design of IoT - IoT Functional Blocks.				
Module:2 IoT (Communication Architectures and Protocols			7 ho	ure
	communication modules – Bluetooth – Zigbee – WiFi – (GPS -	IoT I		
	RPL, CoAP) – MQTT - Wired Communication - Power			1010	5013
(11 10, 02011) 141	, ru z, coru) ingri vinca cemmameatem rever	- Court	 		
Module:3 Tech	nologies Behind IoT			5 ho	urs
	oT paradigm: RFID, Wireless Sensor Networks, Supe	rvisory	/ Coi	ntrol	and
	(SCADA) - M2M - IoT Enabling Technologies: BigDa				
Computing, Emb	edded Systems.				
	ramming the Microcontroller for IoT			5 ho	
	es of sensors – IoT deployment for Raspberry Pi				
platform – Readi	ng from Sensors, Communication: Connecting microco	ntrolle	er Wit	n mo	bile
devices - Commu	unication through Bluetooth - WiFi and USB - Contiki OS	, - Coo	ija Si	mulai	or.
Modulo:5 Posc	ource Management in IoT			5 ho	ure
	ork Configuration Protocol, Open vSwitch Database Mar		ent [
	ocols: Collection Tree, LOADng.	agem	iciit i	10100	- 100
Trouting and Frot	oools. Collection free, Loribing.				
Module:6 loT to	o Web of Things			9 ho	urs
	Things (WoT) – IoT Data Management: Set up cloud	enviro	nme		
	sors, Ďata Analytics Platforms for IOT- Resource Identi				
Maturity Model -					
<u>-</u>					
Module:7 Appl	ications of IoT			7 ho	urs
	for IoT - Green energy buildings and infrastructure - Sn	nart fa	rmin	g - Sr	nart
retailing and Sma	art fleet management				
.					
	•			A I	

Total Lecture hours:

Module:8 Contemporary Issues

2 hours

Text Book(s)

1. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 2019, 1st Edition, Wiley Publications, USA.

Reference Books

- Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A Hands-on Approach, 2014,1st Edition, Universities press, India.
 - Vlasios Tsiatsis, Jan Holler, Catherine Mulligan, Stamatis Karnourskos and David
- 2. Boyle. Internet of Things: Technologies and Applications for a New Age of Intelligence, 2018, 2nd Edition, Academic Press, USA.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT, Project							
Recommended by Board of Studies	04-03-2022						
Approved by Academic Council No. 65 Date 17-03-2022							

BCSE311L	Sensors and Actuator Devices		L	T	Р	С
			2	0	0	2
Pre-requisite	NIL	Syl	labι	IS V	ersi	on
				1.0		

- 1. To create a conceptual understanding of the basic principles of sensors, actuators, and their operations
- 2. To analyze the real-world problems and provide solutions using sensors and actuators
- 3. To promote awareness regarding recent developments in the fields of sensors and actuators

Course Outcomes

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

- 1. Classify different Sensors & Actuators based on various physical phenomena and differentiate their performance characteristics
- 2. Analyze the working principles of thermal, optical & electric sensors and actuators to interpret their mathematical model
- 3. Interpret the functional principles of magnetic, thermal & Chemical sensors and actuators to interpret their mathematical model
- 4. Select the relevant sensors and actuators to design real-time data acquisition from ambience via case studies

Module:1 Overview of Sensors and Actuators

4 hours

The five senses: vision, hearing, smell, taste, and touch – Definitions: Sensors & Actuators – Overview of Sensor and Actuator classifications – Performance characteristics of Sensors & Actuators: Transfer Function, Range, Span, Input and Output Full Scale, Resolution, and Dynamic Range - Calibration & Reliability

Module:2 | Temperature Sensors and Thermal Actuators

3 hours

Thermoresistive sensors: Thermistors, Resistance temperature, and silicon resistive sensors – Thermoelectric sensors – Other Temperature sensors: Optical and Acoustical – Thermomechanical Sensors and Actuators – Case study: Breath analyzer using temperature

Module:3 Optical Sensors and Actuators

4 hours

Principles of Optics: Optical units – Quantum effects – Quantum-based Optical sensors – Photoelectric sensors – Charge coupled device (CCD) based – Thermal-based Optical sensors – Active infrared (AFIR) sensors – Optical Actuators – Case study: Liquid Level Indicator using Optical Sensors

Module:4 | Electric and Magnetic Sensors and Actuators

4 hours

Principles of Electric and Magnetic fields: Basic units – The Electric field: Capacitive Sensors & Actuators – Magnetic sensors and actuators – Magnetoresistance – Magnetostrictive Sensors and Actuators – Magnetometers – Magnetic actuators: Voice Coil Actuators, Motors as Actuators & Magnetic Solenoid Actuators and Magnetic Valves – Case Study: Speed sensing and odometer in a car using smart sensors

Module:5 | Mechanical Sensors and Actuators

5 hours

Definitions and units – Force Sensors: Strain Gauges, Semiconductor Strain Gauges & Tactile Sensors – Accelerometers: Capacitive Accelerometers, Strain Gauge Accelerometers & Magnetic Accelerometers – Pressure Sensors: Mechanical, Piezoresistive, Capacitive & Magnetic – Velocity sensing – Inertial sensors and actuators: Mechanical or Rotor & Optical Gyroscopes – Case study: Tire-pressure monitoring system using smart sensors

Module:6 Acoustic Sensors and Actuators

Definitions and units – Elastic waves and their properties – Microphones: Carbon, Magnetic, Ribbon and Capacitive Microphones – Piezoelectric effect – Piezoelectric Sensors – Acoustic Actuators: Loudspeakers, Headphones and Buzzers - Magnetic and Piezoelectric – Ultrasonic sensors and actuators – Case Study: Ultrasonic parking system

Module:7 Chemical Sensors and Actuators

5 hours

Chemical units and Definitions – Electrochemical sensors: Metal Oxide Sensors and Solid Electrolyte Sensors – Potentiometric smart sensors: Glass Membranes, Soluble Inorganic Salt Membrane and Polymer - Immobilized Ionophore Membranes sensors – Thermochemical, Optical, Mass humidity gas sensors – Chemical Actuators: The Catalytic Converter - The Airbag System using smart sensors – Case study: Water quality monitoring system

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sys	tem										
Мо	dule:8	Contemporary Issues				2 hours					
				Total	Lecture hours:	30 Hours					
Tex	Text Book(s)										
1.		n Ida, "Sensors, Actuato action", 2020, 2 nd Edition, IET			es - A Multidi	sciplinary					
Re	ference	Books									
1.		Fraden, "Handbook of Mo 5 th Edition, Springer, Switzer		Physics,	Designs, and A	pplications",					
2.	2. Subhas Chandra Mukhopadhyay, Octavian Adrian Postolache, Krishanthi P. Jayasundera, Akshya K. Swain, "Sensors for Everyday Life Environmental and Food Engineering", 2017, Volume 23, Springer, Switzerland.										
Мо	Mode of Evaluation: CAT / Written Assignment / Quiz / FAT										
Re	commer	nded by Board of Studies	04-03-2022								
App	proved b	y Academic Council	No. 65	Date	17-03-2022						

Pre-requisite NIL Syllabus version I. T P C Pre-requisite NIL Syllabus version I. II. Pre-requisite NIL Syllabus version I. II. III. II.					_				
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9. Demonstrate a simple parking system using ultrasonic sensors Total Laboratory Hours 30 hours Text Book(s) 1. Volker Ziemann, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", 2018, 1st Edition, CRC Press, United States. Reference Books 1. Inamuddin, Rajender Boddula, Abdullah M. Asiri, "Actuators and Their Applications: Fundamentals, Principles, Materials, and Emerging Technologies", 2020, 1st Edition, Wiley-Scrivener, United States. 2. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1st Edition, William Andrew Inc, United States.		parameters us	sing polymer-based sensors						
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 Text Book(s) Volker Ziemann, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", 2018, 1st Edition, CRC Press, United States. Reference Books Inamuddin, Rajender Boddula, Abdullah M. Asiri, "Actuators and Their Applications: Fundamentals, Principles, Materials, and Emerging Technologies", 2020, 1st Edition, Wiley-Scrivener, United States. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1st Edition, William Andrew Inc, United States. 	9.	Demonstrate							
 Volker Ziemann, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", 2018, 1st Edition, CRC Press, United States. Reference Books Inamuddin, Rajender Boddula, Abdullah M. Asiri, "Actuators and Their Applications: Fundamentals, Principles, Materials, and Emerging Technologies", 2020, 1st Edition, Wiley-Scrivener, United States. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1st Edition, William Andrew Inc, United States. 			Total Laboratory F	Hours	30	ho	urs		
Reference Books 1. Inamuddin, Rajender Boddula, Abdullah M. Asiri, "Actuators and Their Applications: Fundamentals, Principles, Materials, and Emerging Technologies", 2020, 1st Edition, Wiley-Scrivener, United States. 2. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1st Edition, William Andrew Inc, United States.									
 Reference Books Inamuddin, Rajender Boddula, Abdullah M. Asiri, "Actuators and Their Applications: Fundamentals, Principles, Materials, and Emerging Technologies", 2020, 1st Edition, Wiley-Scrivener, United States. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1st Edition, William Andrew Inc, United States. 	1.			the A	rdui	no	and	t	
 Inamuddin, Rajender Boddula, Abdullah M. Asiri, "Actuators and Their Applications: Fundamentals, Principles, Materials, and Emerging Technologies", 2020, 1st Edition, Wiley-Scrivener, United States. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1st Edition, William Andrew Inc, United States. 	Dof								
Fundamentals, Principles, Materials, and Emerging Technologies", 2020, 1 st Edition, Wiley-Scrivener, United States. 2. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1 st Edition, William Andrew Inc, United States.									
Edition, Wiley-Scrivener, United States. 2. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1 st Edition, William Andrew Inc, United States.	١.								
2. Peng Zhang, "Industrial Control Technology: A Handbook for Engineers and Researchers", 2008, 1 st Edition, William Andrew Inc, United States.									
Researchers", 2008, 1 st Edition, William Andrew Inc, United States.	2.								
	Mod								

04-03-2022

Date

17-03-2022

No. 65

Recommended by Board of Studies

Approved by Academic Council

BCSE312L	Programming for IoT Boards		L	Т	Р	С
			2	0	0	2
Pre-requisite	NIL	Sy	llat	ous	ver	sion
				1.	0	

- 1. To introduce Internet of Things (IoT) environment and its technologies for designing smart systems
- 2. To explore open-source computer hardware/software platform, development and debugging environment, programming constructs and necessary libraries
- 3. To learn embedded programming constructs and real time systems

Course Outcome

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

- 1. Investigate various challenges and explore open source hardware prototyping platforms for designing IoT devices
- 2. Understand basic circuits, sensors and interfacing, data conversion process and shield libraries to interface with the real world
- 3. Program SBC by exploring protocols, data conversion process, API and expansion boards for practical IoT devices using Python
- 4. Learn embedded programming constructs and constraints in real time systems for real world socio-economic problems

Module:1 | IoT Ecosystem 3 hours Challenges and Levels of implementation - Enabling Technologies - Overview of Processing **Elements and Peripherals Module:2** Programming for Prototyping Boards Environment: Board, IDE, shields - Programming: syntax, variables, types, operators, constructs and functions - Sketch: skeleton, compile and upload, accessing pins debugging: UART communication protocol and serial library 5 hours Module:3 | Interfacing for Prototyping Boards Circuits: design, wiring, passive components - sensors and actuators: interfacing, read and write - software libraries - shields - interfacing and libraries Module:4 | Programming for Single Board 4 hours Computers Board schematic - setup - configure and use - OS implications: linux - basics, file system

and processes - shell CLI – GUI - Programming API's - RPi.GPIO - PWM library to access pins -Tkinter.

Module:5 Interfacing with Single Board Computers 5 hou

Networking - Internet Connectivity - Standard Internet Protocols - MQTT - CoAP - Networking Socket Interface - Cloud - Public APIs and SDK's for accessing cloud services - Social Network APIs - Interfacing - sensors and actuators - Pi Camera - Servo - APIs for data conversion.

Module:6 Embedded Programming and RTOS 4 hours

MCU - GPIO - WDT - timers/counters - I/O - A/D - D/A - PWM - Interrupts - Memory - serial communication UART - I2C - SPI - Peripheral Interfacing OS - basics - types - tasks - process - threads (POSIX Threads) - thread preemption - Preemptive Task Scheduling Policies - Priority Inversion - Task communication - Task Synchronization issues - racing and deadlock - binary and counting semaphores (Mutex example) - choosing RTOS

Module:7 Real World Projects

3 hours

IoT Integrated Primary Health Care - Face Detection by AI - Cloud IoT Systems for Smart Agriculture - Smart Home Gadgets - Autonomous Car Features - speed and horn intensity control

Module:8	Contemporary Issues	2 hours
	Total Lecture hours:	30 hours

Tex	Text Book(s)									
1.	. Yamanoor, Sai, and Srihari Yamanoor. Python Programming with Raspber	ry Pi,								
	2017, 1st edition, Packt Publishing Ltd,. UK	2017, 1st edition, Packt Publishing Ltd,. UK								
Ref	Reference Books									
1.	,	aspberry								
	Pi, and BeagleBone Black, 2015, 1st edition, McGraw Hill Education, India	-								
2.	2. Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Au	tomation								
	2014. Schwartz, Marco. Internet of things with arduino cookbook, 2016, 1s	edition,								
	Packt Publishing Ltd., UK									
3.	B. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 2015, 1s	t edition,								
	Packt Publishing Ltd., UK									
Мо	Mode of Evaluation: CAT / Written Assignment / Quiz / FAT									
Red	Recommended by Board of Studies 04-03-2022									
App	Approved by Academic Council No. 65 Date 17-03-2022									
<u> </u>	7									

BCSE312P	Programming for IoT Boards Lab		L	Т	Р	С
			0	0	2	1
Pre-requisite	NIL	S	yllak	ous v	ersi/	on
				1.0		

- 1.To introduce Internet of Things (IoT) environment and its technologies for designing smart systems
- 2.To explore open-source computer hardware/software platform, development and debugging environment, programming constructs and necessary libraries
- 3.To learn embedded programming constructs and real time systems

Course Outcome

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

- 1. Use open-source hardware prototyping platform and peripherals for building digital devices and interactive objects that can sense and control the physical world.
- 2. Program SBC for practical IoT devices using Python and explore protocols, data conversion process, API's and expansion boards for real world interaction.

Indicative Experiments										
1.	Introduction to IoT Development Kit and Development Environment									
2.	Internet Controlled LEDs	•								
3.	Temperature Logger									
4.	Home Automation									
5.	Soil Moisture Sensor									
6.	Light Color Control									
7.	Home Security System									
8.	Parking Sensor									
9.	Motor Control									
10.	Water Level Control									
11.	Street Light Control									
		T	otal Labo	ratory Hours	30 hours					
	Book(s)									
1.	Yamanoor, Sai, and Srihari Yan	•	rogramm	ing with Rasp	berry Pi,					
_	2017,1st edition, Packt Publishi									
2.	Donald Norris, The Internet of T									
	Pi, and BeagleBone Black, 2015	5,1st edition,McG	Fraw Hill E	ducation, US	Α.					
	rence Books									
1.	Schwartz, Marco. Home Automa									
	Source Hardware. 2013, 1st Edition, CreateSpace Independent Publishing, USA.									
2.	2. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 2015, 1st									
	edition, Packt Publishing Ltd, UK.									
Mode of Evaluation: CAT / Mid-Term Lab/ FAT										
Reco	Recommended by Board of Studies 04-03-2022									
Appr	Approved by Academic Council No. 65 Date 17-03-2022									

BCSE313L	Fundamentals of Fog and Edge Computing		L	Т	Р	С
			3	0	0	3
Pre-requisite	NIL	Sylla	abu	S V	ersi	on
				1.0		

- 1. To introduce IoT enabling technologies and its opportunities.
- 2. To review underlying technologies, limitations, and challenges along with performance metrics
 - and discuss generic conceptual framework in fog computing.
- 3. To impart the knowledge to log the sensor data and to perform further data analytics.

Course Outcome

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

- 1. Explore technologies behind the communication and management of fogs and edge resources.
- 2. Learn the techniques for storage and computation in fogs, edges, 5G and clouds.
- 3. Implement Internet of Everything (IoE) applications through fog computing architecture and use optimization techniques for the same.
- 4. Analyze the performance and issues of the applications developed using fog and edge architecture.

Module:1 Internet of Things (IoT) and New Computing Paradigms 6 Hours

Introduction - Relevant Technologies - Fog and Edge Computing Completing the Cloud - Hierarchy of Fog and Edge Computing - Business Models - Edge Computing Platforms - Opportunities and Challenges

Module:2 Challenges in Federating Edge Resources

6 Hours

Introduction - Methodology - Integrated C2F2T Literature by Modeling Technique - Integrated C2F2T Literature by Use - Case Scenarios - Integrated C2F2T Literature by Metrics - Threads - Standards

Module:3 Orchestration of Network Slices in Fog, Edge, and Clouds

6 Hours

Introduction – Background - Network Slicing - Network Slicing in Software-Defined Clouds-Network Slicing Management in Edge and Fog - Internet of Vehicles (IoV): Architecture, Protocols and Seven-layer security model architecture for Internet of Vehicles - IoV: Network Models, Challenges and future aspects

Module:4 Optimization Problems in Fog and Edge Computing

6 Hours

Preliminaries - The Case for Optimization in Fog Computing-Formal Modeling Framework for Fog Computing – Metrics - Further Quality Attributes - Optimization Opportunities along the Fog Architecture - Optimization Opportunities along the Service Life Cycle - Toward a Taxonomy of Optimization Problems in Fog Computing

Module:5 | Middleware for Fog and Edge Computing

6 Hours

Need for Fog and Edge Computing Middleware - Design Goals-State-of-the-Art Middleware Infrastructures - System Model - Case Study.

Module:6 | Technologies in Fog Computing

7 Hours

Fog Data Management - Smart Building - Predictive Analysis with FogTorch - Machine Learning in Fog Computing - Data Analytics in the Fog - Data Analytics in the Fog Architecture.

Module:7 | Applications of Fog and Edge Computing

6 Hours

Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real - Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications - Testing Perspectives of Fog - Based IoT Applications - Legal Aspects of Operating IoT Applications in the Fog

Мо	dule:8	Contemporary Issues			2 Hours						
		Tota	al Lecture ho	ıırs:	45 Hours						
			ui 200tai 0 110	u. o.	40 110010						
Tex	Text Book(s)										
1.	Buyya,	Rajkumar, and Satish I	Narayana Sri	rama, F	og and Edge computing:						
	Princip	les and Paradigms, 2019, 1	st edition, Joh	n Wiley 8	Sons, USA.						
Re	ference	Books									
1.	Bahga	, Arshdeep, and Vijay Madis	setti, Cloud co	omputing	: A hands-on approach, 2014,						
	2 nd edit	ion, CreateSpace Independe	ent Publishing	Platform	, USA.						
2	Ovidiu'	Vermesan, Peter Friess, "Int	ernet of Thing	s –From	Research and Innovation to						
	Market	Deployment", 2014, 1st edit	tion, River Pub	olishers, I	India.						
Мо	Mode of Evaluation: CAT / Digital Assignments/ Quiz / FAT										
Re	commer	nded by Board of Studies	04-03-2022								
Apı	Approved by Academic Council No. 65 Date 17-03-2022										

BCSE314L	Privacy and Security in IoT		L	Т	Р	С
			3	0	0	3
Pre-requisite	NIL	Syl	lat	ous	ver	sion
				1.	0	

- 1. To impart knowledge on the state-of-the-art methodologies and Security in Internet of Things (IoT).
- 2. To understand the Privacy Preservation and Trust Models in Internet of Things (IoT).
- 3. To study the Internet of Things (IoT) Security protocols and Security framework.

Course Outcome

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

- 1. Identify different Internet of Things technologies and their applications.
- 2. Assess the need for Privacy and security model for the Internet of Things.
- 3. Explore various Trust Model for IoT and customize real time data for IoT applications.
- 4. Design security framework and solve IoT security issues.

Module:1 | Security in IoT

3 hours

IoT security: Vulnerabilities, Attacks and Countermeasures - Security Engineering for IoT development - IoT security lifecycle.

Module:2Network Robustness and Malware Propagation Control in IoT5 hoursNetwork Robustness - Fusion Based Defense Scheme - Sequential Defense Scheme - Location Certificate Based Scheme - Sybil node detection scheme - Formal Modeling and

Location Certificate Based Scheme - Sybil node detection scheme - Formal Modeling and Verification -Sybil Attack Detection in Vehicular Networks - Performance evaluation of various Malware Dynamics Models - Analysis of Attack Vectors on Smart Home Systems.

Module:3 | Blockchain Technology in IoT

7 hours

Technical Aspects - Integrated Platforms for IoT Enablement - Intersections between IoT and Distributed Ledger - Testing at scale of IoT Blockchain Applications - Access Control Framework for Security and Privacy of IoT - Blockchain Applications in Healthcare.

Module:4 | Privacy Preservation in IoT

8 hours

Privacy Preservation Data Dissemination: Network Model, Threat Model - Problem formulation and definition - Baseline data dissemination - Spatial Privacy Graph based data dissemination - Experiment Validation - Smart building concept-Privacy Threats in Smart Building - Privacy Preserving Approaches in Smart Building - Smart Meter Privacy Preserving Approaches.

Module:5 | Privacy Protection in IoT

6 hours

Lightweight and Robust Schemes for Privacy Protection in IoT Applications: One Time Mask Scheme, One Time Permutation Scheme - Mobile Wireless Body Sensor Network - Participatory Sensing

Module:6 Trust Models for IoT

7 hours

Trust Model Concepts - Public Key Infrastructures Architecture Components - Public Key Certificate Formats - Design Considerations for Digital Certificates - Public Key Reference Infrastructure for the IoT - Authentication in IoT - Computational Security for IoT.

Module:7 | Security Protocols for IoT Access Networks

7 hours

Time Based Secure Key Generation -Security Access Algorithm: Unidirectional, Bidirectional Transmission - Cognitive Security - IoT Security Framework - Secure IoT Layers - Secure Communication Links in IoT - Secure Resource Management, Secure IoT Databases.

Module:8 | Contemporary Issues

				Tota	al Lecture hours:	45 hours	
Tex	Text Book(s)						
1.							
	Implen	nentations, 2016, 1st edition,	CRC Press,	USA.			
Bot	Reference Books						
Re							
1	Russell, Brian and Drew Van Duren. Practical Internet of Things Security, 2016,1st					ity, 2016,1st	
	edition	, PACKT Publishing Ltd, UK					
2	Kim, S	., Deka, G. C., & Zhang, P. (2019). Role	of blockcl	nain technology in le	οΤ	
	applica	itions. Academic Press.					
3		ouse O Security of things:				/ for internet	
	of thing	gs devices and beyond, 2014	1, 1 st edition,	NCC Gro	oup, UK.		
Мо	Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT						
Re	commer	ided by Board of Studies	04-03-2022				
App	proved b	y Academic Council	No. 65 Date 17-03-2022				

BCSE315L	Wearable Computing		L	T F	C	
				0 0		
Pre-requisite	NIL	Syl	labus		<u>sion</u>	
			1	.0		
Course Objective						
	e Wearable components and building blocks of Weara	ble Co	mput	ing.		
5. To enumerate the details of Body Sensor Networks (BSN).						
6. To Integr	ate Wearable and Cloud Computing for BSN applicatio	ns.				
Carrier Outaan						
Course Outcom						
	course, student will be able to:	oonon	to ro	auira	d fo	
	oout software, hardware tools, protocols and comp Computing.	Jonen	is re	quire	u io	
	nd basics of Body Sensor Networks (BSN) ar	nd ite	Dro	aran	nmin	
Framewo	•	iu its	110	yran	11111111	
	wledge about Cloud assisted BSN.					
	out the necessary tools required for BSN applications.					
0. <u>2</u> 00111718	out the headestary today required for Bert applications.					
Module:1 Intr	oduction to Wearable Components			5 I	hour	
	t of Things and Wearables - Wearables' Mass Mark	et Ena	ablers			
,	ce and Human Computer Relationship - A Multi Device					
	ding Blocks for Wearable Computing			7 I	hour	
	nergy (BLE) - Embedded Software Programming - Se	nsors	for W	'eara	bles	
	Notification Settings and Control, Wear Network -					
DataItem - Data	MapItem – DataMap - Google Fit API: main package -	data s	ub pa	ckaç	ge	
Module:3 Bod	y Sensor Networks			6 I	hour	
	h System Architecture - Hardware Architecture o					
	Medium - Power Consumption Considerations - Comm					
	gies - Commercial Sensor Node Platforms - Bio-phys					
	Application Domains - Developing BSN Applicat				nmin	
	equirements for BSN Frameworks - BSN Programming	Frame	ework			
	onomic and Agent-Oriented Body Sensor works			/ 1	hour	
	Programming in BSNs - SPINE framework - Tas	ak Bas	\	Λ.ı.t.o.	nomi	
	Autonomic Physical Activity Recognition - Agent-					
	nsor Networks - Mobile Agent Platform for Sun SP					
	and Implementation of BSNs - Reference Architec					
	: A CBSN Architecture	taro i	01 00	liabe	Tally	
	gration of Wearable and Cloud Computing			7 1	hour	
	Motivations and Challenges- Reference Architectur	e for	Cloud			
	BSNs - BodyCloud: A Cloud-based Platform for Community BSN Applications - Engineering					
Body Cloud Applications - SPINE Based Design Methodology						
Module:6 SPINE-Based Body Sensor Network Applications 6 hours						
Introduction - Background - Physical Activity Recognition - Step Counter - Emotion						
Recognition - Handshake Detection - Physical Rehabilitation						
Module:7 Insta				5 I	hour	
	INE1.x - Install SPINE 1.x - Use SPINE - Run a Simple	e Desl	ctop /	Appli	catio	
	- SPINE Logging Capabilities - SPINE2 - Install SPIN					
	ole Application Using SPINE2					
Module:8 Con	temporary Issues			2 I	hour	
	Total Lecture hours:			45 I	hour	

Text Book(s)

1. Fortino, Giancarlo, Raffaele Gravina, and Stefano Galzarano, Wearable computing: from modelling to implementation of wearable systems based on body sensor networks, 2018, 1st edition, John Wiley & Sons, USA

Reference Books

- Sanjay M. Mishra, Wearable Android™: Android wear & Google Fit app development, 2015, 1st edition, John Wiley & Sons, USA
- 2. Barfield, Woodrow, ed. Fundamentals of wearable computers and augmented reality, 2015. 1st edition. CRC press. USA

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Mode of Evaluation: CAT / Written Assignment / Quiz / FAT					
Recommended by Board of Studies	04-03-2022				
Approved by Academic Council	No. 65	Date	17-03-2022		

BCSE316L	Design of Smart Cities	L	T	Р	С
		3	0	0	3
Pre-requisite	NIL	Syllab		ersi	on
Course Objective			1.0		
Course Objective		, ouet	ninal	-ility	
urban plar	stand the basic concepts of smart cities and their energy	y Susia	amaı	Jility	Ш
	rining. ze the security, privacy, and ethics in smart citie	e nla	nnin	a a	no
developme		ъ ріа		y c	1110
-	n process control and project management in smart cities.				
Course Outcome					
	course, student will be able to:				
	and describe the basic concepts of smart and sustainable	cities.			
	end the knowledge of urban planning and sustainability in s		ities	5.	
	ne security issues and challenges of smart cities and their				
Incorporat	e project management, planning, and stack holders in	the o	desig	gn a	ind
	ent of smart cities.				
	e the various ICT and data analytics to connect go	vernm	ent,	urk	an
	universities, city developers, and communities.	1			
Module:1 Smar				hou	
	plexities of Smart Cities - Urban Network - Sensor Network	k - Ro	le of	Urk	ar
Networks - Trend	s in Urban Development - Community Resource Sensing.				
	BL	<u> </u>			
Module:2 Urba		_		hou	
	Databases - Principles of Urban Planning - Data Organ	าเzลแด	n - r	Kole	O
Planning in Smar	t Cities - Case Studies.				
Module:3 Ener	gy Sustainability in Smart Cities		6	hoı	ırc
	n Making - Energy as a catalyst for Sustainable Transforn	nation			
and efficiency of		idiloii	00	1100	101
,					
Module:4 Secu	irity, Privacy and Ethics in Smart Cities		6	hou	ırs
Security challeng	es in smart cities - Security threats in smart cities - le	oT rela	ated	saf	ety
measures for a sa	afer smart city.				
		1			
	rt Cities Planning and Development			hou	
	nderstanding Smart Cities - Dimensions of Smart Cities -				
	e benchmark of smart cities - Financing smart cities	s deve	elopr	nen	[-
Governance of sn	nart cities.				
Modulo:6 Dros	ess Control and Stabilization		7	hoı	
	ot - Specific applications - Structural health monitoring -	Droco			
	- Internet of Vehicle (IoV) Importance - Applications - S				
	Intelligent Transport Systems (ITS) - ITS Highway safe				
Environmental as		y por	Spoo	۷ С	
Module:7 Proje	ect Management in Smart Cities		6	hou	ırs
	project management of smart cities: web application a	nd mo	bile	bas	ed
implementation.					
Module:8 Con	temporary Issues		2	hou	ırs

Total Lecture hours:

Text Book(s)

1. Carol L. Stimmel, *Building Smart Cities Analytics, ICT, Design Thinking*, 2016, 1st edition, CRC Press, Taylor and Francis, UK

Reference Books

- 1. Andrea Vesco and Francesco Ferrero, *Handbook of research on social, economic, and environmental sustainability in the development of smart cities*, 2015, 1st edition, Information Science Reference, IGI Global, USA
- 2. La Scala, Massimo, et al., eds. From smart grids to smart cities: new challenges in optimizing energy grids. 2021, Vol. 2. John Wiley & Sons, USA
- 3. Angelakis, Vangelis, et al., eds. *Designing, developing, and facilitating smart cities:* urban design to IoT solutions. 2016, Springer, USA

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar					
Recommended by Board of Studies	04-03-2022				
Approved by Academic Council	No. 65	Date	17-03-2022		

BCSE317L	INFORMATION SECURITY		L	T	Р	C
			3	0	0	3
Pre-requisite		Syllabus vers		sior	<u>1</u>	
			1.0	<u> </u>		
Course Objectiv	/es					
1. To learn vario	us threats and attacks in a network.					
2. To understand	and explore fundamental techniques in developing s	ecure ap	plica	atior	ıs.	
3. To learn vario	us methodologies for securing information systems	ranging f	rom	оре	erati	ing
systems to database management systems and to applications.						
Course Outcomes						
After completion of this course, the student shall be able to:						

- 1. Apply fundamental knowledge on key security concepts, access control and authentication.
- 2. Comprehend the use of security techniques for securing the information.
- 3. Apply various data privacy policies in different areas of web based security systems.
- 4. Differentiate the needs and application of security in Operating System and Firewalls.
- 5. Analyze various method of securing databases.

Module:1	Information Security Concepts	4 hours
Information	n Security - Computer Security - Threats - Ha	arm - Vulnerabilities - Program
Security -	Malicious code - Malwares: Viruses, Trojan	Horses and Worms - Counter
measures.		
Module:2	Authentication and Access Control	6 hours
Authentica	tion - Key management schemes - Hierarchical	Key Management Techniques -
Security St	andards - User Authentication Protocols - Implem	enting Access Controls - Access
Control Ma	odale Pola Racad Access Control Attributa B	and Assess Control Attribute

Security Standards - User Authentication Protocols - Implementing Access Controls - Access Control Models - Role Based Access Control - Attribute Based Access Control - Attribute based Encryption in Information Storage - Physical Access Controls.

Modulo: 2 | Operating Systems Security | 7 hours

Module:3Operating Systems Security7 hoursSecurity in Operating System - Security in the design of OS: Simplified Design, LayeredDesign, Kernelized design, Reference Monitor, Trusted Systems, Trusted SystemsFunctions - Trusted Operating System Design - Rootkit.

Module:4 | Security Countermeasures

7 hours

Design of Firewalls - Types - Personal Firewalls - Configurations - Network Address Translation - Data Loss Prevention - Intrusion Detection and Prevention Systems: Types of IDSs, Intrusion Prevention system, Intrusion Response, Goals of IDSs, Strength and Limitations.

Module:5 Database Security

6 hours

Database Security - Database Security Requirements - Reliability and Integrity - Sensitive Data - Types of Disclosures - Preventing Disclosures - Inference - Multilevel Databases - Multilevel Security - Database Attacks - SQL Injection Attacks.

Module:6 | Web Security

6 hours

Browser Attacks: Types, Failed Identification and Authentication - Misleading and Malicious Web Contents - Protection against Malicious Web Pages - Website Data: Code within Data, Cross Site Scripting Attacks - Prevention of Data Attacks - Fake e-mails - Spam Detection - Phishing Attacks - Phishing URL Detection and Prevention.

Module:7 | Privacy Issues

7 hours

Privacy Concepts: Aspects of Information Privacy, Computer-Related Privacy Problems - Threats to Personal Data Privacy - People-Based Privacy Concerns - Privacy Principles and Policies - Individual Actions to Protect Privacy - Governments and Privacy - Identify Theft - Privacy issues on the Web Data - Application of Cryptographic Techniques for Privacy Preservation.

Module:8	Contemporary Issues	2 hours
	Total Lecture hours:	45 hours

Tex	Text Book							
1.	Charles P. Pfleeger, Shari Law Computing, 2018, Fifth Edition, Po			nathan Margulies, Security in				
Ref	Reference Books							
1.	Mark Stamp, Information Security	: Principles	and Prac	tice, 2021, 3rd Edition, Wiley.				
2.	Joanna Lyn Grama, Legal and		ues in Ir	nformation Security, 2020, 3rd				
	Edition, Jones and Bartlett Publisl	hers, Inc.						
Мо	Mode of Evaluation: CAT / written assignment / Quiz / FAT							
Red	Recommended by Board of Studies 04-03-2022							
App	Approved by Academic Council No.65 Date 17-03-2022							

BCSE318L	DATA PRIVACY		L	T	Р	С
			3	0	0	3
Pre-requisite	NIL	S	Syllabus version		on	
				1.0		
Course Objectiv	ves	•				
1. To impart the	need of data privacy.					
2 To categoria	o the statistical and computational techniques	required	to t	shai	h a	ata

- 2. To categorize the statistical and computational techniques required to share data, with a primary focus on the social, and health sciences.
- 3. To formulate architectural, algorithmic, and technological foundations for the maintaining the data privacy.

Course Outcomes

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

- 1. Characterize basic rules, principles for protecting privacy and personally identifiable information.
- 2. Formulate data that supports useful statistical inference while minimizing the disclosure of sensitive information.
- 3. Identify the list of threats on the various types of anonymized data.
- 4. Classify and analyze the methods of test data generation with Privacy and utility.

Need for Sharing Data - Methods of Protecting Data - Importance of Balancing Data Privacy and Utility - Disclosure - Tabular Data - Micro data - Approaches to Statistical disclosure control - Ethics - principles - guidelines and regulations. Module:2 Microdata 7 hours Disclosure - Disclosure risk - Estimating re-identification risk - Non-Perturbative Micro data masking - Perturbative Micro data masking - Information loss in Micro data. Module:3 Static Data Anonymization on Multidimensional Data 7 hours Privacy - Preserving Methods - Classification of Data in a Multidimensional Dataset - Group-based Anonymization: k-Anonymity, I-Diversity, t-Closeness. Module:4 Anonymization on Complex Data Structures 8 hours Privacy-Preserving Graph Data, Privacy-Preserving Time Series Data, Time Series Data Protection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Transaction Data. Module:5 Threats to Anonymized Data Components to Anonymized Data, Threats to Data Structures, Threats by Anonymization Techniques: Randomization, k-Anonymization, I-Diversity, t-Closeness. Module:6 Dynamic Data Protection 5 hours Dynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Toynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Tokenizations Test Data Fundamentals - Insufficiencies of Anonymized Test Data. Privacy regulations: UK Data Protection Act, Swiss Data Protection Act, HIPPA, General Data Protection Regulation. Module:8 Contemporary Issues 2 hours Text Book 1. Natara Venkataramanan, AshwinShriram, Data Privacy: Principles and Practice, 2016,		j	
Need for Sharing Data - Methods of Protecting Data - Importance of Balancing Data Privacy and Utility — Disclosure - Tabular Data - Micro data - Approaches to Statistical disclosure control — Ethics — principles - guidelines and regulations. Module:2 Microdata 7 hours Disclosure - Disclosure risk - Estimating re-identification risk - Non-Perturbative Micro data masking - Perturbative Micro data masking - Information loss in Micro data. Module:3 Static Data Anonymization on Multidimensional Data 7 hours Privacy — Preserving Methods - Classification of Data in a Multidimensional Dataset - Group-based Anonymization: k-Anonymity, I-Diversity, t-Closeness. Module:4 Anonymization on Complex Data Structures 8 hours Privacy-Preserving Graph Data, Privacy-Preserving Time Series Data, Time Series Data Protection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Transaction Data. Module:5 Threats to Anonymized Data 6 hours Threats to Anonymized Data, Threats to Data Structures, Threats by Anonymization Techniques: Randomization, k-Anonymization, I-Diversity, t-Closeness. Module:6 Dynamic Data Protection 5 hours Dynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Dynamic Data Protection, Benefits of Tokenization Compared to Other Methods, Components for Tokenization. Module:7 Privacy-Preserving Test Data Generation and Privacy regulations: UK Data Protection Act, Swiss Data Protection Act, HIPPA, General Data Protection Regulation. Module:8 Contemporary Issues 7 total Lecture hours: 45 hours Text Book			_
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Module:2 Microdata Thours	Need for \$	Sharing Data - Methods of Protecting Data - Importance of	of Balancing Data
Disclosure - Disclosure risk - Estimating re-identification risk - Non-Perturbative Micro data masking - Perturbative Micro data masking - Information loss in Micro data. Module:3 Static Data Anonymization on Multidimensional Data 7 hours Privacy - Preserving Methods - Classification of Data in a Multidimensional Dataset - Groupbased Anonymization: k-Anonymity, I-Diversity, t-Closeness. Module:4 Anonymization on Complex Data Structures 8 hours Privacy-Preserving Graph Data, Privacy-Preserving Time Series Data, Time Series Data Protection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Transaction Data. Module:5 Threats to Anonymized Data 6 hours Threats to Anonymized Data, Threats to Data Structures, Threats by Anonymization Techniques: Randomization, k-Anonymization, I-Diversity, t-Closeness. Module:6 Dynamic Data Protection 5 hours Dynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Dynamic Data Protection, Benefits of Tokenization Compared to Other Methods, Components for Tokenization. Module:7 Privacy-Preserving Test Data Generation and Privacy regulations: UK Data Protection Act, Swiss Data Protection Act, HIPPA, General Data Protection Regulation. Module:8 Contemporary Issues 7 Total Lecture hours: 45 hours Text Book	Privacy and	d Utility – Disclosure - Tabular Data - Micro data - Approa	ches to Statistical
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Module:3 Static Data Anonymization on Multidimensional Data 7 hours	Module:2	Microdata	7 hours
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Module:8 Contemporary Issues 2 hours Total Lecture hours: 45 hours Text Book		· · · · · · · · · · · · · · · · · · ·	, ,
Total Lecture hours: 45 hours Text Book			
Text Book	woudle:8	Contemporary issues	∣ ∠ nours
		Total Lecture hours:	45 hours
1. Nataraj Venkataramanan, Ashwin Shriram, Data Privacy: Principles and Practice, 2016,	Text Book		
	1. Natara	jVenkataramanan, AshwinShriram, Data Privacy: Principles a	nd Practice, 2016,

1st Edition, Taylor & Francis. (ISBN No.: 978-1-49-872104-2), United Kingdom.

Ref	Reference Books								
1.		oHundepool, Josep Domingo-Ferrer, Luisa Franconi, Sarah Giessing, Eric Schulte							
	Nordholt, Keith Spicer, Peter-Paul de Wolf, Statistical Disclosure Control, 2012, 1st								
	Edition Wiley. (ISBN No.: 978-1-	11-997815-2), Ui	nited State	es.					
2.	George T. Duncan. Mark Elliot,	Juan-Jose Salaz	ar-GonZa	lez, Statistical Confidentiality:					
	Principle and Practice. 2011, 1st	Edition, Springe	r. (ISBN N	lo.: 978-1-44-197801-1).					
Мо	de of Evaluation: CAT / written as	signment / Quiz /	FAT						
Red	Recommended by Board of Studies 04-03-2022								
App	Approved by Academic Council No.65 Date 17-03-2022								

BCSE319L	PENETRATION TESTING AND VULNERABILIT ANALYSIS	Υ	L	Т	Р	С
			2	0	0	2
Pre-requisite	NIL	Syllabus version			on	
				1.0		

- 1. To understand the system security-related incidents and insight on potential defenses, countermeasures against common vulnerabilities.
- 2. To provide the knowledge of installation, configuration, and troubleshooting of information security devices.
- 3. To make students familiarize themselves with the tools and common processes in information security audits and analysis of compromised systems.

Course Outcome

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

Module:1 | Pentesting Fundamentals

- 1. Familiarized with the basic principles for Information Gathering and Detecting Vulnerabilities in the system.
- 2. Gain knowledge about the various attacks caused in an application.
- 3. Acquire knowledge about the tools used for penetration testing.
- 4. Learn the knowledge into practice for testing the vulnerabilities and identifying threats.
- 5. Determine the security threats and vulnerabilities in computer networks using penetration testing techniques.

Vulnerability Assessment (VA)- Pentesting Analysis (PTA) -Types of Vulnerability Assessments-Modern Vulnerability Management Program-Ethical Hacking terminology- Five stages of hacking- Vulnerability Research - Impact of hacking - Legal implication of hacking -Compare Vulnerability Assessment (VA) and Penetration Testing (PT) Tools. Module:2 | Information Gathering Methodologies 5 hours Competitive Intelligence- DNS Enumerations- Social Engineering attacks - Scanning and Enumeration. Port Scanning: Network Scanning, Vulnerability Scanning, scanning tools- OS and Fingerprinting Enumeration - System Hacking Password. Module:3 | System Hacking 3 hours Password cracking techniques- Key loggers- Escalating privileges- Hiding Files, Active and Passive sniffing - ARP Poisoning - IP Poisoning and MAC Flooding. Module:4 | Wireless Pentesting 4 hours Wi-Fi Authentication Modes - Bypassing WLAN Authentication - Types of Wireless Encryption - WLAN Encryption Flaws - Access Point Attacks - Attacks on the WLAN Infrastructure - Buffer Overloading. **Module:5** | The Metasploit Framework 3 hours

Metasploit User Interfaces and Setup - Getting Familiar with MSF Syntax - Database Access - Auxiliary Modules- Payloads - Staged vs Non-Staged Payloads - Meterpreter Payloads - Experimenting with Meterpreter.

Module:6 Web Application Attacks 4 h							
Web Application Assessment Methodology - Enumeration - Inspecting URLs - Inspecting							
Page Cont	ent - Viewing Response Headers - Inspecting S	itemaps - Locating Administration					
Consoles.		-					
Module:7	Exploiting Web-Based Vulnerabilities	4 hours					
Exploiting A	Admin Consoles - Cross-Site Scripting (XSS) - S	QL Injection.					
Module:8 Contemporary Issues 2							
	Total Lecture hours:	30 hours					

5 hours

Text Book(s)

- 1. Najera-Gutierrez G, Ansari JA. Web Penetration Testing with Kali Linux: Explore the methods and tools of ethical hacking with Kali Linux., 2018, 3rd Edition, Packt Publishing Ltd, United Kingdom.
- 2. Hadnagy C. Social engineering: The science of human hacking, 2018, 2nd Edition, John Wiley & Sons, United States.

Reference Books

- 1. Weidman G. Penetration testing: a hands-on introduction to hacking,2014, 1st Edition, No Starch Press, United States
- 2. Engebretson P. The basics of hacking and penetration testing: ethical hacking and penetration testing made easy, 2013, 2nd Edition, Elsevier.

Mode of Evaluation: CAT / written assignment / Quiz / FAT						
Recommended by Board of Studies	04-03-2022					
Approved by Academic Council	No.65	Date	17-03-2022			

BCSE319P	PENETRATION TESTING AND VULNERABILITY ANALYSIS LAB			Т	Р	С
			0	0	2	1
Pre-requisite	NIL Sylla		bus	s ve	rsio	n
			1	.0		

- 1. To understand the system security-related incidents and insight on potential defenses, countermeasures against common vulnerabilities.
- 2. To provide the knowledge of installation, configuration, and troubleshooting of information security devices.
- 3. To make students familiarize themselves with the tools and common processes in information security audits and analysis of compromised systems.

Course Outcome

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

- 1. Learn the knowledge into practice for testing the vulnerabilities and identifying threats.
- 2. Determine the security threats and vulnerabilities in computer networks using penetration testing techniques.

Indicative Experiments

- 1. Perform a track of information about Domain Registrars and DNS by lookup technologies
- 2. Perform various Port Scanning methodologies to identify the misconfiguration issues about the infrastructure.
- 3. Analyze the traffic routing and information carried among the network through Wireshark
- 4. Exploit threats and mitigation strategies for, ARP Spoofing, IP Spoofing,
- 5. Demonstrate various approaches followed on password breaking methodology.
- 6. Perform and analyze the wireless network to identify their weakness around access points with defensive mechanisms around it.
- 7. Apply various payloads to gain various categories of backdoor access of a machine using Metasploit and Meterpreter.

Total Laboratory Hours | 30 hours

Text Books

- 1. Najera-Gutierrez G, Ansari JA. Web Penetration Testing with Kali Linux: Explore the methods and tools of ethical hacking with Kali Linux., 2018, 3rd Edition, Packt Publishing Ltd, United Kingdom.
- 2. Hadnagy C. Social engineering: The science of human hacking, 2018, 2nd Edition, John Wiley & Sons, United States.

Reference Books

1. Weidman G. Penetration testing: a hands-on introduction to hacking,2014, 1st Edition, No Starch Press. United States

Mode of assessment: Continuous assessment / FAT						
Recommended by Board of Studies 04-03-2022						
Approved by Academic Council	No.65	Date	17-03-2022			

BCSE320L	WEB APPLICATION SECURITY	L	T	Р	C
		3	0	0	3
Pre-requisite	NIL	Syllabus versio			'n
		1	.0		
Course Objecti	ves				
1. To study and	practice fundamental techniques to develop secure wel	o applicatio	ns.		
2. To identify we	eb applications vulnerabilities and understand vulnerabil	ity manage	me	nt.	
3 To assess we	b application security attacks and defence.				

Course Outcome

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

- 1. Understand security challenges and the need for Authentication and Authorization in webbased systems and applications.
- 2. Familiarize the Application Programming Interface analysis and vulnerability management of securing a web-based system.
- 3. Learn the web application hacking techniques and prevention solutions.
- 4. Apply the best practices of Secure Credentials, session management, and Security Automation in web applications.
- 5. Develop the best strategies to prevent XSS, CSRF, XXE, Injection, DOS attacks and Securing Third-Party Dependencies.

Module:1Web Application Reconnaissance5 hoursInformationGathering - Web Application Mapping - Structure of Modern Web Application:Modern Versus Legacy Web Applications, REST APIs, JavaScript Object Notation, BrowserDOM, SPA Frameworks, Authentication and Authorization Systems, Web Servers, Server-Side Databases, Client-Side Data Stores.Module:2Sub Domain and Application Programming Interface Analysis

Sub Domain: Multiple Applications per Domain - Browser's Built-In Network Analysis Tools - Search Engine Caches - Accidental Archives - Social Snapshots - Zone Transfer Attacks - Brute Forcing Subdomains and Dictionary Attacks - Application Programming Interface Analysis(API): Endpoint Discovery and Endpoint Shapes, Authentication Mechanisms.

Module:3 | Web Application Vulnerability

6 hours

Detecting Client-Side and Server-Side Frameworks - Secure Versus Insecure Architecture Signals - Multiple Layers of Security - Adoption and Reinvention - Common Vulnerabilities and Exposures Database

Module:4 | Web Application Hacking

6 hours

Cross-Site Scripting (XSS): XSS Discovery and Exploitation, Stored XSS, Reflected XSS, DOM-Based XSS, Mutation-Based XSS - Cross-Site Request Forgery (CSRF): Query Parameter Tampering, CSRF Against POST Endpoints - XML External Entity (XXE): Direct and Indirect XXE.

Module:5 | Web Application Attacks

6 hours

SQL Injection - Code Injection - Command Injection - Denial of Service (DoS): regex DoS (ReDoS), Logical DoS Vulnerabilities, Distributed DoS - Exploiting Third-Party Dependencies.

Module:6 | Securing Web Applications

7 hours

Defensive Software Architecture - Vulnerability Analysis and Management - Secure Sockets Layer and Transport Layer Security - Secure Credentials, Hash Credentials - Secure-Coding Anti-Patterns - Security Automation: static and dynamic analysis - Vulnerability Regression Testing - Bug Bounty Programs.

Module:7	Vulnerability Prevention	Management	and	Hack	ing			6	hours
Common \	/ulnerability Sc	corina System -	Defe	ndina	Against	attacks:	XSS.	CSRF.	XXE.

Inje	Injection, and DOS - Securing Third-Party Dependencies.										
Мо	dule:8	Contemporary Issues			2 hours						
		Tota	al Lecture ho	urs:	45 hours						
Te	Text Book										
1.	Andrev	v Hoffman, Web Application	Security- Ex	ploitation	and Countermeasures for						
	Modern Web Applications, March 2020, 1st Edition, O'Reilly Media, California.										
Re	ference	Books									
1.	D. Stu	ttard and M. Pinto, The Web	Applications	Hackers	Handbook, 2011, 2nd Edition,						
	Indiana	apolis, IN: Wiley, John Sons, l	Jnited States								
2.	Malcol	m McDonald, Web Security fo	r Developers	: Real Th	reats, Practical Defense,						
	2020, I	Ilustrated edition, No Starch F	Press, United	States.							
Мо	de of Ev	aluation: CAT, Written Assign	ıment, Quiz, l	FAT							
Re	commer	nded by Board of Studies	04-03-2022								
Ap	Approved by Academic Council No.65 Date 17-03-2022										

BCSE321L	MALWARE ANALYSIS		L	Т	Р	С
			2	0	0	2
Pre-requisite	NIL	Sylla	bu	s v	ers	ion
			1.0)		

- 1. To introduce the malware taxonomy and malware analysis tools.
- 2. To identify and analyze malware samples using static, dynamic analysis, and reverse engineering techniques.
- 3. To detect and analyze malicious documents and mobile malware.

Course Outcome

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

- Possess the skills to carry out static and dynamic malware analysis on various malware samples.
- 2. Understand the executable formats, Windows internals, and APIs.
- 3. Apply techniques and concepts to unpack, extract, and decrypt malware.
- Comprehend reverse-engineering of malware and anti-malware analysis techniques.
- 5. Achieve proficiency with industry-standard malware analysis tools.

Module:1 Fundamentals of Malware Analysis 5 hours

Malware taxonomy - Malware analysis techniques - Packed and Obfuscated Malware - Portable Executable File Format: Headers and Sections, Malware Analysis in Virtual Machines - Malware Analysis Tools: ProcMon/ ProcExplore, BinText, FileAlyzer, OllyDbg, etc.

Module:2 Static Analysis

4 hours

File signature analysis and Identifying file dependencies -Database of file hashes. String analysis - Local and online malware sandboxing - Levels of Abstraction - x86 Architecture - x86/x86_64 Assembly - Static Analysis Tools: PeiD, Dependency Walker, Resource Hacker.

Module:3 Dynamic Analysis 4 hours

Source level vs. Assembly level Debuggers - Kernel vs. User-Mode Debugging – Exceptions - Modifying Execution with a Debugger - Modifying Program Execution in Practice - DLL analysis - Dynamic Analysis Tools: Virustotal, Malware Sandbox, Windows Sysinternals

Module:4 Reverse Engineering

4 hours

Reverse engineering malicious code - Identifying malware passwords - Bypassing authentication -Advanced malware analysis: Virus, Trojan and APK Analysis - Reverse Engineering Tools: IDA Pro and OLLYDBG

Module:5 Malicious Document Analysis

3 hours

PDF and Microsoft Office document structures – Identify PDF and office document vulnerabilities - Analysis of suspicious websites - Examining malicious documents: word, XL, PDF, and RTF files - Malware extraction and analysis tools.

Module:6 Anti-Reverse-Engineering

3 hours

Anti-Disassembly - Anti-Debugging - Anti-Forensic Malware - Packers and Unpacking - Shellcode Analysis - 64-Bit Malware

Module:7 Mobile Malware Analysis

5 hours

Mobile application penetration testing - Android and iOS Vulnerabilities - Exploit Prevention - Handheld Exploitation - Android Root Spreading and Distribution Android

Module:8	Contemporary Issues	2 hours							
Bayes (NB),	Bayes (NB), and Neural Networks (NN).								
(SVM), K-Ne	(SVM), K-Nearest Neighbor (KNN), Random Forest (RF), Decision Trees (DT), Naïve								
Debugging -	Machine learning techniques for malware ana	lysis: Support Vector Machine							

١,	, .	and Neural Networks (NN).	ildolli Folest (NF),	Decision	Tiees (DT), Naive					
		Contemporary Issues			2 hours					
	Total Lecture hours: 30 hou									
Tex	Text Book									
1.	1. Abhijit Mohanta, Anoop Saldanha, Malware Analysis and Detection Engineering a Comprehensive Approach to Detect and Analyze Modern Malware, 2020, 1 st edition, Apress (ISBN 978-1-4842-6192-7), United States.									
2.	Dissec	korski and A. Honig, Prac eting Malicious Software. 20 No.: 9781593272906), Unit	12, 1 st edition, No							
Refe	erence	Books								
1.	Monnappa K A, Learning Malware Analysis- Explore the concepts, tools, and techniques to analyze and investigate Windows malware, 2018, 1 st edition, Packt Publishing, (ISBN 978-1-78839-250-1), United Kingdom.									
Mod	le of Eva	aluation: CAT / Assignment	/ Quiz / FAT / Semi	nar						
Rec	ommen	ded by Board of Studies	04-03-2022							
App	Approved by Academic Council No.65 Date 17-03-2022									

BCSE321P	MALWARE ANALY	SIS LAB		L	T	Р	С
				0	0	2	1
Pre-requisite	NIL		Sylla	bu	s v	ers	ion
				1.0)		

- 1. To introduce the malware taxonomy and malware analysis tools.
- 2. To identify and analyze malware samples using static, dynamic analysis, and reverse engineering techniques.
- 3. To detect and analyze malicious documents and mobile malware.

Course Outcome

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

- 1. Apply techniques and concepts to unpack, extract, and decrypt malware.
- 2. Achieve proficiency with industry-standard malware analysis tools.

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Indic	eative Experiments
1	Examining PE Files using PEview, PE explorer and Resource Hacker
'	Disassembling Portable Executable (PE32)
	imports, exports, functions, main address, malicious string locations
2	Sandboxing malware using SANDBOX tool, Virus Total Analysis, Anyrun Analysis
3	Basic malware analysis:
•	file compilation date
	imports/ exports, suspicious strings
	run-time effect
	procmon filter
	hist -based signatures revealing files
	registry keys, processes, services
	network-based signatures
4	Advanced static malware analysis
'	find address of main, code constructs, suspicious strings,
	 imported functions, their tasks,
	intention of the malware
	impact of the malware via hex code
5	Analyze the malware using IDA Pro for reverse-engineering the malware: strings
	analysis, local variables, graph mode to cross-references, Analyzing Functions
6	Analyze the malware using OllyDbg: Debug the malware, Viewing Threads and
	Stacks, OllyDbg Code-Execution Options, Breakpoints, Loading DLLs, Exception
	Handling
7	Advanced analysis of Windows programs for processes, interactive remote
	shell, uploaded file, address of the subroutine, return value, Windows APIs
8	Malware behavior analysis
	finding the source of malware
	 persistence mechanism, multiple instances replication mechanisms,
	hiding strategies
	API calls for keylogging, constants involved
	post-infection actions of the malware, mutex, SendMessage API structure
9	Malware self-defense, packing and unpacking, obfuscation and de-obfuscation
1.5	using Packers and obfuscation tools
10	Anti-disassembly and anti-debugging techniques used in the binary by
4.	patching the PE, set a breakpoint in the malicious subroutine
11	Analyzing malicious Microsoft Office and Adobe PDF documents to locate malicious

	embedded code such as shellcode, VBA macros or JavaScript, disassemble and/ or debug, shellcode analysis									
	Total Laboratory Hours 30 hours									
Text	Text Book(s)									
1.	M. Sikorski and A. Honig, F									
	Dissecting Malicious Software	e. 2012, 1 st editi	on, No S	tarch Press S	San Francisco,					
	CA. (ISBN No.: 97815932729	06), United State	es.							
Refe	rence Books									
1.	B. Dang, A. Gazet, E. Bachaa	alany, and S. Jo	sse, Pra	ctical Reverse	Engineering:					
	X86, X64, arm, Windows Kern	el, Reversing To	ools, and	Obfuscation.	, 2014, Wiley,					
	United States. (ISBN No. : 978-1-118-78731-1)									
Mode	Mode of assessment: Continuous assessment / FAT									
Reco	Recommended by Board of Studies 04-03-2022									
Appro	Approved by Academic Council No.65 Date 17-03-2022									

BCSE322L	DIGITAL FORENSICS		L	Т	Р	С
			2	0	0	2
Pre-requisite	NIL	Syl	labu	IS V	ersi	on
				1.0		

- 1. To present a comprehensive perception of digital forensic principles, collection, preservation, and analysis of digital evidence.
- 2. To enlighten the importance of forensic procedures, legal considerations, digital evidence controls, and the documentation of forensic analysis.
- 3. To develop a comprehension of the different tools and methods for conducting digital forensic acquisition and analysis.

Course Outcomes

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

- 1. Understand the responsibilities and liabilities of a computer forensic investigator
- 2. Seize a computer from a crime scene without damage and follow the legal procedures and standards.
- 3. Demonstrate the ability to perform forensic data acquisition and analysis.
- 4. Analyze and retrieve hidden and damaged files from different operating systems.
- 5. Apply forensics to recent technologies such as smart phones, email, cloud and social media.

Module:1 Understanding Digital Forensics and Legal Aspects 3 hours

Understanding computer forensics - Preparing for computer investigation - Maintaining professional conduct - understanding computer investigations - Taking a systematic approach - Corporate Hi-Tech investigations - Conducting an investigation.

Module:2 | Acquisition and Storage of Data

4 hours

Understanding Storage Formats for Digital Evidence - Determining the Best Acquisition Method - Contingency Planning for Image Acquisitions - Using Acquisition Tools - Validating Data Acquisitions - Performing RAID Data Acquisitions - Using Remote Network Acquisition Tools - Storing Digital Evidence - Obtaining a Digital Hash - Sample Cases.

Module:3 | Working with Windows

5 hours

Understanding File Systems - Exploring Microsoft File Structures - Examining NTFS Disks - Understanding Whole Disk Encryption - Understanding the Windows Registry - Understanding Microsoft Startup Tasks - Understanding MS-DOS Startup Tasks - Evaluating Computer Forensics Tool Needs - Computer Forensics Software and Hardware Tools.

Module:4 | Working with Linux/Unix Systems

4 hours

UNIX and Linux Overview - Inodes - Boot Process - Drives and Partition Schemes - Examining disk Structures - Understanding Other Disk Structures - Ownership and Permissions, File Attributes, Hidden Files, User Accounts - Case studies - Validating Forensic Data - Addressing Data-Hiding Techniques - Locating and Recovering Graphics File.

Module:5 | Email and Social Media Forensics

4 hours

Investigating E-mail crimes and Violations – Applying Digital Forensics Methods to Social Media Communications - Social Media Forensics on Mobile Devices - Forensics Tools for Social Media Investigations.

Module:6 | Mobile Forensics

4 hours

Mobile phone basics – Acquisition procedures for mobile - Android Device – Android Malware – SIM Forensic Analysis – Case study.

Module:7 Cloud Forensics

4 hours

Wo	Working with the cloud vendor, obtaining evidence, reviewing logs and APIs.							
Module:8 Contemporary Issues					2 hours			
			Total Lecture ho	ours:		30 hours		
Tex	kt Book	(s)						
1.	1. B. Nelson, A. Phillips, F. Enfinger, and C. Steuart, Guide to Computer Forensics and Investigations, 2019, 6th ed. CENGAGE, INDIA (ISBN: 9789353506261)							
Ref	ference	Books						
1.		Årnes, Digital Foren 19262411)	sics, 2018, 1	st ed.,	Wiley, USA(ISBN	l No.:		
2.	2. Nihad A Hassan, Digital Forensics Basics: A Practical Guide to Using Windows OS, 2019, 1st ed, APress, USA (ISBN: 9781484238387)							
Мо	Mode of Evaluation: CAT, assignment, Quiz and FAT							
		nded by Board of Studies						
App	proved b	y Academic Council	No.65	Date	17-03-2022			

BCSE322P	DIGITAL FORENSICS LAB		L	Τ	Р	С		
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Pre-requisite	NIL	Syl	labu	IS V	ersi	on		
				1.0				
Course Objective								
preservation, a 2. To enlighten evidence contr	 To present a comprehensive perception of digital forensic principles, collection, preservation, and analysis of digital evidence. To enlighten the importance of forensic procedures, legal considerations, digital evidence controls, and the documentation of forensic analysis. 							
	comprehension of the different tools and methods sition and analysis.	ior cc	onau	cun		gitai ——		
Course Outcome	s							
 After completion of this course, the student shall be able to: Demonstrate the ability to perform forensic data acquisition and analysis. Apply forensics to recent technologies such as smart phones, email, cloud and social media 								
Indicative Experi	ments							
	Extract the features based on various color models and apply on image and video retrieval							
	y (Deleted, fragmented, hidden)							
Network Fore encrypted _le	ensics (Determining the type attacks, extracting files fes)	rom n	etwo	rk l	ogs,			

6.	Mobile Forensics	(Tools for Android and iOS))
7	Social Media Fore	neice	

Mobile Forensics(Tools for Android and iOS)

7. | Social Media Forensics

Total Laboratory Hours 30 hours

Text Book

1. B. Nelson, A. Phillips, F. Enfinger, and C. Steuart, Guide to Computer Forensics and Investigations, 2019, 6th ed. CENGAGE, INDIA (ISBN: 9789353506261)

Reference Books

1. Nihad A Hassan, Digital Forensics Basics: A Practical Guide to Using Windows OS, 2019, 1st ed, APress, USA (ISBN: 9781484238387)

Mode of assessment: Continuous assessment / FAT

Recommended by board or a	104-03-2022		
Approved by Academic Coun	cil No.65	Date	17-03-2022

OS Forensics (Windows and Linux artifacts, memory, registry)

BCSE323L DIGITAL WATERMARKING AND STEGANOGRAPHY			L	Т	Р	С
		3	0	0	3	
Pre-requisite	NIL	Syll	abı	ıs v	ersi	on
				1.0		

- 1. To understand the basic principles, characteristics, various approaches and applications of digital watermarking and steganography.
- 2. To apply digital watermarking techniques as an authentication tool for distribution of content over the Internet and steganography techniques for covert communication.
- 3. To impart knowledge on the basics of the counter measures like steganalysis for assessing the data hiding methods.

Course Outcome

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

- 1. Learn the fundamental concepts, principles, characteristics and performance measures of digital watermarking and steganography.
- 2. Acquire the various concepts of watermarking for digital authentication and authorization schemes related to electronic documents, image and video.
- 3. Gathering the various concepts of steganography to access the sensitive information concealing of message, image, audio or video within another file.
- 4. Design and implement efficient data hiding methods against steganalysis techniques.

Module:1 Fundamentals of Digital Watermarking

6 hours

Importance of Watermarking - Application and Properties of Watermarking - Models of Watermarking - Basic Message Coding: Mapping Message into Message Vectors, Error Correction Coding - Watermarking with Side Information - Analyzing Errors.

Module:2 Digital Watermarking Schemes

7 hours

Spatial Domain: Correlation based Watermarking, Least Significant bit Watermarking - Frequency domain: Discrete Wavelet Transform Watermarking, Discrete Fourier Transform Watermarking, Discrete Cosine Watermarking, Quantization Watermarking, Haar Transform Watermarking, Hadamard Transform Watermarking - Robust Watermarking - Fragile and Semi Fragile Watermarking.

Module:3 Digital Watermarking Security and Authentication

5 hours

Watermarking Security: Security Requirements, Watermark Security and Cryptography, Watermarking Attacks and Tools - Content Authentication: Exact Authentication, Selective Authentication, Localization, Restoration.

Module:4 | Steganography

7 hours

Basics and Importance of Steganography - Applications and Properties of Steganography - Steganography: LSB embedding, Steganography in palette images -Steganography in JPEG images: JSteg data hiding in spatial and transform domain -Steganography Security.

Module:5 Audio and Video Steganography

6 nours

Audio Steganography: Temporal domain techniques, Transform domain techniques, Cepstral Domain - Video Steganography: Introduction Video Streams, Substitution-Based Techniques, Transform Domain Techniques, Adaptive Techniques, Format-Based Techniques - Cover Generation Techniques Video Quality Metrics - Perceptual Transparency Analysis - Robustness against Compression and Manipulation.

Module:6 | Wet Paper Code

6 hours

Random Linear Codes - LT Codes - Perturbed Quantization, Matrix Embedding - Matrix Embedding Theorem - Binary Hamming Codes - Q-Ary Case Random Linear Codes for Large Payloads.

Module:7 | Steganalysis

6 hours

Steganalysis Principles - Statistical Steganalysis: Steganalysis as detection problem,

Modeling images using features, Receiver operating Characteristics - Targeted Steganalysis : Sample pair analysis, Targeted attack on F5 using Calibration, Targeted attack on ± embedding - Blind Steganalysis: Features for steganalysis of JPEG images (cover vs all-stego and one class neighbor machine).

1	stego and one class neighbor machine).							
Мо	dule:8	Contemporary Isues			2 hours			
		Total	Lecture ho	ours:	45 hours			
To	kt Book	(e)						
1.		Y. Shih, Digital Waterma	rking and	Stogono	graphy Fundamentals and			
1.		ques, 2020, 2 nd Ed. CRC Pres						
2.	J. Frid	rich, Steganography in Digita	l Media: Pr	inciples, a	Algorithms, and Applications,			
	2010,	I st Ed. Cambridge: Cambridge	University P	ress, Uni	ted Kingdom. (ISBN No.: 978-			
	0-52-1	19019-0)	j		,			
Ref	ference	Books						
1.		ox, M. L. Miller, J. A. Bloom, T						
	Stegar	lography, 2008, 2 nd Ed. Ams	terdam: Mo	rgan Kau	fmann Publishers In, United			
	States	(ISBN No.: 978-0-12-372585	-1)					
2.	P. Wa	ayner, Disappearing Cryptog	raphy: Info	rmation	hiding: Steganography and			
	Watermarking, 2008, 3rd ed. Amsterdam: Morgan Kaufmann Publishers In, United							
	States. (ISBN No. : 978-0-08-092270-6)							
Мо	Mode of Evaluation: CAT / Assignment / Quiz / FAT							
Red	Recommended by Board of Studies 04-03-2022							
App	proved b	y Academic Council	No.65	Date	17-03-2022			

Pre-requisite NiL Syllabus version 1.0	BCSE324L	FOUNDATIONS OF BLOCKCHAIN TE	CHNOLOGY	L	Т	Р	С
Course Objectives 1. To understand building blocks of Blockchain. 2. To significance of Distributed Ledger Technology and Smart Contract. 3. To exploit applications of Blockchain in real world scenarios and their impacts. Course Outcomes After completion of this course, the student shall be able to: 1. Understand Blockchain ecosystem and its services in real world sceneries 2. Apply and Analyze the requirement of Distributed Ledger Technology and Smart Contract 3. Design and Demonstrate end-to-end decentralized applications 4. Acquaint the protocol and assess their computational requirements Module:1 Foundations of Blockchain 7 hour Blockchain Techniceture - Challenges - Applications - Blockchain Design Principles - The Blockchain Ecosystem - The consensus problem - Asynchronous Byzantine Agreement AAP protocol and its analysis - peer-to-peer network - Abstract Models - GARAY model RLA Model - Proof of Work (PoW) - Proof of Stake (PoS) based Chains - Hybrid models. Module:2 Distributed Ledger Technology 6 hour Origin of Ledgers - Types and Features of Distributed Ledger Implementations - Blockchain - Ethereum - Public and Private Ledgers - Registries - Ledgers - Practitioner Perspective Keyless Technologies, Transparency as a Strategic Risk, Transparency as a Strategic Raset, Usage of Multiple IDs - Zero Knowledge Proofs - Implementation of Public an Private Blockchain Module:3 Smart Contracts - Life Cycle - Usage Patterns - DLT-based smart contracts - Use Cases: Healthcare Industry and Property Transfer. Module:4 Decentralized Organization Shour Anatomy of a Smart Contracts - Life Cycle - Usage Patterns - DLT-based smart contracts - Use Cases: Healthcare Industry and Property Transfer. Module:5 Types of Blockchain Ecosystem Shour Anatomy of a Smart Contracts - Life Cycle - Usage Patterns - DLT-based smart contracts - Use Cases: Healthcare Industry and Property Transfer. Module:6 Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subredd				3	0	0	3
Course Objectives	Pre-requisite	NIL	Sy	/llabu	JS V	ersi	on
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Module:1 Foundations of Blockchain 7 hour	Contract						
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Module:3Smart Contracts5 hourAnatomy of a Smart Contracts - Life Cycle - Usage Patterns - DLT-based smart contracts - Use Cases: Healthcare Industry and Property Transfer.Module:4Decentralized Organization5 hourDecentralization versus Distribution - Centralized-distributed (Ce-Di) organizations Decentralized-distributed (De-Di) organizations - Decentralized Autonomous Organizations Aragon, DAOstack, DAOhaus and Colony.7 hourModule:5Types of Blockchain Ecosystem7 hourOne-Leader Ecosystem - Joint Venture or Consortia Ecosystems - Regulatory Blockchain Ecosystems - Components in Blockchain Ecosystem: Leaders, Core Group, Activ 	Asset, Usage of N	Multiple IDs - Zero Knowledge Proofs	 Implementatio 	n of	Pub	olic a	and
Anatomy of a Smart Contracts - Life Cycle - Usage Patterns - DLT-based smart contracts - Use Cases: Healthcare Industry and Property Transfer. Module:4 Decentralized Organization 5 hour							
Use Cases: Healthcare Industry and Property Transfer.Module:4Decentralized Organization5 hourDecentralization versus Distribution - Centralized-distributed (Ce-Di) organizationsDecentralized-distributed (De-Di) organizations - Decentralized Autonomous OrganizationsAragon, DAOstack, DAOhaus and Colony.Module:5Types of Blockchain Ecosystem7 hourOne-Leader Ecosystem - Joint Venture or Consortia Ecosystems - Regulatory BlockchainEcosystems - Components in Blockchain Ecosystem: Leaders, Core Group, ActivParticipants, Users, Third-Party Service Providers - Governance for Blockchain EcosystemsModule:6Blockchain Protocols6 hourEthereum tokens - Augur - Golem - Understanding Ethereum tokens - App Coins anProtocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Tokesale structure - Ethereum Subreddit.Module:7High Performance Computing7 hourIntegrity of High Performance Systems - Data Provenance - Cluster Construction anDeployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage ofIntegrity Data.Module:8Contemporary Issues							
Decentralized Organization Decentralized Organization Decentralization Versus Distribution - Centralized-distributed (Ce-Di) organizations Decentralized-distributed (De-Di) organizations - Decentralized Autonomous Organizations Aragon, DAOstack, DAOhaus and Colony. Module:5 Types of Blockchain Ecosystem Thour One-Leader Ecosystem - Joint Venture or Consortia Ecosystems - Regulatory Blockchain Ecosystems Components in Blockchain Ecosystem: Leaders, Core Group, Activ Participants, Users, Third-Party Service Providers - Governance for Blockchain Ecosystems Module:6 Blockchain Protocols Ghour Ethereum tokens - Augur - Golem - Understanding Ethereum tokens - App Coins an Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subreddit. Module:7 High Performance Computing Thour Integrity of High Performance Systems - Data Provenance - Cluster Construction an Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour Construction Cons	•	, ,	- DLT-based sm	nart c	ontr	acts	-
Decentralization versus Distribution - Centralized-distributed (Ce-Di) organizations Decentralized-distributed (De-Di) organizations - Decentralized Autonomous Organizations Aragon, DAOstack, DAOhaus and Colony. Module:5 Types of Blockchain Ecosystem							
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Module:5 Types of Blockchain Ecosystem 7 hour			` ,	_			
Module:5 Types of Blockchain Ecosystem One-Leader Ecosystem - Joint Venture or Consortia Ecosystems - Regulatory Blockchain Ecosystems - Components in Blockchain Ecosystem: Leaders, Core Group, Active Participants, Users, Third-Party Service Providers - Governance for Blockchain Ecosystems Module:6 Blockchain Protocols 6 hour Ethereum tokens - Augur - Golem - Understanding Ethereum tokens - App Coins and Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subreddit. Module:7 High Performance Computing 7 hour Integrity of High Performance Systems - Data Provenance - Cluster Construction and Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour			zea Autonomou	s Oig	jani.	zauc	ms.
One-Leader Ecosystem - Joint Venture or Consortia Ecosystems - Regulatory Blockchair Ecosystems - Components in Blockchain Ecosystem: Leaders, Core Group, Active Participants, Users, Third-Party Service Providers - Governance for Blockchain Ecosystems Module:6 Blockchain Protocols 6 hour Ethereum tokens - Augur - Golem - Understanding Ethereum tokens - App Coins and Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subreddit. Module:7 High Performance Computing 7 hour Integrity of High Performance Systems - Data Provenance - Cluster Construction and Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour						7 ho	ure
Ecosystems - Components in Blockchain Ecosystem: Leaders, Core Group, Activ Participants, Users, Third-Party Service Providers - Governance for Blockchain Ecosystems Module:6 Blockchain Protocols 6 hour Ethereum tokens - Augur - Golem - Understanding Ethereum tokens - App Coins an Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subreddit. Module:7 High Performance Computing 7 hour Integrity of High Performance Systems - Data Provenance - Cluster Construction an Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour			vstems - Regul	atory			
Participants, Users, Third-Party Service Providers - Governance for Blockchain Ecosystems Module:6 Blockchain Protocols 6 hour Ethereum tokens - Augur - Golem - Understanding Ethereum tokens - App Coins an Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subreddit. Module:7 High Performance Computing 7 hour Integrity of High Performance Systems - Data Provenance - Cluster Construction an Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour							
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Ethereum tokens – Augur - Golem - Understanding Ethereum tokens - App Coins an Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subreddit. Module:7 High Performance Computing 7 hour Integrity of High Performance Systems - Data Provenance - Cluster Construction an Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour			arree for Breekerr	<u> </u>			
Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Toke sale structure - Ethereum Subreddit. Module:7 High Performance Computing 7 hour Integrity of High Performance Systems - Data Provenance - Cluster Construction an Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour			ereum tokens -	qqA			
sale structure - Ethereum Subreddit.Module:7High Performance Computing7 hourIntegrity of Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data Blockchain Software Evaluation - Blockchain storage of Integrity Data.Module:8Contemporary Issues2 hour							
Integrity of High Performance Systems - Data Provenance - Cluster Construction an Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour							
Deployment - Mock Workload - Blockchain Software Evaluation - Blockchain storage of Integrity Data. Module:8 Contemporary Issues 2 hour							
Integrity Data. Module:8 Contemporary Issues 2 hour							
Module:8 Contemporary Issues 2 hour		ck Workload - Blockchain Software Eva	aluation - Block	chain	sto	rage	of
	Module:8 Conte						
Total Lecture hours: 45 hour		Total Lecture hours:			4	ho	urs
Text Book							
1. Dhillon, V., Metcalf, D., and Hooper, M, Blockchain enabled applications, 2017, 1st	1. Dhillon, V., M	letcalf, D., and Hooper, M, Blockchain ei	nabled application	ns, 2	2017	', 1s	t

	Edition, CA: Apress, Berkeley.								
D. (
Refe	Reference Books								
1.	1. Diedrich, H., Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations, 2016, 1st Edition, Wildfire publishing, Sydney.								
2.	Wattenhofer, R. P. Distributed Ledger Technology: The Science of the Blockchain 2. (Inverted Forest Publishing), 2017, 2 nd Edition, Createspace Independent Pub, Scotts Valley, California, US.								
Mod	Mode of Evaluation: CAT, written assignment, Quiz, FAT								
Rec	Recommended by Board of Studies 04-03-2022								
App	Approved by Academic Council No. 65 Date 17-03-2022								

BCSE325L	INTRODUCTION TO BITCOIN		L	Т	Р	С		
			3	0	0	3		
Pre-requisite	NIL		Syllal	ous	vers	ion		
•	1.0							
Course Object	ves							
1. To Identify th	e process of Cryptocurrency.							
	d the functionality of Bitcoin.							
	e recent developments on Bitcoin.							
Course Outcor								
	n of this course, the student shall be able to:							
1. Understand t	he fundamentals of Cryptography.							
	lge about various operations associated with Cryptoci	ırren	CV.					
	methods for verification and validation of Bitcoin trans							
	nciples, practices and policies associated with Bitcoin							
	idamentals of Cryptography				5 ho	ours		
	Hash Functions - Hash Pointers and Data Structure	s - C	Digital	Sigr				
	dentities - A Simple Cryptocurrency.		J	J				
	tures of Bitcoin				6 ho	ours		
Bitcoin Transac	ctions - Bitcoin Scripts - Applications of Bitcoin Sc	ripts	- Bito	oin				
	and Limitations.	•						
	coin Techniques				7 h	ours		
	Store and Use Bitcoins - Hot and Cold Storage - Split	ting a	and Sh	narin				
	and Exchanges - Payment Services - Transaction Fee					,, ,		
Module:4 Bit		Ī				ours		
	Miners - Mining Hardware - Energy Consumption and	Fcol	oav -	Mini				
- Mining Incenti	ves - Merkley Tree - hardness of mining - transaction	verifia	ability			0010		
Module:5 Bit	coin and Anonymity		a.o.iiity .		5 h	ours		
Anonymity – R	e-identification of Bitcoin - Mixing and Decentralisation	n of	Bitcoi	n - 7				
and Zero cash.				_				
	ning Strategies				5 ho	ours		
	e Requirements – Application Specific Integrated	Circu	it Res	sista				
	of Volunteer computing - Non externalization of Po							
Virtual Mining.	or relativest compating their externalization of the		•	00.	J. J	tarto		
	coin as a Platform				7 h	ours		
	opend-Only Log - Bitcoin as Smart Property - Secure	Mult	i-Part	v I o				
	as Randomness Source - Prediction Markets and Re							
	ntemporary Issues					ours		
	Total Lecture hours:			4		ours		
Text Book								
	S., Bonneau, J., Miller, A., Felten, E., Narayan	an	ΔRi	tcoir	ı an	d		
Cryptocurrency Technologies, 2016, 1st edition, Princeton University Press, New Jersey.								
Reference Boo	ks							
		ncur	rencie	s 2	<u>017</u>	2 nd		
	1. Antonopoulos, A. M. Mastering Bitcoin: unlocking digital cryptocurrencies, 2017, 2 nd edition, OReilly Media, Inc, United States.							
2. Lewis, Anto	ny, The Basics Of Bitcoins and Blockchains: An Intro	ductio	n To					
Cryptocurrencies and The Technology That Powers Them., 2018, 1 st edition, Mango								
Media Inc., United States.								
	tion: CAT / Assignment / Quiz / FAT							
	by Board of Studies 04-03-2022							
	ademic Council No. 65 Date 17-03	-202	2					
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DOCESSOR	DI COVOLIAIN ADCIUTECTUDI	E DECICN		T-	_		
BCSE326L	BLOCKCHAIN ARCHITECTURI	E DESIGN	3	. T	P 0	C	
Pre-requisite	NIL		Syllab		_	_	
rie-iequisite	INIL		Syllab	1.0	71 SIC	<i>)</i>	
Course Objective	26			1.0			
	knowledge on Blockchain architecture.						
	the design of Blockchain transaction and	security issu	es.				
	various use Cases in Blockchain.						
Course Outcome							
After completion of	of this course, the student shall be able to	:					
1. Understand the	requirements of the fundamentals of Blo	ckchain.					
	ply the concept of Bitcoin.						
	underlying technology of transactions, blo						
•	sight into Bitcoin network, Bitcoin miners a	and Bitcoin tr	ansactio	ns.			
	plore the applications of Blockchain.	Γ					
	amentals of Blockchain	<u> </u>			ho		
	rtance and features – Layers of Blockc						
	layer, propagation layer, consensus la						
	ractical use today – Blockchain gover	nance chall	enges –	BIO	CKCN	ıaın	
technical challeng		<u> </u>			ho	IIKO	
	kchain for Enterprise onents and Concepts - Block Header and	 Identifiers	Linking				
	ng and Consensus: Aggregating transacti						
	ssembling of Blocks, Selecting Chains of		JNS - WIIIII	ng ui	CDI	OUK	
	sactions and Bitcoin Network	Biodito:		-	ho	urs	
	ecycle, Structure, Inputs and Outputs,	Standard T	ransactio				
	discovery for a new node, Block propaga		anoaono				
Module:4 Bitco				8	3 ho	urs	
Consensus in Bit	coin: Proof of Work (PoW), Mining the	Block, Char	nging the	Cor	sen	sus	
Rules - Bitcoin C	ore: Bitcoin core application programming	g interface, r	unning a	bitco	oin c	ore	
1	clients, libraries and toolkits - Bitcoin Ad	ldresses: Im	plementi	ng Ke	eys a	and	
Addresses in Pyth							
	rity and privacy practices				ho		
	ure principles - Technical and inherent ris						
	y: Blockchain and non-blockchain based						
I .	er security best practices: physical bit	•	e, nardw	are	walle	ets,	
	rersifying risk, multi signature and governa kchain Architecture and	ance.			ho	IIFO	
	ications			•	110	uis	
	ology for blockchain applications: blo	ı ockchain ar	polication	ten	nnlat	tes	
	ation development – Ethereum – Solidity	•	•				
	etting – Colored coins – Counterparty.	Doploying	a campi	, чрр	iioati		
	kchain Use Cases			į.	ho	urs	
	nancial Software and Systems - Supply	chain and	logistics				
Music royalties tracking - Advertising insights - Blockchain implementation for Land Records							
	oublishing and selling - Digital Supply cha	•					
System							
Module:8 Cont	emporary Issues				2 ho		
Total Lecture hours: 45 hours							
Text Book(s)							
	Singhal, Gautam Dhameja, Priyan						
Blockchain, A Beginner's Guide to Building Blockchain Solutions, 2018, 1 st edition,							
1 1	•	iain Solution	1S, 2018	, 1 st	editi	ion,	
Apress, New	•						

	law and technology solutions, 2018, 1 st edition, McGraw-Hill publication, New York.								
Re	Reference Books								
1.	1. Swan Melanie, Blockchain: Blueprint for a new economy, 2015, 1st edition, O'Reilly								
	Media, United States.								
Мо	de of Evaluation: CAT / written ass	signment / Quiz	/ FAT						
Re	Recommended by Board of Studies 04-03-2022								
App	Approved by Academic Council No. 65 Date 17-03-2022								

BCSE3	27L	SMART CONTRACTS		L	Т	Р	С
				2	0	0	2
Pre-rec	uisite	NIL	Sy	llab	us v	ersi	on
					1.0		
Course	Objectiv	/es					
1. To u	nderstand	I the Smart Contracts in Blockchain.					
		ools and programming skills required to generate Sma	rt Cont	tracts	S.		
3. To a	ssess the	efficiency of the security issues.					
	Outcom						
		of this course, the student shall be able to:					
		e basics and objectives of Smart Contracts in a Block					
		rarious functionalities and features in an Ethereum to	genera	te Si	mart		
Contrac		0-11-11-1-1					
		Solidity language in creation of a Smart Contracts.					
		mart Contracts in decentralized applications. curity issues and effectiveness of a Smart Contracts i	a rool v	world	۱ ۵۵۵	nor'	ioo
J. ASSE	55 HIE 5E	curity issues and effectiveness of a Smart Contracts in	i i eai v	VOLIC	SCE	Han	05.
Module	v.1 Fun	damentals of Smart Contracts				2 ho	ure
		inologies - Cryptocurrency and Smart Contracts - Un	deretai	ndina			
		ckchain - Terminology, concepts and practices in Sm				> V II	tuai
		ereum Smart Contracts	<u> </u>	itiao		5 ho	urs
		hereum - Prevalence of the Ethereum blockchair	n in S	Smar			
		Ethereum Virtual Machine (EVM) - Instances of wo					
Contrac		(=,					
Module	:3 Vari	ous Aspects in Application of			Į.	5 ho	urs
		art Contracts					
Market	impact a	and scientific innovation – Trust - Security, using N	1erkle	Tree	es -	Fut	ure-
		res in Smart Contracts applications - Workflow of	fdeve	lopir	ng a	ı Sr	nart
		ution environments in writing a Smart Contracts.					
		dity Language Basics				4 ho	
•		dity Source File - Structure of a contracts - Control s	ructure	es –	Fur	ıctio	ns -
		larations.					
		dity with Contracts				<u>4 ho</u>	
		cts - Object-oriented high level language features - V	/isibilit	y an	d G	ette	rs —
		t Contracts.					
		entralized Applications				<u>4 ho</u>	
		oplication Architecture - Connecting to the Blockchain	and Sr	nart	Cor	ıtrac	ts –
		Deployment.				4 1	
		urity Issues	Calar	4:		4 ho	
		ust-in-People to Trust-in-Code - Data permanence	Selec	cuve-	aOD:	3CUI	ty -
		measures. temporary Issues				2 ha	
woult	;.0 CON	Total Lecture hours:				2 ho 0 ho	
T (P		Total Lecture Hours.			اد	7 110	นเจ
Text Bo		- Landian - Oct. 12 11 22 0 72		.			
		g, Longxiang Gao, Liqun Huang, Jian Guan, Ether	eum S	smar	τC	ontra	acts
De	veiopmer	t in Solidity, 2021, 1st Edition, Springer Singapore.					
Refere	nce Book	(S					
		Introducing Ethereum and solidity, 2017, (Vol. 318). E	Rorkolo	S	nrin		
1. Da	nnen. C	IIIII OUUCIIU LIIIGIGUIII AIIU SOIIUIIV. ZUTT. LVOI. STOTEI	ים ואכום	v. ن	יו וו וע	JUI.	

Modi, Ritesh, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and Blockchain, 2018, Packt Publishing Ltd, United Kingdom.
 Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder,

1 1	Bitcoin and cryptocurrency technologies: a comprehensive introduction, 2016, Princeton							
University Press.								
Mode of Evaluation: CAT / written assignment / Quiz / FAT								
Recommended by Board of Studies	04-03-2022							
Approved by Academic Council No. 65 Date 17-03-2022								

BCSE327P SMART CONTRACTS LAB			L	Т	Р	С
			0	0	2	1
Pre-requisite	NIL	Syll	labι	IS V	ersi	on
				1.0		

- 1. To understand the Smart Contracts in Blockchain.
- 2. To learn the tools and programming skills required to generate Smart Contracts.
- 3. To assess the efficiency of the security issues.

Course Outcomes

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

- 1. Evaluate the various functionalities and features in an Ethereum to generate Smart Contracts.
- 2. Assess the security issues and effectiveness of a Smart Contracts in real world scenarios.

Indicative Experiments

- 1. Setting up Ethereum network by using Geth command line interface.
- 2. Identifying and setting up a testnet, like Ropsten or Kovan, so that free ethers can be used as transaction.
- 3. Transfer ethers from one account to another on an Ethereum testnet.
- 4. Constructing Solidity code for a decentralized application where the owner can create a contracts (with a tenant) which can be replicated to all nodes.
- 5. In a rented house setup with the owner and the tenants, the tenant can submit a deposit and the contracts's state changes on all the decentralized nodes.
- 6. The owner should be able to check the balance of the contracts from any one of the nodes.
- 7. Using Remix on the Solidity code to develop, compile and deploy the contracts.
- 8. Using setter and getter functions to interact with the contracts
- 9. Withdrawing funds from a contracts to a restricted account, preferably the owner's, with different levels of security restrictions.
- 10. Deploying a contracts on an external blockchain by using Ganache and/or MyEtherwalllet, Metamask.

Total Laboratory Hours | 30 hours

Text Book

 Gavin Zheng, Longxiang Gao, Liqun Huang, Jian Guan, Ethereum Smart Contracts Development in Solidity, 2021, 1st Edition, Springer Singapore.

Reference Books

- 1. Modi, Ritesh. Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain. 2018, Packt Publishing Ltd, United Kingdom.
- 2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and cryptocurrency technologies: a comprehensive introduction, 2016, Princeton University Press.

University Frees.							
Mode of assessment: Continuous assessment / FAT							
Recommended by Board of Studies	04-03-2022						
Approved by Academic Council	No. 65	Date	17-03-2022				

BCSE328L	L CRYPTOCURRENCY TECHNOLOGIES L T			Т	Р	С
			3	0	0	3
Pre-requisite NIL Syllabu		ıbu	s ve	ersi	on	
			1	.0		

- 1. To introduce the cryptocurrency concepts and techniques used in business transactions.
- 2. To provide skills and knowledge about operations and management in cryptocurrency technologies applied in large scale business.
- 3. To develop own cryptocurrencies that meets the business and customer needs.

Course Outcome

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

- 1. Understand the evolution, principles and benefits of cryptocurrencies.
- 2. Assess existing technologies to choose an appropriate technology that meets business needs.
- 3. Implement the scripting foundations to cater the needs of generating own cryptocurrencies.
- 4. Decide a suitable model to capture the business needs by interpreting different crypto primitives.
- 5. Infer the various bitcoin related security and privacy issues and building own cryptocurrencies.

Module:1 Fundamentals of Cryptocurrency

7 hours

Cryptocurrency - Origin and Importance - Legal Status - Usage of Cryptocurrency - Blockchain Structure - Interaction between Blockchain and Cryptocurrencies - Importance and uses of Cryptocurrency - Hardware and Software requirements of Block chain.

Module:2 Functional Aspects of Cryptocurrency

8 hours

Bitcoin and other Cryptocurrencies - Distributed consensus and atomic broadcast - Alternatives to Bitcoin consensus - Alternative coins - Byzantine fault-tolerant consensus methods - Blockchain based cryptocurrency and its applications - Technologies borrowed in Blockchain.

Module:3 | Bitcoin Scripting

5 hours

Bitcoin scripting language and their uses - Transactions - Signatures - Pay to script hash - Segregated Witness - Pay To Multi-signature - Storing Data - Timelocks - Hash Time-Locked Contracts - Atomic Swaps - Payment Channels.

Module:4 | Crypto Primitives for Cryptocurrency

5 hours

Hash functions - Puzzle-friendly Hash - Collison resistant hash - Hash pointers and digital signatures - public key crypto - verifiable random functions - Zero-knowledge systems - Bitcoin Blockchain - Interaction with the blockchain - Elliptic curve cryptography in blockchain - SHA-256.

Module:5 Security & Privacy Issues in Cryptocurrency

4 hours

Building a Secure Bitcoin payment system - Building a Secure payment gateway - Compiling Bitcoin from source new cryptocurrency - Cloning Bitcoin - Reader coin rebranding - Securing Peer-to-Peer Auctions in Ethereum - Applications of blockchain in cyber security.

Module:6 | Building Own Cryptocurrency

7 hours

Coding Own Cryptocurrency on Ethereum - Building ERC-20 Token - Integrity of information - E-Governance and other contract enforcement mechanisms - Limitations of blockchain - Myths vs. reality of blockchain technology.

Module:7 | Future Directions of Cryptocurrency

7 hours

(Int	Smart Property - Efficient micro-payments - Coupling Transactions and Payment (Interdependent Transactions) - Public Randomness Source Prediction Markets - Escrow									
trar	transactions - Green addresses - Auctions and Markets - Multi-party Lotteries.									
Module:8 Contemporary Issues 2 hour										
		To	tal Lecture ho	urs:	45 hours					
Tex	kt Book									
1.	Daska	lakis, Nikos, and Panagioti	s Georgitseas.	An Intro	oduction to Cryptocurrencies:					
		rypto Market Ecosystem, 20								
Ref	ference	Books								
1.	Grabo	wski, Mark. Cryptocurrenc	cies: A Prime	r on Dig	ital Money, 2019, 1 st Edition,					
	Routle	dge, New York.			•					
2.	Naraya	anan, Arvind, et al. Bitcoi	n and cryptoc	urrency 1	technologies: a comprehensive					
	introduction, 2016, 1 st Edition, Princeton University Press, New Jersey.									
Мо	Mode of Evaluation: CAT / written assignment / Quiz / FAT									
Red	Recommended by Board of Studies 04-03-2022									
App	proved b	by Academic Council	No. 65	Date	17-03-2022					

BCSE329L BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY			L	Т	Р	С
			2	0	0	2
Pre-requisite	NIL	Syllabus version				
				1.	0	

- 1. To understand Blockchain and Distributed Ledger Technologies.
- 2. To learn the development in Blockchain functionalities.
- 3. To identify alternative techniques to proof of work for Blockchain protocols, proof of stake/space.

Course Outcomes

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

- 1. Comprehend the functionality of blockchain.
- 2. Choose a blockchain implementation based on real time scenario.
- 3. Examine the techniques for anonymity preservation.
- 4. Determine the Blockchain challenges.
- 5. Identify the use cases of distributed ledger technology.
- 6. Evaluate alternative blockchain and their applicability.

Module:1Blockchain and Distributed Ledger Fundamentals4 hoursBlockchain - Distributed Ledger - Cryptographic basics for cryptocurrency - signatureschemes, encryption schemes and elliptic curve cryptography - CAP theorem - Categories ofBlockchain: Public blockchain, Private blockchain, Permissioned Ledger,Tokenizedblockchain, Tokenless blockchain, and Sidechains.

Module:2 | Blockchain Functionality

5 hours

Distributed identity: Public and private keys, Digital identification and wallets - Decentralized network - Permissioned distributed Ledger - Blockchain data structure - Double spending - Network consensus - Sybil attacks - Block rewards and miners - Forks and consensus chain - Finality in Blockchain Consensus - Limitation of proof-of-work - Alternatives to Proof of Work.

Module:3 | Blockchain Implementation

4 hours

Bitcoin and Merkle Root - Eventual Consistency and Bitcoin - Byzantine Fault Tolerance - Bitcoin and Secure Hashing - Bitcoin block-size - Bitcoin Mining - Blockchain Collaborative Implementations: Hyperledger, Corda - Ethereum's ERC 20 and token explosion.

Module:4 Decentralization using Blockchain

4 hours

Blockchain and full ecosystem decentralization: Smart contract, Decentralized autonomous organization (DAO), Decentralized applications - Platforms for decentralization.

Module:5Zero Knowledge Proofs and Protocols in Blockchain4 hoursPseudo-anonymity vs. anonymity - Succinct non interactive argument for Knowledge(SNARK) - pairing on Elliptic curves - Zcash - Zk-SNARKS for anonymity preservation.

Module:6 Blockchain Challenges

3 hours

Blockchain Governance Challenges: Bitcoin Blocksize Debate, The Ethereum DAO Fork, Ethereum's Move to PoS and Scaling Challenges - Blockchain Technical Challenges: Denial-of-Service Attacks, Security in Smart Contracts, Scaling, Sharding.

Module:7 Distributed Ledger Technology in Alternative Blockchain

4 hours

Kadena, Ripple, Stellar, Rootstock, Drivechain, Quorum – Decentralized Network manager: Tezos, Maidsafe, BigChainDB - Decentralized Cloud Storage: Storj.

Module:8	Contemporary Issues	2 hours
	Total Lecture hours:	30 hours
I — — —		

Text Book

1. Goldfeder, S., Bonneau, J., Miller, A., Felten, E., Narayanan, A. Bitcoin and

	Cryptocurrency Technologies, 2016, 1 st edition, Princeton University Press, New								
	Jersey.								
Ref	Reference Books								
1.	lyer, Kedar, et al. Blockchain: A Practical Guide to Developing Business, Law, and								
	Technology Solutions., 2018, 1st edition, McGraw-Hill Education, United Kingdom.								
2.	Wattenhofer, R. Distributed Ledger	Technology	The Scie	ence of the Blockchain,					
	2017, 1 st edition, CreateSpace Inde	ependent Pul	olishing Pl	latform, United States.					
Мо	de of Evaluation: CAT / written assig	nment / Quiz	z / FAT						
Red	Recommended by Board of Studies 04-03-2022								
App	Approved by Academic Council No. 65 Date 17-03-2022								

BC	SE329P	BLOCKCHAIN AND		LEDGER		L	T	P	С
		TECHNO	DLOGY LAB			0	0	2	1
Dra	e-requisite	NIL				_		1	
FIE	e-requisite	NIL			Syli	au	1.0	vers	1011
<u></u>	urse Objective						1.0	1	
		Blockchain and Distributed	Ledger Technol	odios					
		velopment in Blockchain fur		ogies.					
		ernative techniques to pro		Blockchair	n nrot	റവ	ols	nro	of of
	ike/space.	ornative teeriniques to pre	or or work for	Dioonorian	ı pıoc	00.	010,	prov	J1
	с, орассі								
Co	urse Outcome	S							
		f this course, the student sh	nall be able to:						
,	or completion o	. and deares, and etademics.	ian be able to:						
1.	Implement a blo	ockchain for real time scena	rio.						
		ative blockchain and their a							
	dicative Experi								
1.	Deploy a local	private blockchain over a r	etwork with Eth	ereum or F	Rust.				
2.	Implement the	e mining module of Bitcoin	client using Rus	t. The mini	ng mo	dυ	ile, d	or mi	ner,
	should produc	e blocks that solve proof-of	-work puzzle.						
3.		est smart contracts on a tes	sting framework	using the I	Ethere	un	n Vii	tual	
	Machine (EVI	Л).							
4	Danilara a alaak	d : 1 b d d E		4					
4.	Deploy a chall	ncode using Hyperledger Fa	abric on a custor	n network.					
5.	Crooto a Huna	vilodaar Cabria Blackabain e	onico en Claud						
J.	Стеате а пуре	erledger Fabric Blockchain s	service on Cloud	•					
6.	Denloving a F	RC20 token on the Ethereu	ım Tastnat						
0.	Deploying a L	INOZO lokeli oli tile Etileret	iiii restrict.						
7.	Launch vour o	wn token on alternative blo	ckchain such as	BigchainΓ)B				
•				2.90.142					
	1		Total La	boratory H	lours	1	30 h	our	S
Te	xt Book								
1		., Bonneau, J., Miller, A., Fo	elten, E., Naraya	ınan, A. Bi	tcoin a	anc	d		
	Cryptocurrer	ncy Technologies, 2016, 1 st	edition, Princeto	n Universi	ty Pre	SS	, Ne	W	
	Jersey.								
Re	ference Books								
1		et al. Blockchain: A Praction							ıd
		Solutions., 2018, 1st edition		ducation, l	Jnited	Ki	ngd	om.	
		n: CAT / written assignmen							
		Board of Studies	04-03-2022						
Аp	pproved by Academic Council No. 65 Date 17-03-2022								

BCSE330L	PUBLIC KEY INFRASTRUCTURE AND TRUST MANAGEMENT			Т	Р	С
			3	0	0	3
Pre-requisite		Syllabus version			ion	
		1.0				

- 1. To provide the knowledge on Public Key Cryptography techniques and Public Key infrastructure.
- 2. To study about the Digital Certificates and the security challenges.
- 3. To understand the various trust models and the trust management systems.

Course Outcome:

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

- 1. Analyze and design Public Key cryptographic algorithms.
- 2. Evaluate the components of PKI and design & integrate PKI services
- 3. Design the Digital Certificates with PKI considerations
- 4. Identify the access control mechanism and provide solution for the security challenges
- 5. Analyze and select suitable trust model and manage with operational considerations

Module:1 | Public Key Cryptography Basics

5 hours

Public Key Cryptography: Secret key, Public key, public/private key pair, Services of public key cryptography - RABIN Cryptosystem - ElGamal Cryptosystem - Message Integrity and Authentication: Random Oracle model, message authentication, Cryptographic hash functions.

Module:2 | Public Key Infrastructure

7 hours

Components and architecture of fully functional Public key infrastructure(PKI): Certification authority, Certificate repository, Certificate revocation, Key backup and recovery, Automatic key update, Key history management, Cross-certification, Support for non-repudiation, Time stamping, Client software, Core PKI Services, PKI-Enabled Services, PKI interoperability, deployment and assessment PKI data structures - PKI architectures: Single CA, Hierarchical PKI, Mesh PKI, Trust Lists, Bridge Certification Authority (CA), Registration Authority (RA), Simple PKI (SPKI), PKI application: Smart card integration with PKI's.

Module:3 | Digital Certificates

7 hours

Introduction to Digital Certificate - Certificate Structure and Semantics - Alternative Certificate Formats - Certificate Policies - Object Identifiers - Policy Authorities - Certification Authority - Key/Certificate Life Cycle Management - Certificate Revocation - Representing certificates in terms of S-Expressions - Certificate Chain.

Module:4 | Access Control Mechanisms and Security Challenges

7 hours

Access Control Mechanisms: Discretionary Access Control (DAC) – Mandatory Access Control (MAC) – Role Based Access Control (RBAC) - Issues: Revocation- Anonymity-Privacy issues - Entity Authentication - Passwords and Challenge Response - zero-knowledge and bio-metrics - Key management - security key distribution – Kerberos - Symmetric Key agreement - Public Key Distribution and Hi-jacking - Issues of revocation - Anonymity and Privacy.

	Trust Models				7 hours	
Distributed Trust Architecture - Mesh Configuration - Hub-and-Spoke Configuration - Four-						
Corner Trust Model - Web Model - User-Centric Trust - Cross-Certification - Entity Naming -						
	Certificate Path Processing - Path Construction - Path Validation - Trust Anchor					
	ions - Multiple Key Pairs - K	ey Pair Uses -	Relations	ship betwe	een Key Pairs and	
Certificates						
	Trust Management System				5 hours	
	work based Trust Managem					
	MRep, EigenRep, P2Prep) -					
	merce and E- Business: Infor		id Lechno	logy Busi		
Module: /	Operational Consideration	ns			5 hours	
Client-Side	Software - Off-line Operati	ions - Physica	Security	- Hardwa	are Components -	
	Compromise - Disaster Prep					
	<u>n – Recovery - Electronic Sig</u>	ınature Legisla	tion and C	Considerat		
Module:8	Contemporary Issues				2 hours	
				ı	_	
		Total Lectur	e hours:		45 hours	
Text Book	(s)					
	R. Vacca, Public Key Infra			sted App	olications and Web	
	es, 2019, 1 st edition. Auerbad					
	e Adams, Steve Lloyd,					
	ment Considerations, 2011,	2nd Edition, A	ddison-W	esley, US		
Reference						
1. Buchmann J, Karatsiolis E, Wiesmaier A, Karatsiolis E., Introduction to public key						
infrastructures, 2013, Berlin: Springer.						
-	Mode of Evaluation: CAT / written assignment / Quiz / FAT					
	nded by Board of Studies	04-03-2022				
Approved I	by Academic Council	No. 65	Date	17-03-20)22	

BCSE391J	Technical Answers to Real Problems Project	L	T	Р	С
DC3E3913	reclinical Aliswers to Real Problems Project		0	0	3
Pre-requisite	NIL	Syllabus version			ion
		1.0			

- 1. To gain an understanding of real-life issues faced by society.
- 2. To study appropriate technologies in order to find a solution to real life issues.
- 3. Students will design system components intended to solve a real-life issue.

Course Outcome:

- 1. Identify real life issue(s) faced by society.
- 2. Apply appropriate technologies to suggest a solution to the identified issue(s).
- 3. Design the related system components/processes intended to provide a solution to the identified issue(s).

Module Content

Students are expected to perform a survey and interact with society to find out the real life issues.

Logical steps with the application of appropriate technologies should be suggested to solve the identified issues.

Subsequently the student should design the related system components or processes which is intended to provide the solution to the identified real-life issues.

General Guidelines:

- 1. Identification of real-life problems
- 2. Field visits can be arranged by the faculty concerned
- 3. Maximum of 3 students can form a team (within the same/different discipline)
- 4. Minimum of eight hours on self-managed team activity
- 5. Appropriate scientific methodologies to be utilized to solve the identified issue
- 6. Solution should be in the form of fabrication/coding/modelling/product design/process design/relevant scientific methodology(ies)
- 7. Consolidated report to be submitted for assessment
- 8. Participation, involvement and contribution in group discussions during the contact hours will be used as the modalities for the continuous assessment of the theory component
- 9. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility
- 10. Contribution of each group member to be assessed

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No.65	Date	17-03-2022

BCSE392J	Design Project	L	Т	Р	С
BCSE392J		0	0	0	3
Pre-requisite	NIL	Syllabus version			ion
		1.0			

- 1. Students will be able to upgrade a prototype to a design prototype.
- 2. Describe and demonstrate the techniques and skills necessary for the project.
- 3. Acquire knowledge and better understanding of design systems.

Course Outcome:

- 1. Develop new skills and demonstrate the ability to upgrade a prototype to a design prototype or working model.
- 2. Utilize the techniques, skills, and modern tools necessary for the project.
- 3. Synthesize knowledge and use insight and creativity to better understand and improve design systems.

Module Content

Students are expected to develop new skills and demonstrate the ability to develop prototypes to design prototype or working models related to an engineering product or a process.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE393J	Laboratory Project		Т	Р	С
DC3E3933			0	0	3
Pre-requisite	NIL	Syllabus versio			ion
		1.0			

- 1. The student will be able to conduct experiments on the concepts already learnt.
- 2. Analyse experimental data.
- 3. Present the results with appropriate interpretation.

Course Outcome:

- 1. Design and conduct experiments in order to gain hands-on experience on the concepts already studied.
- 2. Analyse and interpret experimental data.
- 3. Write clear and concise technical reports and research articles

Module Content

Students are expected to perform experiments and gain hands-on experience on the theory courses they have already studied or registered in the ongoing semester. The theory course registered is not expected to have laboratory component and the student is expected to register with the same faculty who handled the theory course. This is mostly applicable to the elective courses. The nature of the laboratory experiments is depended on the course.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE394J	Product Development Project		T	Р	С
DC3E394J			0	0	3
Pre-requisite	NIL	Syllabus version			ion
		1.0			

- 1. Students will be able to translate a prototype to a useful product.
- 2. Apply relevant codes and standards during product development.
- 3. The student will be able to present his results by means of clear technical reports.

Course Outcome:

- 1. Demonstrate the ability to translate the developed prototype/working model to a viable product useful to society/industry.
- 2. Apply the appropriate codes/regulations/standards during product development.
- 3. Write clear and concise technical reports and research articles

Module Content

Students are expected to translate the developed prototypes / working models into a product which has application to society or industry.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No.65	Date	17-03-2022

BCSE396J	Reading Course		Т	Р	С
DC3E390J			0	0	3
Pre-requisite	NIL	Syllabus versio			ion
		1.0			

- 1. The student will be able to analyse and interpret published literature for information pertaining to niche areas.
- 2. Scrutinize technical literature and arrive at conclusions.
- 3. Use insight and creativity for a better understanding of the domain of interest.

Course Outcome:

- 1. Retrieve, analyse, and interpret published literature/books providing information related to niche areas/focused domains.
- 2. Examine technical literature, resolve ambiguity, and develop conclusions.
- 3. Synthesize knowledge and use insight and creativity to better understand the domain of interest.

Module Content

This is oriented towards reading published literature or books related to niche areas or focussed domains under the guidance of a faculty.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No.65	Date	17-03-2022

BCSE397J	CCCT207 I Crossial Brainet	L	Т	Р	С
BC3E3973	Special Project	0	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

- 1. Students will be able to identify and solve problems in a time-bound manner.
- 2. Describe major approaches and findings in the area of interest.
- 3. Present the results in a clear and concise manner.

Course Outcome:

- 1. To identify, formulate, and solve problems using appropriate information and approaches in a time-bound manner.
- 2. To demonstrate an understanding of major approaches, concepts, and current research findings in the area of interest.
- 3. Write clear and concise research articles for publication in conference proceedings/peer-reviewed journals.

Module Content

This is an open-ended course in which the student is expected to work on a time bound research project under the supervision of a faculty. The result may be a tangible output in terms of publication of research articles in a conference proceeding or in a peer-reviewed Scopus indexed journal.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE398J	Simulation Project	L	T	Р	С
BCSE398J Simulation Project		0	0	0	3
Pre-requisite	NIL	Syllabus version			ion
		1.0			

- 1. Students will be able to simulate a real system.
- 2. Identify the variables which affect the system.
- 3. Describe the performance of a real system.

Course Outcome:

- 1. Demonstrate the ability to simulate and critically analyse the working of a real system.
- 2. Identify and study the different variables which affect the system elaborately.
- 3. Evaluate the impact and performance of the real system.

Module Content

The student is expected to simulate and critically analyse the working of a real system. Role of different variables which affect the system has to be studied extensively such that the impact of each step in the process is understood, thereby the performance of each step of the engineering process is evaluated.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BEEE303L	Control Systems		L T P C
			3 0 0 3
Pre-requisites	BEEE101L, BEEE101P, BMAT102L		Syllabus version
			1.0
Course Objectiv	es		
1. Introduce the	fundamentals of physical systems mod	elling and co	ntrol of linear time
invariant systems			
	tical control system design with realistic s		
Impart knowled	lge of state variable models and state feed	dback design.	
Course Outcome			
	n of this course, the student will be able to		
	nematical models of the physical systems.		
	stem performance in time and frequency o		
	stability of linear time invariant system in t		
	nsators and controllers to meet the perform		cations.
5. Perform state s	space analysis and design state feedback	control.	
		T	
	ems and their Representations		6 hours
	in control systems: open loop and clo		
	rical and electro-mechanical systems, ele	ectrical analog	jous systems; Block
	n, signal flow graphs.	T	
	Response Analysis	<u> </u>	6 hours
	gnals, time response of first and seco		
	eady state error, static error constants and	l system type.	
	lity Analysis and Root Locus		6 hours
	and definition, characteristic equation,		
	us technique: construction, properties and	applications.	
	uency Response Analysis	Carrolation	6 hours
	in specifications; Bode plot, Polar plot;	Correlation	between frequency
	domain specifications.	Ι	5 hours
	lity in Frequency Domain	alvaia vaina t	5 hours
	gain margin, phase margin; stability an	arysis using i	requency response
	stability criterion.	Ι	7 hours
	pensators and Controllers	l n in time der	
	sic compensators, cascade compensation compensation, design of lag, lead, lag		
	nd PID controllers in frequency domain.	-lead Selles C	Joinpensalors using
Module:7 State			7 hours
	e variable and state model, solution of	l Fistate equati	
transfer function	· · · · · · · · · · · · · · · · · · ·	•	ods, controllability,
	e placement control, observer design.	osition metric	ous, controllability,
	temporary Issues		2 hours
Wodule.0 Oom	emporary issues		Z IIOUIS
		T	
	Total Lecture hours:		45 hours
Text Books		.	
	ise, Control System Engineering, 2019, 8 ^t		
	aghi, Benjamin C. Kuo, Automatic Cont	rol System, 2	$2017, 9^{m}$ Edition,
McGraw-Hill			
Deference Book	_		

K. Ogata, Modern Control Engineering, 2016, 5th Edition, Pearson
 R.C. Dorf & R.H. Bishop, Modern Control Systems, 2017, 13th Edition, Pearson

Reference Books

	Education						
3.							
4. J. Nagrath and M. Gopal, Control System Engineering, 2018, 6 th Edition, New Age International Publishers							
Мо	de of Evaluation: CAT, Assignment,	Quiz, FAT					
Re	Recommended by Board of Studies 19-02-2022						
App	proved by Academic Council	No. 65	Date	17-03-2022			

BEEE303P Control Systems Lab			L	Τ	P	С
			0	0	2	1
Pre-requisites	BEEE101L, BEEE101P, BMAT102L	Syll	abı	IS V	ersi	on
			•	1.0		
Course Objectiv	ves .					
	er function and state space models of physical systems.					
	plement a PID controller/State feedback controller/ Lag/L	_ead/l	Lag-	-lea	d	
compensators.						
O						
Course Outcom						
	on of this course, the student will be able to:					
	ck control for meeting system specifications. ability and response of linear time invariant systems.					
	ne and frequency domain analyses of first and second o	dor c	vete	me		
3. Perioriii ule ui	ne and nequency domain analyses of hist and second of	uei s	ysic	11115	•	
Indicative Expe	riments					
	study of block diagram reduction technique					
	on of time domain specifications					
Study of fire	st and second order electrical networks					
	alysis of linear systems					
PID control	ler design using Bode plot					
	ler design using root locus					
	or design in frequency and time domains					
	controllability and observability properties of a system					
	nsator design for linear servo motor for speed control ap	olicati	on			
	nent controller design for inverted pendulum					
	er design for position control of servo plant					
	ontrol design for ball and beam system					
	er design for magnetic levitation system					
	on of transfer function of separately excited DC generate					
	n of transfer function of field-controlled separately excite		Mot	or		
16. Controller re	ealization from MATLAB / SIMULINK using Embedded C					
	Total Laboratory Ho	urs	30 ł	nour	S	
	nent: Continuous assessment, FAT					
Text Book	S. Nise, Control System Engineering, 2019, 8 th Edition					

Sons

Recommended by Board of Studies

Approved by Academic Council

19-02-2022

Date

17-03-2022

No. 65

Project and Internship

BCSE399J	Summer Industrial Internship	L	T	Р	С
DC3E3993	Summer maustrial internship	0	0	0	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Course Outcome:

- 1. Demonstrate professional and ethical responsibility.
- 2. Understand the impact of engineering solutions in a global, economic, environmental and societal context.
- 3. Develop the ability to engage in research and to involve in life-long learning.
- 4. Comprehend contemporary issues.

Module Content

Four weeks of work at industry site.

Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

	Recommended by Board of Studies	09-03-2022		
,	Approved by Academic Council	No. 65	Date	17-03-2022

BCSE497J	Droinet I	L	Т	Р	С
BCSE497J Project - I		0	0	0	3
Pre-requisite	NIL Syllabu			vers	ion
		1.0			

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

- 1. Demonstrate professional and ethical responsibility.
- 2. Evaluate evidence to determine and implement best practice.
- 3. Mentor and support peers to achieve excellence in practice of the discipline.
- 4. Work in multi-disciplinary teams and provide solutions to problems that arise in multi-disciplinary work.

Module Content

Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

Can be individual work or a group project, with a maximum of 3 students.

In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.

Carried out inside or outside the university, in any relevant industry or research institution.

Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - project report to be submitted, presentation and project reviews

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

BCSE498J	Project II / Internable		Т	Р	С
	Project – II / Internship	0	0	0	5
Pre-requisite	NIL	Syllabus version			
		1.0			

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

- 1. Formulate specific problem statements for well-defined real life problems with reasonable assumptions and constraints.
- 2. Perform literature search and / or patent search in the area of interest.
- 3. Conduct experiments / Design and Analysis / solution iterations and document the results.
- 4. Perform error analysis / benchmarking / costing.
- 5. Synthesize the results and arrive at scientific conclusions / products / solution.
- 6. Document the results in the form of technical report / presentation.

Module Content

- 1. Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
- 2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
- 3. Can be individual work or a group project, with a maximum of 3 students.
- 4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
- 5. Carried out inside or outside the university, in any relevant industry or research institution.
- 6. Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: : Assessment on the project - project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022			
Approved by Academic Council	No. 65	Date	17-03-2022	

BCHY101L	Engineering Chemistry	L	1	Γ	Р	С
		3)	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				

- 1. To enable students to have fundamental understanding of the basic concepts of different disciplines of chemistry.
- 2. To provide avenues for learning advanced concepts from school to university
- 3. To empower students with emerging concepts in applied chemistry to be useful in addressing societal needs
- 4. To integrate analytical and computational ability with experimental skills to create individuals competent in basic science and its by-product of its application.
- 5. To offer opportunities to create pathways for self-reliant in terms of knowledge and higher learning

Course Outcomes:

- 1. Understand the fundamental concepts in organic, inorganic, physical, and analytical chemistry.
- 2. Analyze the principles of applied chemistry in solving the societal issues.
- 3. Apply chemical concepts for the advancement of materials.
- 4. Appreciate the fundamental principles of spectroscopy and the related applications.
- 5. Design new materials, energy conversion devices and new protective coating techniques.

Module:1 Chemical thermodynamics and kinetics

6 hours

Laws of thermodynamics - entropy change (selected processes) – spontaneity of a chemical reaction and Gibbs free energy - heat transfer; Kinetics - Concept of activation energy and energy barrier - Arrhenius equation- effect of catalysts (homo and heterogeneous) – Enzyme catalysis (Michaelis-Menten Mechanism).

Module:2 | Metal complexes and organometallics

6 hours

Inorganic complexes - structure, bonding and application; Organometallics - introduction, stability, structure and applications of metal carbonyls, ferrocene and Grignard reagent; Metals in biology (haemoglobin, chlorophyll- structure and property).

Module:3 Organic intermediates and reaction transformations

6 hours

Organic intermediates - stability and structure of carbocations, carbanions and radicals; Aromatics (aromaticity) and heterocycles (3, 4, 5, 6 membered and fused systems); Organic transformations for making useful drugs for specific disease targets (two examples) and dyes (addition, elimination, substitution and cross coupling reactions).

Module:4 | Energy devices

6 hours

Electrochemical and electrolytic cells – electrode materials with examples (semi-conductors), electrode-electrolyte interface- chemistry of Li ion secondary batteries, supercapacitors; Fuel cells: H₂-O₂ and solid oxide fuel cell (SOFC); Solar cells - photovoltaic cell (silicon based), photoelectrochemical cells and dye-sensitized cells.

Module:5 Functional materials

7 hours

Oxides of AB, AB₂, ABO₃ type (specific examples); Composites - types and properties; Polymers - thermosetting and thermoplastic polymers – synthesis and application (TEFLON, BAKELITE); Conducting polymers- polyacetylene and effect of doping – chemistry of display devices specific to OLEDs; Nano materials – introduction, bulk *vs* nano (quantum dots), top-down and bottom-up approaches for synthesis, and properties of nano Au.

Module:6 | Spectroscopic, diffraction and microscopic techniques

5 hours

Fundamental concepts in spectroscopic and instrumental techniques; Principle and applications of UV-Visible and XRD techniques (numericals); Overview of various techniques such as AAS, IR, NMR, SEM and TEM.

Module:7 Industrial applications

Water purification methods - zeolites, ion-exchange resins and reverse osmosis; Fuels and combustion -LCV, HCV, Bomb calorimeter (numericals), anti-knocking agents); Protective coatings for corrosion control: cathodic and anodic protection - PVD technique; Chemical sensors for environmental monitoring - gas sensors; Overview of computational methodologies: energy minimization and conformational analysis.

Mod	dule:8 Contemporary topics				2 hours
Gue	est lectures from Industry and, Resear	ch and De	evelopment O	rganizations	
			Total Le	cture hours:	45 hours
Toy	tbook				
		May Day	o C Duratan	Cothorino M	umahu Datriak
1.	Theodore E. Brown, H Eugene, Le	-			• •
	Woodward, Matthew E. Stoltzfus, C	nemistry:	The Central	Science, 2017	, 14th edition,
_	Pearson Publishers, 2017. UK				
	erence Books				
1.	Peter Vollhardt, Neil Schore, Organ	ic Chemis	try: Structure	and Function,	2018, 8th ed.
	WH Freeman, London				
2.	Atkins' Physical Chemistry: Interna	tional, 20	18, Eleventh	edition, Oxf	ord University
	Press; UK				
3.	Colin Banwell, Elaine McCash, Fun	damentals	s for Molecula	r Spectroscop	y, 4th Edition,
	McGraw Hill, US				
4.	Solid State Chemistry and its Applic	ations, Ar	thony R. Wes	st. 2014, 2nd	edition, Wiley,
	UK.		-		-
5.	Angà le Reinders, Pierre Verlind	den, Wilf	ried van Sa	ırk, Alexandre	e Freundlich,
	Photovoltaic solar energy: From fur				
6.	UK.		• •	,	•
	Lawrence S. Brown and Thomas H	olme. Che	mistry for end	aineerina stude	ents. 2018. 4 th
	edition - Open access version	,		,	, — ,
Mod	le of Evaluation: CAT, Written assigni	ment. Quiz	and FAT		
		6.2021			
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	roved by Academic Council No. 6	33	Date	23.09.2021	

BCH	IY101P	Engine	ring Cher	nistry Lab		L	Т	Р	С
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Pre-	requisite	NIL				Syllal	ous	vers	ion
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	opics.								
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		by Board of Studies	28.06.20			001			
App	roved by Aca	ademic Council	No. 63	Date	23.09.2	021			

Pre-requisite Nil Syllabus version	BECE101L	Basic Electronics		L	T	P	С
1.0 Course Objectives 1. To introduce the students to the basic concepts of electronic components, sources measurements, and instrumentation. 2. To apply the inculcated knowledge for developing simple circuits using various electronic components and devices 3. To familiarize the students with the basic concepts of number systems and digital logic. 4. To analyse the concepts associated with multiple sensors and their sensing mechanisms. Course Outcome Students will be able to 1. Understand the basic electronic components, sources, and measuring equipment 2. Comprehend the characteristics of diodes, transistors and their applications 3. Design and analyse the amplifiers and oscillators 4. Design and implement simple digital circuits 5. Analyse the performance metrics of the measurement systems. 4. Design and implement simple digital circuits 5. Analyse the performance metrics of the measurement systems. 6. Comprehend the basic concept of various sensors and their sensing mechanisms. Module:1 Electronic Components, Sources, and Measuring Equipment 3 hours 2. Evolution of Electronics - Impact of Electronics in Industry and Society - Familiarization of Resistors, Capacitors, Inductors - Colour Coding - types and specifications, - Electromechanical components - Relay and Contactors - Regulated Power supply, Functior Generator - Multimeter - CRO Module:2 Junction Diodes 4 hours 5 hours 5 hours 5 hours 5 hours 5 hours 5 hours 6 hours				2	0 ()	2
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Intrinsic and extrinsic semiconductors — doping - PN Junctions, Formation of Junction Physical operation of diode, Barrier Potential, I - V Characteristics, Rectifiers, Zener diode - I-V Characteristics, Zener diode as Voltage regulator. Module:3 Transistors 5 hours					4 1-		
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I-V Characteristics, Zener diode as Voltage regulator.Module:3Transistors5 hoursBipolar Junction Transistor (BJT) - Device structure and physical operation, Concept of CB CE and CC Configuration, Transistor as a Switch, - Metal-Oxide Field Effect Transistor (MOSFET) - Device Structure, mode of operation and Characteristics, MOSFET configurations (CS, CD, CG).Device Structure, mode of operation and Characteristics, MOSFET configurations (CS, CD, CG).Module:4Amplifiers and Oscillators4 hoursBJT as an amplifier (CE configuration), MOSFET as an amplifier (CS configuration) Feedback concept, Oscillators - Barkhaunsen's criteria for sustained oscillation, RC Phase Shift Oscillator, LC Oscillator.4 hoursModule:5Digital Logics4 hoursNumber systems, conversion of bases, Boolean algebra, Logic Gates, Concept of universal gate, Simplification and implementation of Boolean functions.3 hoursModule:6Principles of Measurement and Analysis3 hoursUnits and standards, Errors, Functional Elements of a Measurement System and Instruments, Applications and Classification of Instruments, Types of measured Quantities3 hoursMeasures of Dispersion, Sample deviation and sample mean, Calibration and standard.5 hoursModule:7Sensors and Transducers5 hoursSensor fundamentals and characteristics - General concepts and terminology or measurement systems, Sensors and transducers - Classification of sensors, Static and dynamic characteristics. Principle of Resistive Sensors, Capacitive Sensors, Inductive Sensors, Magnetic sensors, Optical sensor, Self-generating SensorsModule:8Contemporary issues2 hours							
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dynamic characteristics. Principle of Resistive Sensors, Capacitive Sensors, Inductive Sensors, Magnetic sensors, Optical sensor, Self-generating Sensors Module:8 Contemporary issues 2 hours							
Sensors, Magnetic sensors, Optical sensor, Self-generating Sensors Module:8 Contemporary issues 2 hours							
Module:8 Contemporary issues 2 hours							
Guest lectures from Industry and, Research and Development Organisations					2 h	ou	rs
	Guest lectures from	om Industry and, Research and Development Organisation	วทร				

Total Lecture hours:

Tex	xt Book(s)							
1.	A. P. Malvino, D. J. Bates, Electron	ic Principles,	2017, 7/e,	, Tata McGraw-Hill.				
2	Albert D. Helfrick and William D	. Cooper, "N	lodern El	ectronic Instrumentation and				
	Measurement Techniques", 2016, F	First Edition, F	earson E	ducation, Noida, India.				
Ref	Reference Books							
1.	1. David A Bell, Electronic Devices and Circuits, Oxford Press, 5 th Edition, 2008							
2	2 Robert L. Bolysted and Louis Nashelsky, Electronic Devices and Circuit Theory,							
	Prentice Hall of India, 11th Edition,	2017						
3	D. Patranabis – Sensor and Transd	lucers (2e) Pr	entice Ha	II, New Delhi, 2003				
4	A.K. Sawhney, Puneet Sawhney, A	A Course In E	lectrical a	and Electronic Measurements,				
	and Instrumentation, Dhanpat Rai &	& Co., 2015						
Мо	de of Evaluation: Internal Assessmer	nt (CAT, Quiz	zes, Digita	al Assignments) & FAT				
Re	commended by Board of Studies	08.07.2021						
App	proved by Academic Council	No. 63	Date	23.09.2021				

BEC	E101P	Rag	sic Electron	ics I ah			1	Т	Р	С
DLO	<u> </u>	Ba.	SIC LICCUOII	ics Lab			0	0	2	1
Pre-	requisite	Nil				Sylla	abu		rsic	n
							1	.0		
	rse Objectiv									
		arious characteristics o				h table				
		the concept of digital erformance metrics of						of va	arioi	ıs
sens	•		modediomor	it oyotomi	dia onare	10101101	.00 (), VC	11100	
	rse Outcom									
	lents will be									
		rious characteristics a				nsistor	S			
		rcuits using logic gates hysical parameters us								
0. 101	casare the p		ative Experi		10					
1	Identify, ma	rk the terminal and fin			cular compo	onent 1	from	the	giv	en
		ectronic components, S	Study of elec	tronic me	asurement	device	es (N	∕lulti	met	er,
_		on generator)			_					
2		eristics of PN Junction		Zener dio	des					
3	Half Wave a	and Full Wave Rectifie	r circuits							
4		e as a voltage regulato								
5	Characteris	tics of BJT in Commor	n Emitter Cor	figuration	l					
6	Characteris	tics of MOSFET in Cor	mmon Source	e Configu	ration					
7	Frequency	esponse of BJT single	stage ampli	fier						
8	Study of the	signal generation usir	ng RC Phase	Shift Os	cillator					
9	Study of log	ic gates and implemer	ntation of Boo	lean Fun	ctions					
10	Strain gaug	e sensors for measure	ment of norn	nal strain.						
11	Displaceme	ent measurement using	g LVDT and I	_DR.						
12	Temperatur	e measurement using	RTD, Therm			•				
				Total La	boratory H	lours	3	0 h	our	3
Text	Book(s)	a D. I. Datas, Floatus	nia Duinainta	2017 7	/a Tata Ma	· C =====	1 1:11			
1.		o, D. J. Bates, Electro lelfrick and William D							n a	nd
_		nt Techniques", 2016,							ni a	iiu
Refe	erence Book		•		·	,				
1.		Bolysted and Louis I		Electronic	Devices	and C	ircu	it T	heo	ry,
		Il of India, 11th Edition		Daniel in 1	Iall Ni - D	- II-' C	000			
2 Mod		ois – Sensor and Trans								
		nent: Continuous asser by Board of Studies	08.07.2021	/ Oral ex	ammanon	and Ol	Hers	•		
		demic Council	No. 63	Date	23.09.202	21				
- F 12.										

В	NC4041	Tachwinel Fundish Communication			T	
BE	NG101L	Technical English Communication		2	T 0	P C 0 2
Dre	e-requisite	NIL	SvII.			rsion
110	z-requisite	INIL	Oyni		.0	131011
Co	urse Objectiv	es:				
		p LSRW skills for effective communication in professiona	al situ	atio	าร	
		ce knowledge of grammar and vocabulary for meaningful				on
		stand information from diverse texts for effective technica				
Со	urse Outcom					
		mar and vocabulary appropriately while writing and spea				
		concepts of communication skills in formal and informal				
		ate effective reading and listening skills to synthesize an	ia ara	ıw ır	ıtelli	gent
	inferences	rly and significantly in academic and general contexts				
Mo		oduction to Communication			l ho	ııre
		ess - Types of communication: Intra-personal, Interpersor				
		ommunication / Cross-cultural Communication - Commun			arrie	ers
		good communication - Principles of Effective Communic	ation		l ho	
		nmatical Aspects - Modal Verbs - Concord (SVA) - Conditionals - Error de	toctic		HIO	uis
		ten Correspondence	lecile		l ho	
		etters - Resume Writing - Statement of Purpose			- 110	<u> </u>
		iness Correspondence			l ho	urs
		Calling for Quotation, Complaint & Sales Letter – Memo	- Mir			
		ing products and processes				
		essional Writing			l ho	urs
Pa	raphrasing & S	Summarizing - Executive Summary - Structure and Types	of P	ropc	sal -	_
	commendation					
		n Building & Leadership Skills			l ho	urs
		dership - Team Leadership Model - Negotiation Skills - C	onflic	t		
	nagement	a a rah Writing			المما	
		earch Writing Analysing a research article - Approaches to Review Pap	or M/r		l ho	urs
		earch article - Referencing	ei vvi	ıııı	, -	
		st Lecture from Industry and R&D organizations		- 2	2 ho	ıırs
Co	ntemporary Iss					
		Total Lecture hou	urs:	3	0 ho	urs
Te	xt Book(s)					
1.		nakshi & Sangeeta Sharma. (2015). <i>Technical Commun</i>	icatio	n: P	Princi	ples
<u> </u>		(3 rd Edition). India: Oxford University Press.				
	ference Book		<u> </u>	• •	Δ	
1.	4 th Edition. In	y & Chandra .V. (2010). <i>Communication for Business A l</i> dia: Pearson Longman.				
2.		ay & Pushpalatha. (2018). <i>English Language and Commu</i> dia: Oxford University Press.	unica	tion	Skill	s for
3.		a. (2020). English Language Skills for Engineers. India: N	/lcGra	w F	lill	
4.		raf. (2018). <i>Effective Technical Communication</i> 2 nd Edition	n. Cł	nenr	nai:	
5.		=ducation. ha & Muralikrishna,C. (2014). <i>Communication Skills for E</i>	-nain	ppro	Inc	lia:
	Pearson Edu		g i			u.

6.	6. Watkins, P. (2018). Teaching and Developing Reading Skills: Cambridge Handbooks for									
	Language teachers. India: Cambridge University Press.									
Мо	Mode of Evaluation: CAT / Assignment / Quiz / FAT / Group Discussion									
Re	commended by Board of Studies	28.06.2021								
Ap	proved by Academic Council	No. 63	Date	23.09.2021						

BEN	IG101P	Technical E	English Comr	nunicati	on Lab		L	Т	Р	С
							0	0	2	1
Pre-	requisite	NIL				Syll			<u>ersi</u>	<u>on</u>
								1.0		
	rse Objectiv									
		oriate grammatical stru				tion				
		nglish communication s								
		eaningful communicati	on skills in wri	ting and	public spea	iking				
	rse Outcom									
		rofessional rhetoric an								
		rial on technology and								
		e and productive skills	s in real life sit	uations a	and develop	work	piac	ce		
	munication	*								
	cative Expe									
1.		& Vocabulary								
	Error Dete									
		Worksheets								
2.		to Narratives	0 T - 1 T - 11 -	_						
		of eminent personalitie								
		istening Comprehensi	on / Summaris	sing						
3.	Video Res		4							
		alysis & digital resume								
4		Preparing a digital résu		nerview						
4.		Process Description	1							
		and Sequencing Demonstration of produ	et and proces	20						
5.	Mock Mee		ict and proces	55						
5.		neetings and meeting e	atiquette							
		Conduct of meetings		minutae	of the mee	tina				
6.		esearch article	and draiting	iiiiutes	Of the file	ung				
0.		and Technical articles								
		Vriting Literature review	N							
7.	Analytical		••							
		ies on Communication	Team Buildir	ng and L	eadership					
		Group Discussion	i, roam Ballali	ig and L	oadorornp					
8.	Presentati									
-		Conference/Seminar p	paper							
		ndividual/ Group prese								
9.	Intensive									
		locumentaries								
		lote taking and Summ	arising							
10.	Interview		<u>_</u>							
		uestions and techniqu	ies							
		lock Interviews								
	· •		То	tal Labo	ratory Hou	rs 3	0 h	our	S	
Mod	le of Assess	ment: Continuous As					' Qu	iz/ (Oral	
		I Group Activity.			J					
		y Board of Studies	28.06.2021							
		ndemic Council	No. 63	Date	23.09.20	21				

BEN	IG102P	Tec	hnical Repor	t Writing]		LT	Р	C
			-				0 0	2	1
Pre-	requisite	Technical English C	ommunication			Sylla	abus '	vers	ion
							1.0		
	rse Objectiv								
1. To	o augment s _l	pecific writing skills for	preparing tec	hnical re	ports				
2. To	think critica	ally, evaluate, analyse	general and c	omplex t	echnical inf	ormatic	on		
3. To	o acquire pro	oficiency in writing and	d presenting re	ports					
		-							
Cou	rse Outcom	es:							
1.W	rite error free	sentences using app	ropriate gramr	nar, voc	abulary and	style			
2. S	ynthesize in	formation and concept	ts in preparing	reports					
		he ability to write and		•	erse topics				
					•				
Indi	cative Expe	riments		70					
1.		Grammar, Vocabular	y and Editing	1					
	Usage of	Tenses - Adjectives	and Adverbs	- Jargo	on vs Tech	nnical \	Vocab	ulary	/ -
		ns - Mechanics of Edit	ting: Punctuati	on and F	Proof Readi	ng			
	Activity: W								
2.		and Analyses							
		e Technical Details fro			azınes - Art	ticles ai	nd e-c	onte	nt
2		riting introduction and		e W					
3.		sation of Information s to Converge Objectiv		to in Div	oroo Tooba	ical Pa	norto		
		reparing Questionnair		la III DIV	erse recim	icai Re	ports		
4.	Data Visua		<u> </u>						
٠. ا		Data - Graphs - Tab	les – Charts -	Imager	/ - Infograpi	hics			
	Activity: Ti				, <u>J</u>				
5.		on to Reports							
		Definition - Purpose -		s and T	pes of Rep	orts			
		orksheets on Types o	f reports						
6.	Structure of			_					
		ace – Acknowledgeme							and
		Results – Discussion - entifying the structure		Sugges	tions/Recor	mmena	ations	;	
7.	Report Wri		or report						
'·		ction - Draft an Outline	and Organize	Informa	tion				
		rafting reports	and Organizo	miomia					
8.		ntary Texts							
		Index – Glossary – R	eferences – Bi	bliograp	hy - Notes				
		rganizing supplementa			•				
9.		Final Reports							
		Content - Style - Layo							
		xamining clarity and co	oherence in fin	al repor	S				
10.	Presentation								
		Technical Reports	diadan assas d						
	Activity: P	lanning, creating and o				1	2	0 b -	
Mad	lo of access	monti Continuous As			ratory Hou			0 ho	
	examination	ment: Continuous Ass	sessment / FA	i / Assi(jiinents / G	≀ui∠ / Pl	resent	.auor	IS /
		by Board of Studies	28.06.2021						
		ademic Council	No. 63	Date	23.09.202	21			
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BMAT101L	Calculus	TL	. -	ΓР	С
		3		0	
Pre-requisite	Nil	Syllab	ous	vers	ion
•			1.		
Course Objectiv	ves				
	e requisite and relevant background necessary to understa	nd the	oth	ner	
	ering mathematics courses offered for Engineers and Scie				
	mportant topics of applied mathematics, namely Single and			iable	
	ctor Calculus etc.				
3. Enhance to us	se technology to model the physical situations into mathem	atical	pro	blem	ıs,
experiment, inter	rpret results, and verify conclusions.		•		
Course Outcom	nes				
At the end of the	course the student should be able to:				
1. Apply single v	ariable differentiation and integration to solve applied prob	lems i	n		
	find the maxima and minima of functions				
2. Evaluate parti	al derivatives, limits, total differentials, Jacobians, Taylor se	eries a	and		
optimization prol	plems involving several variables with or without constraint	s			
3. Evaluate mult	iple integrals in Cartesian, Polar, Cylindrical and Spherical	coord	ina	tes.	
4. Use special fu	nctions to evaluate various types of integrals.				
5. Understand g	radient, directional derivatives, divergence, curl, Green's, S	tokes	an	d Ga	uss
Divergence theo					
	gle Variable Calculus			8 hc	
	Extrema on an Interval Rolle's Theorem and the Mea				
	lecreasing functionsFirst derivative test-Second derivative				
	ty. Integration-Average function value - Area between cu	rves -	Vo	lume	s of
solids of revoluti					
	tivariable Calculus			5 hc	
	variables-limits and continuity-partial derivatives –total dif	ferent	ial-	Jaco	bian
and its propertie					
	lication of Multivariable Calculus			5 hc	
	on for two variables–maxima and minima–constrained max	(ima a	ınd	minir	na-
Lagrange's multi					
	tiple integrals			8 hc	
	uble integrals-change of order of integration-change of va				
	olar co-ordinates - evaluation of triple integrals-change of v	ariable	es t	oetwe	∍en
	/lindrical and spherical co-ordinates.				
	cial Functions			6 hc	
	na functions-interrelation between beta and gamma funct				
	s using gamma and beta functions. Dirichlet's integra	I -Erre	or	tunct	ions
complementary					
	tor Differentiation			5 hc	
	ctor valued functions – gradient, tangent plane-direc				
	curl-scalar and vector potentials. Statement of vector	den	ititie	es-sın	nple
problems.				٠.	
	tor Integration			6 hc	
	d volume integrals - Statement of Green's, Stoke's and Ga	uss di	ver	genc	е
	eation and evaluation of vector integrals using them.			0:	
	temporary Topics			2 hc	urs
Guest lectures fr	om Industry and, Research and Development Organization			45 :	
	Total Lecture hours	3 :	4	45 hc	urs
Text Book					

1. George B.Thomas, D.Weir and J. Hass, Thomas Calculus, 2014, 13th edition,

Pearson

Ref	ference Books							
1.	Erwin Kreyszig, Advanced Enginee	ering Mather	natics, 2	015, 10th Edition, Wiley India				
2.	B.S. Grewal, Higher Engineering M	lathematics,	2020, 4	4th Edition, Khanna Publishers				
3. John Bird, Higher Engineering Mathematics, 2017, 6th Edition, Elsevier Limited.								
4.	4. James Stewart, Calculus: Early Transcendental, 2017, 8th edition, Cengage Learning.							
5.	K.A.Stroud and Dexter J. Booth, Er	ngineering N	/lathema	tics, 2013, 7th Edition, Palgrave				
	Macmillan.							
Мо	de of Evaluation: CAT, Assignment,	Quiz and F	ΑT					
Red	Recommended by Board of Studies 24.06.2021							
App	Approved by Academic Council No. 63 Date 23.09.2021							

BMA	AT101P		Calculus L	ab			L	Т	Р	С
							0	0	2	1
Pre-	requisite	NIL				Syll			ersi	on
								1.0		
	rse Objectiv									
		vith the basic syntax, se								
		ot only in calculus but a				g and	scie	ence	:S	
		athematical functions a								
		gle and multiple integra	als and unde	erstand it	graphically.					
	rse Outcome	-								
		course the student sho								
		IATLAB code for challe				4! -				
		olays, interpret and illus	strate eleme	ntary ma	tnematicai ti	ınctio	ns a	and		
	edures. cative Exper	monto		1						
		to MATLAB through m	atriana and a	nonoral C	Syntox					
1. 2.		visualizing curves and				comi	outo	tion		
۷.	using MATL		Surfaces iii	IVIATLAD	– Symbolic	COM	Jula	lion	5	
3.		Extremum of a single va	ariable functi	on						
4.		ng integration as Area								
5.		of Volume by Integrals (
6.		naxima and minima of f								
7.		grange multiplier optimi			ыоо					
8.		olume under surfaces	ization motifi	<u> </u>						
9.		riple integrals								
10.		radient, curl and diverg	gence							
11.		ne integrals in vectors	•							
12.		een's theorem to real w	vorld problem	าร						
					oratory Hour	s 30) ho	urs		
Text	t Book				•					
1.	Brian H. Hal	nn, Daniel T. Valentine,	, Essential M	IATLAB 1	for Engineer	s and				
	Scientists, A	cademic Press, 7th ed	ition, 2019.							
Refe	erence Book									
1.	Amos Gilat,	MATLAB: An Introduct	ion with App	lications	, Wiley, 6/e,	2016.	-			
2	Maritn Broka	ate, Pammy Manchand	da, Abul Has	an Siddi	qi, Calculus	for So	cien	tists	and	;
		Springer, 2019	•		•					
Mod	e of assessm	ent: DA and FAT								
Rec	ommended b	y Board of Studies 2	24.06.2021							
Appı	roved by Aca	demic Council I	No. 63	Date	23.09.202	1				

BMAT102L Differential Equations and Transforms			L	Т	Р	С
			3	1	0	4
Pre-requisite BMAT101L, BMAT101P Sy		Sy	llab	us	vers	sion
				1.0)	

- 1. To impart the knowledge of Laplace transform, an important transform techniques for Engineers which requires knowledge of integration.
- 2. Presenting the elementary notions of Fourier series, this is vital in practical harmonic analysis.
- 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 Outcomes

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

- 1. Find solution for second and higher order differential equations, formation and solving partial differential equations.
- 2. Understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution.
- 3. Employ the tools of Fourier series and Fourier transforms.
- 4. Know the techniques of solving differential equations and partial differential equations.
- 5. Know the Z-transform and its application in population dynamics and digital signal processing.

Module:1 Ordinary Differential Equations (ODE)

6 hours

Second order non- homogenous differential equations with constant coefficients- Differential equations with variable coefficients- method of undetermined coefficients-method of Variation of parameters-Solving Damped forced oscillations and LCR circuit theory problems.

Module:2 | Partial Differential Equations (PDE)

5 hours

Formation of partial differential equations – Singular integrals — Solutions of standard types of first order partial differential equations – Lagrange's linear equation-Method of separation of variables

Module:3 Laplace Transform

7 hours

Definition- Properties of Laplace transform-Laplace transform of standard functions - Laplace transform of periodic functions-Unit step function-Impulse function. Inverse Laplace transform-Partial fractions method and by Convolution theorem..

Module:4 | Solution to ODE and PDE by Laplace transform

7 hours

Solution of ODE's – Non-homogeneous terms involving Heaviside function, Impulse function - Solving Non-homogeneous system using Laplace transform - solution to First order PDE by Laplace transform.

Module:5 | Fourier Series

hours

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

Module:6 | Fourier Transform

hours

Complex Fourier transform - properties - Relation between Fourier and Laplace Transforms-Fourier sine and cosine transforms - Parseval's identity- Convolution Theorem and simple applications to solve PDE.

Module:7 | Z-Transform

6 hours

Definition of Z-transform and Inverse Z-transform - Standard functions - Partial fractions and

convolution method. Difference equation - first and second order difference equations with constant coefficients - solution of simple difference equations using Z-transform.								
Module:8	Contemporary Issues				2 hours			
		Tot	al Lecture	e hours:	45 hours			
		Tota	l Tutorial	hours :	15 hours			
Text Book	Text Book(s)							
1. Erw	vin Kreyszig, Advanced Engineer	ing Mathe	matics, 20)15, 10th I	Edition, John Wiley			
Indi	a.							
2. B.S	. Grewal, Higher Engineering	Mathen	natics, 20	020, 44th	Edition, Khanna			
Pub	olishers.							
Reference	Books							
1. Mic	hael D. Greenberg, Advanced	Engineer	ing Math	ematics, 2	2006, 2nd Edition,			
Pea	arson Education, Indian edition.							
2. A F	First Course in Differential Equ	ations wit	h Modellii	ng Applica	ations, Dennis Zill,			
201	8, 11th Edition, Cengage Publish	ners.						
Mode of Evaluation: CAT, written assignment, Quiz, FAT								
Recommer	nded by Board of Studies	24-06-20)21					
Approved b	oy Academic Council	No. 64	Date	16-12-20	21			

BMAT201L Complex Variables and Linear Algebra			L	T	Р	С
			3	1	0	4
Pre-requisite	BMAT102L	Sy	llab	us v	ersi	ion
				1.0		

- 1. To present comprehensive, compact, and integrated treatment of one of the most important branches of applied mathematics namely Complex variables to the engineers and the scientists.
- 2. To present comprehensive, compact, and integrated treatment of another most important branches of applied mathematics namely Linear Algebra to the engineers and the scientists.
- 3. To provide students with a framework of the concepts that will help them to analyse deeply about many complex problems.

Course Outcomes

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

- 1. Construct analytic functions and find complex potential of fluid flow and electric fields.
- 2. Find the image of straight lines by elementary transformations and to express analytic functions in power series.
- 3. Evaluate real integrals using techniques of contour integration.
- 4. Use the power of inner product and norm for analysis.
- 5. Use matrices and transformations for solving engineering problems.

Module:1 | Analytic Functions

7hours

Complex variable - Analytic functions and Cauchy – Riemann equations; Laplace equation and Harmonic functions; Construction of Harmonic conjugate and analytic functions; Applications of analytic functions to fluid-flow and electric field problems.

Module:2 | Conformal and Bilinear transformations

7 hours

Conformal mapping - Elementary transformations; Translation, Magnification, Rotation, Inversion; Exponential and Square transformations ($w = e^z$, z^2); Bilinear transformation; Cross-ratio-Images of the regions bounded by straight lines under the above transformations:

Module:3 | Complex Integration

7 hours

Functions given by Power Series - Taylor and Laurent series-Singularities - Poles - Residues; Integration of a complex function along a contour; Statements of Cauchy-Goursat theorem- Cauchy's integral formula-Cauchy's residue theorem-Evaluation of real integrals-Indented contour integral.

Module:4 | Vector Spaces

6 hours

Vector space – subspace; linear combination - span - linearly dependent – Independent – bases; Dimensions; Finite dimensional vector space. Row and column spaces; Rank and nullity.

Module:5 Linear Transformations

hou

Linear transformations – Basic properties; Invertible linear transformation; Matrices of linear transformations; Vector space of linear transformations; Change of bases; Similarity.

Module:6 Inner Product Spaces

5 hours

Dot products and inner products; Lengths and angles of vectors; Matrix representations of inner products; Gram - Schmidt - Orthogonalization.

Module:7 | Matrices and System of Equations

5 hours

Eigenvalues and Eigen vectors; Properties of Eigenvalues and Eigen vectors; Cayley-Hamilton theorem; System of linear equations; Gaussian elimination and Gauss Jordan methods.

Module:8 | Contemporary issues:

	Total Lecture hours: Total Tutorial hours :	45 hours 15 hours
	Total Tutorial nours .	15 Hours
Text F	Book(s)	
1.	G. Dennis Zill, Patrick D. Shanahan, A first co	ourse in complex analysis with
	applications, 2013, 3rd Edition, Jones and Bartlett P	ublishers Series in Mathematics.
2.	Jin Ho Kwak, Sungpyo Hong, Linear Algebra, 2004,	Second edition, Springer.
D - 6		
Keter	rence Books	
		tics, 2015, 10 th Edition, John
	Erwin Kreyszig, Advanced Engineering Mathemat	tics, 2015, 10 th Edition, John
1.	Erwin Kreyszig, Advanced Engineering Mathemat Wiley & Sons (Wiley student Edition).	
1.	Erwin Kreyszig, Advanced Engineering Mathemat	

- 4. Gilbert Strang, Introduction to Linear Algebra, 2015, 5th Edition, Cengage Learning
- 5. B.S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers.

Mode of Evaluation: Digital Assignments(Solutions by using soft skill), Quiz, Continuous Assessments, Final Assessment Test.

2011, 9th Edition Pearson Education.

Recommended by Board of Studies	d by Board of Studies 24-06-2021		
Approved by Academic Council	No. 64	Date	16-12-2021

BMAT202L Probability and Statistics				Т	Р	С	
			3	0	0	3	
Pre-requisite	BMAT101L, BMAT101P	T101L, BMAT101P Syllabus version		sion			
				1.0)		
Course Objectives							

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

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 analyzing data specific to an experiment.
- 3. Apply statistical methods like correlation, regression analysis in analyzing, 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.

Module:1 Introduction to Statistics

6 hours

Statistics and data analysis; Measures of central tendency; Measure of Dispersion, Moments-Skewness-Kurtosis (Concepts only).

Module:2 Random variables

8 hours

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.

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 distribution; Poisson distributions; Normal distribution; Gamma distribution; Exponential distribution; Weibull distribution.

Module:5 | Hypothesis Testing-I

4 hours

Testing of hypothesis –Types of errors - Critical region, Procedure for testing of 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 way-Two way-Three way classifications - CRD-RBD- LSD.

Module:7 | Reliability

5 hours

Basic concepts- Hazard function-Reliabilities of series and parallel systems- System

Reliability - Maintainability-Preventive and repair maintenance- Availability.						
Module:8	Contemporary Issues			2 hours		
		Total lastura ha		4E hours		
		Total lecture ho	urs:	45 hours		
Text Book:						
1. R.	E. Walpole, R. H. Myers	s, S. L. Mayers,	K. Ye, I	Probability and Statistics for		
eng	ineers and scientists, 201	2, 9 th Edition, Pea	arson Edu	cation.		
Reference	Books					
				Statistics and Probability for		
Eng	jineers, 2016, 6 th Edition, _s	John Wiley & Son	s.			
	Balagurusamy, Reliability I					
3. J. l	 Devore, Probability an 	d Statistics, 201	2, 8 th Ed	ition, Brooks/Cole, Cengage		
Lea	rning.					
4. R. /	A. Johnson, Miller Freun	d's, Probability a	nd Statist	ics for Engineers, 2011, 8th		
edit	ion, Prentice Hall India.					
5. Bila	I M. Ayyub, Richard F	I. McCuen, Prob	oability, S	Statistics and Reliability for		
Eng	ineers and Scientists, 201	11, 3 rd edition, CR	C press.			
Mode of	Evaluation: Digital Assig	nments, Continu	ous Ass	essment Tests, Quiz, Final		
Assessmer	nt Test.					
Recommer	nded by Board of Studies	24-06-2021				
Approved b	y Academic Council	No. 64	Date	16-12-2021		

BMA	AT202P	Probability and Statistics Lab	L	Т	Р	С		
			0	0	2	1		
Pre-	requisite	BMAT101L, BMAT101P	Sylla			ion		
				1.0				
	rse Objective							
2	 To enable the students for having experimental knowledge of basic concepts of statistics using R programming. To study the relationship of real-time data and decision making through testing methods using R. To make students capable to do experimental research using statistics in various engineering problems. 							
Carr	roe Outeema	•						
	rse Outcome	course the student should be able to:						
^("	ie end of the t	course the student should be able to.						
	 Demonstrate R programming for statistical data. Carry out appropriate analysis of statistical methods through experimental techniques using R. 							
Indi	cative Experi	ments						
1.		Understanding Data types; importing/exporting data						
2.	Computing	Summary Statistics /plotting and visualizing data usin	ıg					
		nd Graphical Representations						
3.	Applying co	orrelation and simple linear regression model to rea	al 📗					
	dataset; con	nputing and interpreting the coefficient of determination	To					
4.	Applying mu	ultiple linear regression model to real dataset; computin		bora				
		ting the multiple coefficients of determination	ho	urs: 🤄	30			
5.		obability distributions: Binomial distribution						
6.		ibution, Poisson distribution						
7.	Testing of hitime problen	ypothesis for one sample mean and proportion from reans	al					
8.		ypothesis for two sample means and proportion from rea	al					
9.		t-test for independent and dependent samples						
10	Applying Ch	i-square test for goodness of fit test and Contingency tes	st					
	to real datas							
11.		ANOVA for real dataset for Completely randomize domized Block design, Latin square Design	ed					
Text	Book							
1	I. Statistical	analysis with R by Joseph Schmuller, John wiley an	ıd					
		New Jersey 2017.						
Refe	erence Books:							
1		of R: A First course in Programming and Statistics, by	Tilma	n M	Dav	ies,		
2		ollock, 2016. a Science, by Hadley Wickham and Garrett Grolemun	ıd, O'	Reill	y Me	∍dia		
Mod	·	ent: Continuous assessment, FAT / Oral examination an	d othe	rs				
Door	Decembered by Deard of Studies 24 06 2021							

Date

16-12-2021

No. 64

Recommended by Board of Studies 24-06-2021

Approved by Academic Council

Course Code Course Title				Р	С
BPHY101L Engineering Physics		3	0	0	3
Pre-requisite	NIL S	yllal	ous	vers	sion
			1.0		

- 1. To explain the dual nature of radiation and matter.
- 2. To apply Schrödinger's equation to solve finite and infinite potential problems and apply quantum ideas at the nanoscale.
- 3. To understand the Maxwell's equations for electromagnetic waves and apply the concepts to semiconductors for engineering applications.

Course Outcome

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

- 1. Comprehend the phenomenon of waves and electromagnetic waves.
- 2. Understand the principles of quantum mechanics.
- 3. Apply quantum mechanical ideas to subatomic domain.
- 4. Appreciate the fundamental principles of a laser and its types.
- 5. Design a typical optical fiber communication system using optoelectronic devices.

Module:1 Introduction to waves

7 hours

Waves on a string - Wave equation on a string (derivation) - Harmonic waves- reflection and transmission of waves at a boundary (Qualitative) - Standing waves and their eigenfrequencies.

Module:2 | Electromagnetic waves

7 hours

Physics of divergence - gradient and curl - Qualitative understanding of surface and volume integral - Maxwell Equations (Qualitative) - Displacement current - Electromagnetic wave equation in free space - Plane electromagnetic waves in free space - Hertz's experiment.

Module:3 | Elements of quantum mechanics

6 hours

Need for Quantum Mechanics: Idea of Quantization (Planck and Einstein) - Compton effect (Qualitative) – de Broglie hypothesis - - Davisson-Germer experiment - Wave function and probability interpretation - Heisenberg uncertainty principle - Schrödinger wave equation (time dependent and time independent).

Module:4 | Applications of quantum mechanics

5 hours

Eigenvalues and eigenfunction of particle confined in one dimensional box - Basics of nanophysics - Quantum confinement and nanostructures - Tunnel effect (qualitative) and scanning tunneling microscope.

Module:5 Lasers

6 hours

Laser characteristics - spatial and temporal coherence - Einstein coefficients and their significance - Population inversion - two, three and four level systems - Pumping schemes - threshold gain coefficient - Components of a laser - He-Ne, Nd:YAG and CO2 lasers and their engineering applications.

Module:6 Propagation of EM waves in optical fibers

6 hours

Introduction to optical fiber communication system - light propagation through fibers - Acceptance angle - Numerical aperture - V-parameter - Types of fibers - Attenuation - Dispersion-intermodal and intramodal. Application of fiber in medicine - Endoscopy.

Module:7 Optoelectronic devices

6 hours

Introduction to semiconductors - direct and indirect bandgap - Sources: LED and laser diode, Photodetectors: PN and PIN.

Module:8 | Contemporary issues

Total Lecture hours:	45 hours

Textbook(s)

- 1. H. D. Young and R. A. Freedman, University Physics with Modern Physics, 2020, 15th Edition, Pearson, USA.
- 2. D. K. Mynbaev and Lowell L. Scheiner, Fiber Optic Communication Technology, 2011, 1st Edition, Pearson, USA

Reference Books

- 1. H. J. Pain, The Physics of vibrations and waves, 2013, 6th Edition, Wiley Publications, India
- 2. R. A. Serway, J. W. Jewett, Jr, Physics for Scientists and Engineers with Modern Physics, 2019, 10th Edition, Cengage Learning, USA.
- 3. K. Krane, Modern Physics, 2020, 4th Edition, Wiley Edition, India.
- 4. M.N.O. Sadiku, Principles of Electromagnetics, 2015, 6th Edition, Oxford University Press, India.
- 5. W. Silfvast, Laser Fundamentals, 2012, 2nd Edition, Cambridge University Press, India.

Mode of Evaluation:	Written assignment,	i, Quiz, CAT and FAT

Recommended by Board of Studies	26-06-2021		
Approved by Academic Council	No. 63	Date	23-09-2021

BPH	IY101P	Engir	eering Phys	sics Lab			L	Т	Р	С
		<u> </u>	<u> </u>				0	0	2	1
Pre-requisite		12 th or equivalent				Syl	labi	us v	ers	ion
							1.0			
Cou	rse Objective	es			<u>'</u>					
To a	pply theoretic	al knowledge gained i	n the theory	course an	d get hands	s-on	ехр	erie	nce	of
the t	opics.									
Cou	rse Outcome)								
At th	ne end of the o	course the student will	be able to							
		end the dual nature of r								
2	2. Get hand	s-on experience on	the topics	of quanti	um mechai	nical	ide	eas	in	the
	laboratory									
		power lasers in optics	and optical f	<u>iber relate</u>	ed experime	nts.				
Indi	cative Experi									
1.		e the dependence of fu		requency	with the len	igth a	and	ten	sion	of
		string using sonometer								
2.		e the characteristics of								
3.		e the wavelength of las		le-Ne lase	er and diode	e lase	ers	of d	iffere	ent
		s) using diffraction grat						_		
4.		rate the wave nature o					te s	hee	t	
5.		e the Planck's constan								
6.		Illy demonstrate the dis								
		equation (e.g., particle								
7.		e the refractive index o	of a prism usi	ing spectr	ometer (ang	gle of	pri	sm	will t	Эе
	given)									
8.	To determine the efficiency of a solar cell									
9.	To determine the acceptance angle and numerical aperture of an optical fiber									
10. To demonstrate the phase velocity and group velocity (simulation)										
	Total Laboratory Hours 30 hours									
Mode of assessment: Continuous assessment / FAT / Oral examination										
	Recommended by Board of Studies 26.06.2021 Approved by Academic Council No. 63 Date 23.09.2021									
Appı	roved by Acad	demic Council	No. 63	Date	23.09.202	21				

BSTS101P	Quantitative Skills Practice I	 	ΤР	С		
			0 3	1.5		
Pre-requisite	Nil	Syllabu	s ver	sion		
1.0						
Course Objectives:						
	ce the logical reasoning skills of the students and help ther	n impro	ve			
	solving abilities					
	e skills required to solve quantitative aptitude problems	ional n	ırnoo			
3. TO DOOSE	the verbal ability of the students for academic and profess	ionai pi	irpose	38		
Course Outcom	PS'					
	ound knowledge to solve problems of Quantitative Aptitude					
	rate ability to solve problems of Logical Reasoning					
	ne ability to tackle questions of Verbal Ability					
Module:1 Logi			5 h	ours		
	egorization questions					
	s involving students grouping words into right group orders	of logic	al ser	ารе		
Cryptarithmetic						
	arrangements and Blood relations	1 0		ours		
Relations	ent - Circular Arrangement - Multi-dimensional Arrangeme	nt - Bio	oa			
	o and Proportion		6 h	ours		
	on - Variation - Simple equations - Problems on Ages - Mi	 ixtures		ours		
alligations	variation cimple equations i robiems on Ages ivi	Ataros	ana			
	entages, Simple and Compound Interest		6 h	ours		
	Fractions and Decimals - Percentage Increase / Decrease	- Simp				
	erest - Relation Between Simple and Compound Interest	•				
Module:5 Num				ours		
Number system-	Power cycle - Remainder cycle - Factors, Multiples - HC	ेंF and				
	ential grammar for Placement		7 h	ours		
 Preposition 						
•	s and Adverbs					
• Tense	177.					
Speech a						
	nd Phrasal Verbs					
	ons, Gerunds and Infinitives and Indefinite Articles					
	of Articles					
Preposition						
· ·	nd Prepositions and Prepositional Phrases					
Interrogation	·					
	ding Comprehension for Placement		3 h	ours		
	ns - Comprehension strategies - Practice exercises					
	abulary for Placement		<u>6</u> h	ours		
Exposure to questions related to Synonyms – Antonyms – Analogy - Confusing words -						
Spelling correctn						
	Total Lecture hour	s:	45 h	ours		
Text Book(s)						
1. SMART. (20	18). Place Mentor 1st (Ed.). Chennai: Oxford University Pr		_			
2. Aggarwal R.	S. (2017). Quantitative Aptitude for Competitive Examinati	ons 3 rd	(Ed.)).		
	S. Chand Publishing.					

3.	FACE. (2016). <i>Aptipedia Aptitude Encyclopedia</i> 1 st (Ed.). New Delhi: Wiley					
	Publications.					
4.	ETHNUS. (2016). Aptimithra,1st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.					
Re	Reference Books					
1.	Sharma Arun. (2016). <i>Quantitative Aptitude</i> , 7 th (Ed.). Noida: McGraw Hill Education Pvt.					
	Ltd.					
Мо	Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)					
Re	Recommended by Board of Studies 28.06.2021					
Apı	Approved by Academic Council No. 63 Date 23.09.2021					

BSTS102P	Quantitative Skills Practi	ce II	L		P	С	
Due ve avrieite	A1:1	C			3	1.5	
Pre-requisite	Nil	3	yllab	<u>us v</u> 1.0	ers	SION	
Course Objectiv	es.			1.0			
-	gger the students' logical thinking skills ar	nd apply it in real-li	fe sc	enar	ios	;	
	leploy the strategies of solving quantitative						
	, ,						
4. Assist to r	un the gamut of employability skills						
Cauras Outaam							
1 Recome r	roficient in interacting and using decision	making models of	factiv	رماير			
	derstand the given concepts expressly to				ıtati	ion	
	nowledge of solving quantitative aptitude a						
effortlessl							
Module:1 Logic	cal Reasoning puzzles - Advanced			2	ho	urs	
Advanced puzzle					110	, ui 3	
 Sudoku 							
	der style word statement puzzles						
Anagram							
Rebus pu Module:2 Logic	cal connectives, Syllogism and Venn			2	h a	ours	
diagi					ПС	urs	
	es - Advanced Syllogisms - 4, 5, 6 and	other multiple state	emen	it pro	ble	ems	
	nn Diagram questions: Set theory	·		•			
	nutation, Combination and Probability vanced			4	ho	ours	
	unting Principle- Permutation and Combin	nation - Computa	tion c	of			
	vanced problems - Circular Permutations				atio	on -	
Advanced proble	ms -Advanced probability						
Module:4 Quar	ntitative Aptitude			6	ho	ours	
	gressions, Geometry and Quadratic ed	uations - Advanc	ed				
 Logarithm 	<u> </u>	•					
 Arithmetic 	c Progression						
 Geometri 	c Progression						
 Geometry 							
Mensurat							
Coded income	•						
	Equations						
	d by advanced questions of CAT level e interpretation			2	ho	urs	
Image interpretation: Methods - Exposure to image interpretation questions through							
brainstorming and	•	, , , , , , , , , , , , , , , , , , ,					
Module:6 Critic	cal Reasoning - Advanced			3	ho	urs	
	cal Reasoning - Exposure to advanced qu	lestions of GMAT I	evel		110	uis	
Module:7 Recr	uitment Essentials			0	ho	LIFC	
Mock interviews		<u> </u>		0	110	ours	
Cracking other l	kinds of interviews						

Skype/ Telephonic interviews

Panel interviews

Stress interviews

Guesstimation

- 1. Best methods to approach Guesstimation questions
- 2. Practice with impromptu interview on Guesstimation questions

Case studies/ situational interview

- 1. Scientific strategies to answer case study and situational interview questions
- 2. Best ways to present cases
- 3. Practice on presenting cases and answering situational interviews asked in recruitment rounds

recruitment rounds								
dule:8	Problem solving and Algor	ithmic skills	5	18 hours				
Logical methods to solve problem statements in Programming - Basic algorithms								
introduced								
	Total	l Lecture ho	urs:	45 hours				
			ļ.					
SMAR	T. (2018). <i>Place Mentor</i> 1 st (E	d.). Chenna	i: Oxford	University Press.				
Aggary	val R.S. (2017). Quantitative	Aptitude for	Competiti	ive Examinations 3 rd (Ed.).				
00	, ,	,	, , , , , , , , , , , , , , , , , , , ,	(,				
FACE.	(2016). Aptipedia Aptitude Er	ncyclopedia 1	1 st (Ed.).	New Delhi: Wiley				
Publications.								
4. ETHNUS. (2016). <i>Aptimithra</i> ,1 st (Ed.) Bangalore: McGraw-Hill Education Pvt.Ltd.								
Reference Books								
. Sharma Arun. (2016). <i>Quantitative Aptitude</i> , 7 th (Ed.). Noida: McGraw Hill Education Pvt.								
Ltd.								
Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)								
Recommended by Board of Studies 28.06.2021								
Approved by Academic Council No. 63 Date 23.09.2021								
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BSTS201P Qualitative Skills Practice - I O 0 0 3 1.5	Course Code	Course Title		LTPC		
Pre-requisite NIL						
Course Objectives: 1. To enhance the logical reasoning skills of students and improve problem-solving abilities 2. To strengthen the ability of solving quantitative aptitude problems 3. To enrich the verbal ability of the students for academic purposes Course Outcomes: 1. Become experts in solving problems of quantitative Aptitude 2. Learn to defend and critique concepts of logical reasoning 3. Integrate and display verbal ability effectively Module:1 Lessons on excellence 2 hours Skill introspection - Skill acquisition - consistent practice Module:2 Thinking Skill 6 hours Problem Solving Critical Thinking Lateral Thinking Rebus puzzles, and word-link builder questions Module:3 Logical Reasoning 6 hours Coding and Decoding Series Analogy Odd Man Out Visual Reasoning Module:4 Sudoku puzzles 3 hours Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers Module:5 Attention to detail 3 hours Picture and word driven Qs to develop attention to detail as a skill Module:6 Quantitative Aptitude 14 hours Speed Maths Addition and Subtraction of bigger numbers Square and square roots Cubes and cube roots Vedic maths techniques Multiplication Shortcuts Multiplication Shortcuts Multiplication Scores Comparing fractions		*	,c - 1			
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SimplificationsComparing fractions	•					
Comparing fractions	_					
	Comparing fractions					
 Shortcuts to find HCF and LCM 						
Divisibility tests shortcuts	 Divisibility 	y tests shortcuts				

Algebra and	l functions	
Module:7	Verbal Ability	6 hours

Grammar challenge

A practice paper with sentence based and passage-based questions on grammar discussed - Nouns and Pronouns, Verbs, Subject-Verb Agreement, Pronoun-Antecedent Agreement, Punctuations

Verbal reasoning

Module:8 Recruitment Essentials

5 hours

Looking at an engineering career through the prism of an effective resume

- Importance of a resume the footprint of a person's career achievements
- Designing an effective resume
- An effective resume vs. a poor resume
- Skills you must build starting today the requisite?
- How does one build skills

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

		Total	Lecture ho	urs:	45 hours				
Te	Text Book(s)								
1.	1. SMART. (2018). <i>Place Mentor</i> 1 st (Ed.). Chennai: Oxford University Press.								
2.	2. Aggarwal R.S. (2017). <i>Quantitative Aptitude for Competitive Examinations</i> 3 rd (Ed.). New Delhi: S. Chand Publishing.								
3.	. FACE. (2016). <i>Aptipedia Aptitude Encyclopedia</i> 1 st (Ed.). New Delhi: Wiley Publications.								
4.	4. ETHNUS. (2016). <i>Aptimithra</i> ,1 st (Ed.) Bangalore: McGraw-Hill Education Pvt.Ltd.								
Re	ference E	Books							
1.	Sharma Arun. (2016). <i>Quantitative Aptitude</i> , 7 th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.								
Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)									
Re	Recommended by Board of Studies 28-06-2021								
Ар	Approved by Academic Council No. 68 Date 19-12-2022								

Course Co	ode	Course Title		LTPC
BSTS202		Qualitative Skills Practic	e - II	0 0 3 1.5
Pre-requis		NIL		Syllabus version
				1.0
Course Ob	jectiv	es:		
		ritical thinking skills to related to their		
		strate competency in verbal, quantitat		soning aptitude
3. To pi	roduc	e good written skills for effective comr	nunication	
Course Ou	toom	001		
		es: cal thinking skills to problems solving i	rolated to th	noir subject matter
		ate competency in verbal, quantitative		
		od written skills for use in academic a		
<u> </u>	uj go	ou white is the fee in adductine a	ina proroco	
Module:1	Logi	cal Reasoning		5 hours
Clock	ks	-		
1	ndars			
	ction S	Sense		
Cube	_			
		nced problems		F Is
	Data	interpretation and Data ciency - Advanced		5 hours
		Data Interpretation and Data Sufficier	ncv auestio	ns of CAT level
		hart problems	ioj quodilo	110 01 07 11 10 101
		oblems		
		and work– Advanced		5 hours
• Work	k with	different efficiencies		
• Pipe	es and	l cisterns: Multiple pipe problems		
• Wor	k equ	ivalence		
		f wages		
		I application problems with complexity	in calculat	
		, Speed and Distance - Advanced		5 hours
		speed		
1		d Problems based on trains		
1		d Problems based on boats and strea	ms	
		d Problems based on races		
Module:5		t and loss, Partnerships and		5 hours
• Dortr		ages - Advanced		
	nershi	۲		
Avera Weight	•	average		
-		problems discussed		
Auva	ii iCCU	problems discussed		
Module:6	Num	ber system - Advanced		4 hours
		Jetem / terrenieses		

Advanced application problems on Numbers involving HCF, LCM, divisibility tests, remainder and power cycles.

Module:7 | Verbal Ability

13hours

Sentence Correction - Advanced

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Quick introduction to 8 types of errors followed by exposure to GMAT level questions

Sentence Completion and Para-jumbles - Advanced

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Practice on advanced GRE/ GMAT level questions

Reading Comprehension – Advanced

Exposure to RCs of the level of GRE/ GMAT relating to a wide variety of subjects

Module:8 Writing skills for Placement

3 hours

Essay writing

- Idea generation for topics
- Best practices

Education Pvt. Ltd.

Practice and feedback

				Total	Lectu	re hours	:		45 h	ours
Tex	xt Book	(s)								
1.	SMAR	T. (2018). Place N	lentor 1 ^s	t (Ed.)	. Chenna	ii: Oxford	University	y Press.	
2.	Aggar	val R.S.	(2017). (Quantitat	ive Ap	titude for	Competiti	ve Exam	inations 3	rd
	(Ed.). I	New Dell	ոi։ Տ. Cha	nd Publi	shing.		•			
3.	FACE.	(2016).	Aptipedia	Aptitude	e Ency	clopedia	1 st (Ed.).	New Dell	าi: Wiley	
	Publica	ations.							-	
4.	ETHN	JS. (201	6). Aptim	ithra,1st	(Ed.)	Bangalo	e: McGra	w-Hill Ed	lucation P	vt.
	Ltd.	•				Ū				
Re	ference	Books								
1.	Sharm	a Arun.	(2016).	Quanti	tative	Aptitude	7 th (Ed.).	Noida:	McGraw	Hill

Mode of evaluation: CAT, Assessments and FAT (Computer Based Test)					
Recommended by Board of Studies	28-06-2021				
Approved by Academic Council	No. 68	Date	19-12-2022		

Course Code	Course Title	L	Т	Р	С
BCSE401L	Internet of Things	3	0	0	3
Pre-requisite	NIL	Syllabus version			ion
		1.0			

- 1. To apprise students with basic knowledge of IoT that paves a platform to understand physical, logical design
- 2. To teach a student how to analyze requirements of various communication models and protocols.
- 3. To analyze IoT application and deploy for real-time scenario.
- 4. To understand the advanced computing technology of IoT using Fog Computing

Course Outcomes

- 1. Describe layers of IoT and IoT devices used for various applications.
- 2. Understand the standards, protocols and communication models of IoT
- 3. Comprehend advanced IoT applications and technologies from the basics of IoT.
- 4. Understand working principles of various sensor for different IoT platforms.
- 5. Understand the challenges of IoT using privacy and security metrics
- 6. Solve real-time problems and demonstrate IoT applications in various domains using prototype models

Module:1	Things & Internet	6 hours			
Introduction	n, Things: About sensors & actuators, Internet: Device	es at Different			
Layers, IP	v4 Addresses, IPv6Addresses, Interior Gateway Rou	ıting Protocol,			
Exterior Ga	teway Routing Protocol				
Module:2	Standards and Protocols	7 hours			
IEEE 802.1	11, IEEE 802.15.4, LoRaWAN,6LowPAN, Application Pro	tocols			
Module:3	Things Data Analytics	6 hours			
Supervised	Learning, Unsupervised Learning, Bias and Variance Tra	adeoff, Artificial			
Neural Networks, Evaluation Method					
Module:4	Privacy and Security of Things Data	8 hours			
Data Privad	Data Privacy, Elliptic Curve Cryptography, Blockchain				
Module:5	Smart Device Localization, Clustering and Data	8 hours			
	Fusion				
Distance-b	ased Localization Methods, Distance-free Localizat	ion Methods,			
clustering T	echnique, Sensor Data Fusion				
	Fog Computing	5 hours			
	n, Technologies for Fog Computing, Mobility in Fog Fr	amework, Fog			
Orchestrati					
	Applications of IoT	3 hours			
	n, Smart Healthcare, Smart City				
	Recent Trends	2 hours			
Guest lectu	res from Industry and, Research and Development Orga				
	Total Lecture hours:	45 hours			
	Text Book(s)				
1. Sudhir	Kumar, Fundamentals of Internet of Things,1st edition, 2	022			

2.	John Davies, Carolina Fortuna, Tl	ne Internet	of Thing	gs: From Data to Insight,		
	6 March 2020.			Ç		
Ref	Reference Books					
1.	1. Ryan Betts, Architecting for the Internet of Things, Published by O'Reilly Media,					
	Inc.,2016					
2.	Rajkumar Buyya (Editor), Amir Va	ahidDastje	rdi, Interi	net of Things: Principles		
	and Paradigms 1st edition By Mor	gan Kaufn	nann ,20	16		
Мо	de of Evaluation: CAT, written assi	gnment , (Quiz, FA	Γ		
	3					
Recommended by Board of Studies 12-05-2023						
App	proved by Academic Council	No. 70	Date	24-06-2023		

Course Code	Course Title	L	Т	Р	С
BCSE402L	Big Data Analytics	3	0	0	3
Pre-requisite	NIL	Syllabus version			sion
		1.0			

- 1. To introduce the fundamental concepts and importance of big data analytics, emphasizing its relevance in various domains.
- 2. To equip students with the necessary skills and tools to effectively manage and analyze large-scale data sets, including hands-on experience on relevant technologies.
- 3. To illustrate the practical application of big data analytics methods and techniques in solving strategic business problems, showcasing real-world examples and case studies.

Course Outcomes

- 1. Recall the characteristics of digital data, data sources, data storage and the applications of big data in different fields.
- 2. Utilize Hadoop ecosystem tools and Hadoop YARN functions for parallel processing of application tasks.
- 3. Comprehend the Map Reduce programming model and the Map Reduce Daemon framework.
- 4. Apply NoSQL databases for data store management to solve big data problems
- 5. Analyze and evaluate the use of spark stack components with RDDs, ETL built-in functions for handling big data.

Module:1 | Overview of BigData Analytics

5 hours

Introduction - Need of BigData - BigData : Definitions - Characteristics - Evolution - Challenges - Scalability and Parallel processing - Classification of Analytics - Data Storage and Analysis - Use cases of BigData Applications

Module:2 | Hadoop for Big data

7 hours

Hadoop and Ecosystem core components – Features, Streaming, pipes Interacting with Hadoop Ecosystem, HDFS: The Design of HDFS- HDFS Concepts - Blocks – Name nodes and Data nodes; Processing Data with Hadoop - Basic File system Operations, Hadoop File systems - Interfaces – I/O - Managing Resources and Applications with Hadoop YARN - Hadoop ecosystem - Hive: Data Types – HQL - Pig: Grunt Shell - Pig Latin data Model & Data Scripts

Module:3 | Map Reduce

6 hours

MapReduce Framework - Programming Model - Map Reduce: Map Tasks - Key value pair - Reduce Tasks - Grouping by key - Partitioning - Combiners - Reduce Tasks - MapReduce Execution - Composing Map Reduce for Calculations and Algorithms

Module:4 | NoSQL Big Data Management

5 hours

NoSQL Data Store – Data Architecture Patterns – Mongo DB : Data Types - Query Languages - Database commands – Cassandra : CQL Data Types – CRUD – Import and Export - HBase

Module:5 | Spark for Big Data Analytics

6 hours

Introduction to Data Analysis with Spark – Functional Programming Basics - Parallel Programming using Resilient Distributed Datasets - Spark SQL - Data Analysis Operations - Spark RDD - Characteristics - Transform and Action Commands -Data Frame Operations - Spark for ETL - Analytics Reporting and Data Visualization Module:6 Data Stream and Real-Time Analytics 7 hours Data Stream - Concepts & Data Stream Management - Stream Computing Aspects: Sampling, Filtering & Counting Distinct Elements in Streams – Estimating Moments - Frequent Item sets - Handling Larger Datasets for Finding Frequent Item sets - Limited Passes Algorithms Module:7 Graph and Social Network Analytics Graph Model - Representing Graph as Triples - RDF for Graph Databases -SPARQL - Network Organization and Graph Analytics - Social Network Graph Analysis - Topological - Centralities - K-Core - Clustering - Ranking - Counting and Graph matches Module:8 Recent Trends Guest lectures from Industry and, Research and Development Organizations **Total Lecture hours:** 45 hours Text Book(s) Raj Kamal, PreetiSaxena, "Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning", 2019, 1st Edition, McGraw Hill. **Reference Books** Sayan Goswami, Amit Kumar Das, Sourabh Mukherjee, "Big Data Simplified", 2019, 1st Edition, Pearson Education. Subhashini Chellappan, Seema Acharya, "Big Data and Analytics", 2019, 2nd Edition, Wiley. Tom White,"Hadoop: The Definitive Guide", 2009, O'Reilly Media, Inc. Jure Leskovec, Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", 2020, 3rd Edition, Cambridge University Pres. Mode of Evaluation: CAT, Assignments, Quiz, FAT Recommended by Board of Studies 12-05-2023 Approved by Academic Council No. 70 Date 24-06-2023

Course Code	Course Title	L	Т	Р	С
BCSE403L	Digital Image Processing	3	0	0	3
Pre-requisite	NIL	Syllabus version			sion
		1.0			

- 1. To provide the basic knowledge on image processing concepts.
- 2. To develop the ability to apprehend and implement various image processing algorithms.
- 3. To facilitate the students to comprehend the contextual need pertaining to various image processing applications.

Course Outcomes

- 1. Ascertain and describe the basics of image processing concepts through mathematical interpretation.
- 2. Acquire the knowledge of various image transforms and image enhancement techniques involved.
- 3. Demonstrate image restoration process and its respective filters required and attain the knowledge of color image processing techniques.
- 4. Experiment the various image segmentation and morphological operations for a meaningful partition of objects.
- 5. Design the various basic feature extraction procedures and illustrate the various image compression techniques and their applications.

Module: 1 | Digital Image Fundamentals 6 hours Introduction: Digital Image, Applications, Fundamental steps of Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationship between pixels, Mathematical Tools used in Digital Image Processing. Module:2 Intensity Transformations and Spatial Filtering 6 hours Intensity Transformation Functions, Spatial Enhancement Techniques - Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Module:3 | Image Transforms and Filtering in the Frequency 6 hours Domain Discrete Fourier Transform, Discrete Cosine Transform, Smoothing in the Frequency Domain, Sharpening in the Frequency Domain, Wavelet Transformation - Haar Transform. Module:4 | Image Restoration and Color Image Processing 6 hours Model of Image Degradation/Restoration, Noise models, Restoration in the presence of noise only spatial filtering, Inverse filtering, Weiner filtering, Color Fundamentals, Color Models, Color Image Smoothing and Sharpening. Module:5 **Image Segmentation and Morphological Image** 7 hours Processina Point, Line and Edge Detection, Edge Based Segmentation - Thres holding based segmentation, Region growing and Region splitting and merging, Segmentation using morphological water sheds, Erosion, Dilation, Opening, Closing, Hit or Miss Transform, Thinning, Thickening, Skeletonization. Module:6 | Feature Extraction 6 hours

Boundary Preprocessing, Boundary feature descriptors, Histogram based features, Homogenous region extraction and representation, Texture descriptors, GLCM, LBP, SIFT, SURF.				
Module:7 Image Compression and Watermark	ing	6 hours		
Lossless compression versus lossy compression		coding, Arithmetic		
coding, Block Truncation coding, JPEG, Digital Image Watermarking – visible and				
invisible watermarking – digital watermarking based on DWT.				
Module:8 Recent Trends 2 hours				
Guest lectures from Industry and, Research and Development Organizations				
To	tal Lecture ho	ours: 45 hours		
Text Book(s)				
1. Rafael C. Gonzalez and Richard E. Woods, I	Digital Image P	Processing, Fourth		
Global Edition,				
Pearson Education Limited, United States, Prince	nted in Malaysi	ia, 2018.		
Reference Books				
1. S. Sridhar Digital Image Processing, Second	Edition, Oxford	I University Press,		
India, 2016				
2. William K. Pratt, Digital Image Processing, Joh	n Wiley, 4th E	dition, 2007.		
Mode of Evaluation: CAT, Assignments, Quiz, FAT.				
Recommended by Board of Studies 12-05-2	023			
Approved by Academic Council No. 70	Date 2	4-06-2023		

Course Code	Course Title	L	Т	Р	С
BCSE404L	Internet and Web Programming	3	0	0	3
Pre-requisite	NIL	Syll	Syllabus version		
		1.0			

- 1. To provide a practical approach to learning web technologies and programming.
- 2. To enable full-stack web development by learning every aspect of building a database driven web application.
- 3. To demonstrate how the client-server model of Internet programming works

Course Outcomes

After successfully completing the course the student should be able to

- 1. Identify the different protocols used in the web and comprehend the architecture of the web.
- 2. Apply frontend technologies such as markup, styling and interactivity to the web pages.
- 3. Build full database-driven web applications using server-side programming.
- 4. Create asynchronous processes thereby creating effective web pages.
- 5. Construct complete websites using the latest web technologies and MVC pattern

Module:1 Introduction To Internet

3 hours

Internet Overview- Networks – WWW –Web Protocols – Web Organization and Addressing – Internet Service Providers, DNS Servers, Connection Types, Internet Addresses - Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture – URL - Domain Name – Web Content Authoring - Webserver Administration – Search Engines

Module:2 | Web Designing

8 hours

HTML5 – Text tags; Graphics, Video and Sound Tags; Link and Anchor Tags; Table Tags; Form elements, HTML 5 Input types, semantic tags, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layouts

Module:3 | Client Side Scripting

8 hours

JavaScript -Variables and Data Types - Statements - Operators- Literals-Functions- Objects- Arrays- Built-in Objects - Exceptions, Event handling, Validation - DOM - Canvas- JQuery

Module:4 | Server Side Scripting

6 hours

Structure of PHP – Expressions and Control Flow – Functions and Objects – Arrays – Form Handling – File Handling – Email - Validation and Error Handling – Cookies – Session

Module:5 | Database Connectivity

6 hours

MySQL – Introduction - database design concepts - the Structured Query, Language (SQL) - communicating with a MySQL backend via the PHP - MySQL API - More MySQL database access – PHP Data Objects - JSON

Module:6 Developing Interactive Web Applications

6 hours

XML Basics – Namespaces – Transforming XML documents - XSL, XSLT, XML Schema- DTD,XSD - AJAX –AJAX calls - XML http – request – response – AJAX

with PHP - Data Formats - AJAX with Database – Processing Server Response -				
AJAX Security				
Module:7 Application Development 6 hours				
Introduction to Node.js- NPM - Events, Timers, and Callbacks in Node.js - file				
upload – email – Express framework – request –response –routing - templates- view				
engines. Introduction to Mongo DB- creating DB, collection – CRUD operations -				
Accessing MongoDB from Node.js. – Accessing online Mongo DB from Node JS.				
Module:8 Recent Trends 2 hours				
Guest lectures from Industry and, Research and Development Organizations				
Total Lecture hours: 45 hours				
Text Book(s)				
1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, "Internet & World Wide Web How				
to Program", Deitel series, 5th edition, 2012				
2. Simon Holmes, GETTING MEAN: with MONGO, EXPRESS, ANGLUAR JS, &				
NODE JS, Second edition, Manning Publications, 2015				
Reference Books				
1. DT Editorial Services, HTML 5 Black Book, 2nd edition, Dream Tech press,				
2018.				
2010.				
Mode of Evaluation: CAT, Assignments, Quiz and FAT				
Recommended by Board of Studies 12-05-2023				
Approved by Academic Council No. 70 Date 24-06-2023				

Course Code	Course Title	L	T	Р	С
BCSE405L	Advanced Java Programming	3	0	0	3
Pre-requisite	NIL	Syllabus versio			ion
		1.0			

- 1. To demonstrate the use of Object Oriented Programming and threads concepts in Java.
- 2. To familiarize students with Graphical user interface, networking, distributed application, web development using servlet and JSP.
- 3. To impart the core features of spring and hibernate framework.

Course Outcomes

After successfully completing the course the student should be able to

- 1. Choose the appropriate OOP technique for solving the given problem and use multithreads when required.
- 2. Design Graphical User Interface using JavaFX.
- 3. Build applications using java networking concepts and Deploy distributed applications using RMI.
- 4. Design, Develop and Deploy dynamic web applications using Servlets with JDBC.
- 5. Design and Develop applications using JSP and Enterprise Java Bean.
- 6. Recognize the capabilities of java framework to facilitate solving industrial applications using Spring and Hibernate framework.

Module:1 Java Fundamentals and Multithreading

7 hours

Java Fundamentals- Class, Packages and Interface. Multi threading: thread life-cycle, thread creation, thread priorities, thread scheduler, thread pool, thread group, synchronization and Inter thread communication.

Module:2 | Java FX

6 hours

JavaFX architecture, life cycle, collections, event, utilities, scene control, FXML and Webview.

Module:3 | Java Networking and RMI

6 hours

Java Networking – TCP - UDP - InetAddress and Ports - Socket Programming. Java Remote Method Invocation – Invocation concept – Remote Interface – Passing Objects – Client Side and Server side RMI Process.

Module:4 | Servlets with Database Connectivity

5 hours

Java Servlets – MVC Architecture – Container Architecture – Controller Components – Dynamic Forms – Servlet Context - The JDBC API: The API components, database operations like creating tables, CRUD(Create, Read, Update, Delete) operations using SQL – JDBC Drivers.

Module:5 | Java Server Pages and Enterprise Java Beans

7 hou

JSP Scripting Elements – Tags - Variables and Objects – Methods – Control Statements – User Sessions – Cookies – Session Objects – JSTL and Servlets with JSP. Enterprise JavaBeans: Deployment Descriptors – Session JavaBean – Entity JavaBean – Message and Driven Bean.

Module:6 | Spring Framework

6 hours

Introduction to Spring – Bean scope and lifecycle –Bean Definition Inheritance - Dependency injection – Spring MVC: Building spring web Apps – Creating controllers and views. Introduction to docker, deploying spring boot with docker.

Modu	le:7 Hibernate Framework	6 hours					
Introdu	Introduction to Hibernate – Architecture, Lifecycle, Configuration, Session and						
Persis	stent class, Hibernate Query Languages and Criteria queries. S	Spring Hibernate					
	ations.						
Modu	le:8 Recent Trends	2 hours					
Guest	lectures from Industry and, Research and Development Orga	anizations					
	Total Lecture hour	rs: 45 hours					
Text E	Book(s)						
1. He	erbert Schildt, "Java: The Complete Reference", 11th Edition,	, McGraw-Hill					
Pι	ublishers, 2019.						
2. Sa	antosh Kumar K "JDBC 4.2, Servlet 3.1, and JSP 2.3 Includes	JSF 2.2 and					
De	esign Patterns, Black Book", 2 nd Edition, DT Editorial Services	s, 2016.					
Refere	ence Books						
1. Sa	antosh Kumar K "Spring and Hibernate", Mc.Graw Hill Educat	ion, 2017.					
2 Dr	reamtech Press "Core and Advanced Java, Black Book	", DT Editorial					
Se	ervices, 2018.						
Mode	Mode of Evaluation: CAT / written assignment / Quiz / FAT						
Recon	nmended by Board of Studies 12-05-2023						
	ved by Academic Council No. 70 Date 24-06-20	23					

Course Code	Course Title	L	Т	Р	С
BCSE406L	406L NoSQL Databases		0	0	3
Pre-requisite	NIL	Syllabus version			on
		1.0			

- 1. To recognize the emergence, requirements and benefits of a NoSQL database.
- 2. To compare NoSQL databases with each other and relational systems.
- 3. To create wide-column, document, key-value, graph and object-oriented databases, add content, and run queries.

Course Outcomes

- 1. Define, compare and use the four types of NoSQL Databases.
- 2. Explain key value databases and apply queries on those databases.
- 3. Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.
- 4. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented and Graph oriented NoSQL databases.
- 5. Evaluate NoSQL database development tools and programming languages.

Module:1 Introduction

5 hours

The Relational Database Revolution with SQL - Design Limitations - Impedance Mismatch - Schema Evolution - Horizontal Scalability- Motivations for Not Just/No SQL (NoSQL) Databases - Data Management with Distributed Databases - SQL Versus NoSQL Databases - The CAP Theorem - ACID and BASE - Types of Eventual Consistency - Types of NoSQL Databases

Module:2 | Key-Value Databases

4 hours

From Arrays to Key-Value Databases - Essential Features of Key-Value Databases - Properties of keys - Characteristics of values - Data Modeling Terms for Key-Value Databases - Key - Architecture and Implementation terms - Designing Structured Values - Limitations of Key-Value Databases - Design Patterns for Key-Value Databases - Redis database - Queries - Case Study: Key-Value Databases for Mobile Application Configuration.

Module:3 | Document Databases

6 hours

Introduction to Document Databases – Mongo DB - Collections - Basic operations on collections (CRUD) - Find operation - Sorting - Limiting - Aggregate operations: Aggregation pipeline - Operators - Combining aggregate operators

Module:4 Designing Document Databases

7 hours

Partitioning - Types of Partitions - Vertical Partitioning - Horizontal Partitioning or Sharding - Separating Data with Shard Keys – Replication - Distributing Data with a Partitioning Algorithm - Data Modelling and Query Processing - Normalization – De-Normalization - Query Processor - Indexing - Distributed Consistency - Joins

Module:5 Column Family Databases

6 hours

Introduction to Column Family Databases - Google Big Table - Differences and Similarities to Key-Value and Document Databases - Architectures Used in Column Family Databases - Cassandra Architecture: Peer-to-Peer - Commit Log - Bloom Filter - Consistency Level - Processes and Protocols - Replication - Anti-Entropy -

Gossip Protocol - Hinted Handoff - Handling of deletion - When to Use Column Family							
Module:6 Designing Column Family Databases 7 hours							
Column Family Database Terminology – Key space - Row Key - Column - Column							
Families – Cassandra - CQL Queries - Primary Key and Clustering Key - CRUD							
operations - Cluster - Partition - Replication - Consistency levels - Guidelines for							
Designing Tables - Indexing - Primary and Secondary Index							
Module:7 Graph Databases 8 hours							
Introduction to Graph Databases - What Is a Graph? - Graphs and Network							
Modeling - Advantages of Graph Database - Elements of Graphs - Operations on							
Graphs - Properties of Graphs and Nodes - Types of Graphs - Graph Design - Neo4J							
- Cypher Query Language: Creating, Removing and Querying Nodes and Relations							
- Basic Graph Traversal - Finding Path and Distance between nodes - Gremlin:							
Query by Graph Traversal - Using NoSQL and Relational Databases Together							
Module:8 Recent Trends 2 hours							
Guest lectures from Industry and, Research and Development Organizations							
Total Lecture hours: 45 hours							
Total Lecture hours: 45 hours Text Book(s)							
Text Book(s)							
Text Book(s) 1. Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015							
Text Book(s) 1. Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015 Reference Books							
Text Book(s) 1. Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015 Reference Books 1. Adam Fowler, NoSQL For Dummies, For Dummies, 1st edition, 2015 2. Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021							
Text Book(s) 1. Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015 Reference Books 1. Adam Fowler, NoSQL For Dummies, For Dummies, 1st edition, 2015 2. Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021 3. Pramod J. Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley, 1st edition, 2012							
 Text Book(s) Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015 Reference Books Adam Fowler, NoSQL For Dummies, For Dummies, 1st edition, 2015 Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021 Pramod J. Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley, 1st edition, 2012 Guy Harrison, "Next Generation database: NoSQL New SQL and Big Data", 							
 Text Book(s) Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015 Reference Books Adam Fowler, NoSQL For Dummies, For Dummies, 1st edition, 2015 Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021 Pramod J. Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley, 1st edition, 2012 Guy Harrison, "Next Generation database: NoSQL New SQL and Big Data", Apress, 1st Edition, 2015. 							
 Text Book(s) Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015 Reference Books Adam Fowler, NoSQL For Dummies, For Dummies, 1st edition, 2015 Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021 Pramod J. Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley, 1st edition, 2012 Guy Harrison, "Next Generation database: NoSQL New SQL and Big Data", 							
 Text Book(s) Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015 Reference Books Adam Fowler, NoSQL For Dummies, For Dummies, 1st edition, 2015 Gerardus Blokdyk, NoSQL Databases A Complete Guide, 5STARCooks, 2021 Pramod J. Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley, 1st edition, 2012 Guy Harrison, "Next Generation database: NoSQL New SQL and Big Data", Apress, 1st Edition, 2015. 							

Course Code	Course Title	L	T	Р	С
BCSE407L Computer Vision				0	3
Pre-requisite	NIL	Syllabus version			ion
		1.0			

- 1. To solve real world problems with image or video as input.
- 2. To make use of low level image processing algorithms to provide information about the scene.
- 3. To emphasize on computer vision applications

Course Outcomes

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

- 1. Analyze image formation using digital camera and its principles
- 2. Evaluate feature extraction and feature estimation for image or video
- 3. Apply 3D vision techniques
- 4. Identify the computer vision applications

Module:1 | Low Level Vision

6 hours

Image Formation – Sampling and Aliazing – Linear Filters and Convolution – Correlation and Patterns – Image Pyramid

Module:2 | Feature Detection and Matching

5 hours

Points and patches-Feature detectors, Feature descriptors, Feature matching, Feature tracking; Edges: Edge detection and linking; Vanishing points

Module:3 | Segmentation

7 hours

Active Contours – Split and Merge – Mean Shift and Mode Shift – Normalized cut – Graph cut and Energy based methods – Deep Learning based Segmentation Models for Computer Vision

Module:4 | Motion Estimation and Recognition

7 hours

Translational alignment – Parametric Motion - Spline-based motion – Optical Flow – Layered Motion- Object Detection – Face Recognition – Scene Understanding

Module:5 | Stereo Correspondence and 3D Reconstruction

6 hours

Epipolar Geometry – Local Methods – Multi view stereo – Shape from X – Active Range finding – Model based reconstruction

Module:6 | Image Stitching and Image Rendering

6 hours

Stitching: Motion models, Global alignment, Compositing; Rendering: Layered depth images, Light fields and Lumi graphs, Environment Mattes

Module:7 | Computer Vision Applications

6 hours

Contour tracking and rotoscoping – Medical Image Segmentation – Video summarization and compression – Stereo based head tracking – Z-keying and background replacement

Module:8 Recent Trends

2 hours

Guest lectures from Industry and, Research and Development Organizations

Total Lecture hours: | 45 hours

Text Book(s)

 Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2011

Reference Books

1.	Richard Hartley and Andrew Zisseri Vision, Second Edition, Cambridge I	erman, Multiple View Geometry in Computer e University Press, March 2004.					
2.	J J						
3.	3. Alan C. Bovik, Handbook of Image and Video Processing, ISBN- 978-0123885623, ELSEVIER, ACADEMIC PRESS, 2005						
4.	K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.						
5	R.C. Gonzalez and R.E. Woods, D 1992	igital Ima	ge Prod	cessing, Addison- Wesley,			
Мо	Mode of Evaluation: CAT, written assignment , Quiz, FAT						
Re	ecommended by Board of Studies 1	12-05-202	3				
Ар	pproved by Academic Council N	No. 70	Date	24-06-2023			

Course Code	Course Title	L	Т	Р	С
BCSE408L	Cloud Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			ion
		1.0		•	

- 1. To understand the fundamental of cloud computing and the virtual machine
- 2. To gain knowledge of the various cloud service and deployment models
- 3. To understand cloud management and cloud security concept

Course Outcomes

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

- 1. Design and develop cloud application and deploy it.
- 2. Evaluate the various cloud services and deployment models in the infrastructure
- 3. Apply the various cloud security concepts for application development
- 4. Design and manage cloud services with cloud simulation and various cloud platforms.
- 5. Design and develop AI and IoT applications in the cloud environment

Module:1 | Introduction

5 hours

Cloud Computing definition - Evolution of Cloud Computing - Benefits and challenges of cloud computing - Cloud services - Cloud deployment - Cloud architecture - NIST architecture - Business models.

Module:2 | Virtualization

6 hours

Introduction to Virtual Machine (VM) - basics of Virtualization - Types of Virtualizations - Desktop Virtualization - Application Virtualization - Server Virtualization - Storage Virtualization - OS level Virtualization - Virtualization for cloud computing - Software-defined data Center (SDDC).

Module:3 Public Cloud

7 hours

Public cloud benefits – Challenges – public cloud services – AWS – compute – storage –network services –Google cloud service (GCP) – compute – storage – network – Cloud AI services – Multitenant - case study.

Module:4 | Private Cloud

7 hours

Private cloud benefits – challenges – private cloud services – VM migration – cloud provisioning – managing private cloud - OpenStack architecture – components – OpenStack installation –Google private cloud services - case study.

Module:5 | Cloud Management & Security

6 hours

Data center –cloud management – resource management - automation –benefits of automation - Infrastructure security – network security – host level security.

Module:6 | Security Principles

6 hours

Cloud security overview – CIA triads - Threats – risk management - computer security incident response team (CSIRT)–cloud security design principles - cloud security standards: privacy, confidentiality, and integrity –cloud security policy – service level agreement (SLA)

Module:7 | Cloud Application development

6hours

Tools for cloud development – simulators – cloudsim - develop an application and deploy in public cloud services – deploy Al application in the cloud – IoT cloud services – cloud security services.

Module:8 Recent Trends

2 hours

Guest lectures from Industry and, Research and Development Organizations						
			Total Le	cture hours:	45 hours	
Te	xt Book(s)					
1.	Hemanand D, Chembian W T, V	VallemRan	adheer F	Reddy, Cloud	Computing:	
	Cloud Concepts; Methodology, N	etwork Arc	hitecture	, 2021.	_	
Re	ference Books					
1.	Stephen Baron, AWS: The Com	plete Begir	ner's Gu	uide to Master	ring Amazon	
	Web Services, 2020.	-				
2.	Shaun Hummel, Cloud Compu	iting: Arch	itecture	Fundamentals	s for Cloud	
	Systems, 2017.	_				
3.	Chris Dotson, Practical Cloud	Security:	A Guide	for Secure	Design and	
	Deployment, 2019	_			-	
Mo	de of Evaluation: CAT / written as:	signment /	Quiz / FA	λΤ		
	commended by Board of Studies	12-05-202	23			
Ap	proved by Academic Council	No. 70	Date	24-06-2023		

Course Code	Course Title	L	T	Р	С
BCSE409L	Natural Language Processing	3	0	0	3
Pre-requisite	NIL	Syllabus versio			sion
		1.0			

- 1. To introduce the fundamental concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
- 2. To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach.
- 3. To get acquainted with the algorithmic description of the main language levels that includes morphology, syntax, semantics, and pragmatics for information retrieval and machine translation applications.

Course Outcomes

- 1. Understand the fundamental concepts of Natural Language Processing.
- 2. Develop useful systems for language processing and related tasks involving text processing and demonstrate text-based processing of natural language with respect to morphology.
- 3. Check the syntactic and semantic correctness of natural language.
- 4. Select a suitable language modelling & Feature Representation to develop real-world applications.
- 5. Develop computational methods for real-world applications using deep learning.

Module:1 Introduction to NLP

4 hours

Introduction to NLP – Ambiguous nature of NLP - Morphological Analysis - Syntax Analysis – Semantic Analysis –Pragmatic Analysis – Discourse Analysis - Introduction to real-life applications of NLP – Introduction to corpora – Corpora Analysis.

Module:2 | Morphological Analysis and POS Tagging

7 houi

Sentence Segmentation – Language Specific issues – Text Normalization – Stemming - Inflectional and Derivation Morphology - Morphological Analysis and Generation using finite state transducers - Introduction to POS Tagging, Hidden Markov Models for POS Tagging - Viterbi Decoding for HMM.

Module:3 | Syntax Analysis

6 hours

Ambiguities in Syntax Analysis - Issues with Context Free Grammar based parsing-Shallow parsing- Conditional Random Fields (CRF), Dependency Grammar-Dependency Parsing, Neural Network Dependency Parser.

Module:4 | Semantic Analysis

7 hours

Semantics - Lexical Semantics- Word Senses - Relations between Senses - Word Sense Disambiguation (WSD) - Word Similarity Analysis using Thesaurus and Distributional methods - Word2vec - fastText word Embedding - Lesk Algorithm - Thematic Roles, Semantic Role labelling - Pragmatics Analysis - Anaphora Resolution.

Module:5 | N Gram Modeling & Word Embeddings

7 hours

Vector space representation - The role of language models - Simple N-gram models - Estimating parameters - Evaluating language models - Basic smoothing – Laplace Smoothing – BERT.

Мо	dule:6	Applicati	ions Of NLF	P-						5 hours
Tex	kt Cate	gorization:	Sentiment	Analy	sis,	Named	Enti	y Reco	gnition-	Neural
Ma	chine Tr	anslation (NMT).							
			ons Of NLP							7 hours
1			 Abstractiv 							
			Systems (QA						QA – Kno	owledge
Bas	sed QA	-Question a	answering S	ystems	s usin	g GPT	mode	<u> </u>		
		Recent T								2 hours
Gu	est lectu	res from Ir	dustry and,	Resea	rch a	nd Dev	elopm	ent Orga	anization	IS
			Te	otal Le	cture	hours	:		4	5 hours
Tex	kt Book									
1.			nd James H	. Marti	n "Sp	eech ar	nd Lar	nguage I	Processi	ng", 3rd
		Prentice I	· ·							
2.			/lanning and							stical
			Processing	<u>ı", The</u>	MIT F	Press –	Repri	nt 2016.		
	<u>ference</u>									
1.			nnes Hapke			ard," Na	itural	_anguag	je Proce	ssing
	in Actio	on", Mannir	ng Publication	ns, 20	19.					
2.	Sowm	aVajjala,	Bodhisattwa	a Mai	umde	er, Anu	ıi Gı	ıpta, H	arshitSu	rana,
			Language P							,
Ma										
IVIO	ue oi Ev	aiuation: C	CAT / written	assiyi	ment	/ QuiZ	/ FAI	i Projec	ι	
Re	commer	ided by Bo	ard of Studie	es	12-05	5-2023				
		y Academ				'0 Dat	ie :	24-06-20)23	

Course Code	Course Title	L	Т	Р	С
BCSE410L	Cyber Security	3	0	0	3
Pre-requisite	NIL	Syllabus version			n
		1.0			

- 1. To understand the need for cybersecurity for solving the real word problems
- 2. To aware of ethical hacking methodologies for protecting cyber-physical systems.
- 3. To familiarize the defensive mechanisms, countermeasures, and best practices.

Course Outcomes

- 1. Understand the emerging cybersecurity attacks and their adversarial risk
- 2. Identify the emerging vulnerabilities and attacks, and countermeasures in cyber-physical systems.
- 3. Comprehend the need for ethical hacking to minimize the security risk
- 4. Know the emerging security solutions using automated tools and techniques

Module:1 | Foundation for Cyber Security

4 hours

Hacker - Ethical hacker - Cyber-attacks: Network infrastructure attacks, Operating system attacks, Application and other specialized attacks - Security Assessment Principles

Module:2 | Hacking Methodology

5 hours

Methodology: Scanning the Systems and Network - Attack tree analysis - Assessing Vulnerabilities - Penetration Testing - Security Testing tools

Module:3 | Social Engineering

7 hours

Social Engineering Implications - Performing Social Engineering Attacks - Social Engineering Countermeasures: Policies, User awareness and training - Social Engineering Tool kit - Physical Security

Module:4 | Password Security

7 hours

Password Vulnerabilities - Passwords Cracking Tools - Brute-force attacks - Rainbow attack - Password Cracking Countermeasures - Password Policy - Securing Operating Systems - Keyloggers tools

Module:5 | Wireless and Mobile Security

7 hours

Wireless and mobile Vulnerabilities and Attacks - Encrypted Traffic and countermeasures - Rogue wireless devices and countermeasures - MAC spoofing and countermeasures - Securing wireless workstations, Wi-Fi and Internet of Things

Module:6 | Operating System Security

6 hours

OS Vulnerabilities: Windows, Linux and Mac - Detecting Null Sessions - Exploiting Missing Patches - Metasploit - Burp suite - Countermeasures against Buffer overflow and NFS attacks

Module:7 | Web Application and Databases Security

7 hours

Web App Security: Seeking out Web Vulnerabilities - Directory traversal - Inputfiltering attacks - Code injection, SQL injection, Cross-site scripting Counter

	measures - Database Security: Database vulnerabilities - Minimizing Database Security Risks and Storage Security Risks - Counter measures and tools						
Mc	dule:8	Recent Trends				2 hours	
Gu	ıest lectı	ires from Industry and, Res	earch and	d Develop	oment Organiz	ations	
				Total Le	cture hours:	45 hours	
Te	xt Book	(s)					
1.	Kevin I 7th Ed	Beaver CISSP, Hacking for tion	Dummies	s, 2022, .	John Wiley & S	Sons, Inc,	
Re	ference	Books					
1.	1	iodbole, SunitBelapure, Cy		•	0 3		
		ter forensics and legal pers					
2		, Charles J., Christopher security essentials, 2018, Jo			aig, and Dona	ald Short,	
3.	Samm	ons, John, and Michael Cro device safety made easy, 2	ss. The b	asics of c	cyber safety: co	omputer and	
4	4 Charles P. Pfleeger, Shari Lawrence, Pfleeger Jonathan Margulies; Security in Computing, 2015, Pearson Education Inc., 5th Edition.						
Mc	de of Ev	valuation: CAT, Assignment	, Quiz, F <i>A</i>	\ Τ			
Re	comme	nded by Board of Studies	12-05-20	023			
Ap	proved I	oy Academic Council	No. 70	Date	24-06-2023		

Course Code	Course Title	L	Т	Р	С
BCSE411L	Robotics and Automation	3	0	0	3
Pre-requisite	NIL	Syllabus Version			ion
		1.0			

- 1. To introduce the parts, working aspects and types of robots.
- 2. To make the students familiar with machine operations and automation using robots.
- 3. To discuss the various domain applications and implementation of robot control systems.

Course Outcomes

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

- 1. Explain the basic working concepts of robots and to understand the kinematics of robot.
- 2. Analyze the various sensors and drive mechanism in robot for automation.
- 3. Understand the basic control system concepts for robot-controlled engineering.
- 4. Able to classify the actuation system and select appropriate type for their application.
- 5. Able to understand about robots and its applications in automation field

Module:1	Introduction to Robotics		5 hours		
Introduction	to robotics - law of robotics - History of robotics - 7	Types and	components		
of a robot -	Classification of robots				
Module:2	End effectors		5 hours		
End Effecto	End Effectors: Types of end effectors - Mechanical Gripper: Gripper force analysis				
- Vacuum c	up - Magnetic gripper - Special types of grippers				
Module:3	Robot Kinematics		7 hours		
Kinematics	systems: Definition of mechanisms and manipula	itors, socia	al issues and		
safety. Kine	ematic Modelling: Translation and Rotation Repre	esentation	, Coordinate		
transformat	ion, DH parameters.				
Module:4	Sensors and Imaging System		8 hours		
Sensor: Co	ntact and Proximity - Position, Velocity, Force -	Tactile. In	troduction to		
image proc	essing- types of image dimensions - acquisition of	of images	Resolution		
and quantiz	ation of images - Vision system applications in ro	botics.			
Module:5	Control system concepts for robotics		6 hours		
Closed-loop	and open-loop control systems for robotics - Bas	sics of con	trol: Transfer		
functions -	Non-linear and advanced controls.				
Module:6	Actuation Systems		6 hours		
Actuators: I	Electric, Hydraulic and Pneumatic - Transmission	: Gears -	Timing Belts		
and Bearing	gs - Parameters for selection of actuators				
Module:7	Automation in robotics and its applications		6 hours		
Overview o	f automation: Architecture of automation and inte	gration wi	th sensors –		
actuators – components - Robot Applications in automation field like Machine					
	loading, Pick and place operations, Inspection				
Module:8	Recent Trends		2 hours		
Guest lectu	Guest lectures from Industry and, Research and Development Organizations				
	Total Lecture hours:		45 hours		

Text Book(s)

- 1. John J. Craig, "Introduction to Robotics Mechanics and Control", Pearson Education Limited 2022.
- 2. Saeed B. Niku, "Introduction to Robotics Analysis, Control, Applications", John Wiley & Sons Ltd 2020.

Reference Books

- 1. Saha S.K., "Introduction to Robotics", 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
- 2. Ghosal A., "Robotics", Oxford, New Delhi, 2006.

Mode of Evaluation: CAT, written assignment, Quiz, FAT

Recommended by Board of Studies	12-05-202	3		
Approved by Academic Council	No. 70	Date	24-06-2023	

Course Code	Course Title	L	T	Р	С
BCSE412L	Parallel Computing	3	0	0	3
Pre-requisite NIL		Syllabus version			
		1.0			

- 1. To introduce the fundamentals of parallel computing architectures and paradigms.
- 2. To understand the technologies, system architecture, and communication architecture that has driven the growth of parallel computing systems.
- 3. To develop and execute basic parallel applications using programming models and tools.

Course Outcomes

Students who complete this course successfully are expected to:

- 1. Comprehend the hardware and software organization of parallel computing systems.
- 2. Design and implement Parallel algorithms.
- 3. Experiment with mechanisms such as client/server and P2P algorithms, remote procedure calls (RPC/RMI).
- 4. Analyse the requirements for programming parallel systems and critically evaluate the strengths and weaknesses of parallel programming models.
- 5. Analyse the efficiency of a parallel processing system and evaluate the types of application for which parallel programming is useful.

Module:1 | Parallelism Fundamentals 4 hours Motivation - Key Concepts and Challenges - Overview of Parallel computing -Flynn's Taxonomy – Multi-Core Processors – Shared vs Distributed memory. Module:2 | Parallel Architectures 7hours Introduction - SIMD - Vector Processing - GPUs, TPUs- Instruction Level Support for Parallel Programming - Introduction to Open MP Programming. Module:3 | Parallel Algorithm Design 8 hours Decomposition Techniques – Characteristics of Tasks and Interactions – Mapping Techniques for Load balancing – Methods for Containing Interaction Over heads -Parallel Algorithm Models - Design concepts: Threading for Functionality, Threading for Performance, Turnaround, Throughput, Decomposing the work, Task Decomposition, Data Decomposition; Correctness concepts: Race Conditions, Critical Region, Mutual Exclusion, Synchronization, Barrier Synchronization, Deadlock; Performance concepts: Speedup, Efficiency, Granularity, Load Balance; Module:4 | Communication Operations One-to-All Broadcast and All-to-One Reduction - All-to-All Broadcast and Reduction - All-Reduce and Prefix-Sum Operations - Scatter and Gather - All-to-All

Communication Operations.

Module:5 Analytical Modeling 5 hours

Personalized Communication - Circular Shift - Improving the Speed of Some

Sources of Overhead in Parallel Programs - Performance Metrics for Parallel Systems - Effect of Granularity and Data Mapping on Performance - Scalability of Parallel Systems - Minimum Execution Time and Minimum Cost-Optimal Execution

Time –Analysis of PRAM - Asymptotic Analysis of Parallel Programs - Other						
Scalability Metrics.						
Module:6 Parallel Programming	7 hours					
Shared Memory Programming - Distributed Memory Programmi	ng– Distributed					
Shared Memory – Message Passing – Programming Using the Message Passing						
Paradigm - Group Communication - Heterogeneous computing s	ystems – Case					
Study (RPC and Java RMI).	•					
Module:7 Parallel Algorithms	5hours					
Matrix Multiplication - Sorting Algorithms - Graph Algorithms - Appli	ications					
Module:8 Recent Trends	2 hours					
Guest lectures from Industry and, Research and Development Orga	nizations					
Total Lecture hours:	45 hours					
Text Book(s)						
1. Ananth Grama, Anshul Gupta, George Karypis and V	ipin Kumar,					
"Introduction to Parallel Computing", Pearson, 2nd Edition, 20						
2. David Kirk, Wen-mei W. Hwu, Programming Massively Parallel	Processors -					
A Hands-on Approach, Morgan Kaufmann, 3rd Edition, 2016.						
Reference Books						
1. Michael J. Quinn, Parallel Computing: Theory and Practice	e, 2nd edition,					
McGraw Hill Education, India, 2017.						
2. Ian Foster, Gerhard R. Joubert, Ludek Kucera, Wolfgang E. Na	•					
Peters, Parallel Computing: Technology Trends: Advances in P	arallel					
Computing, IOS Press,2020.						
Mode of Evaluation: CAT / written assignment / Quiz / FAT						
Recommended by Board of Studies 12-05-2023						
Approved by Academic Council No. 70 Date 24-06-20	23					

Course Code	Course Code Course Title		T	Р	С
BCSE413L	Soft Computing	3	0	0	3
Pre-requisite	NIL	Syll	abus	vers	ion
		1.0			

- 1. To introduce the concepts of neural networks and advanced neural networks.
- 2. To understand the fundamentals of fuzzy sets, fuzzy logic and rough sets.
- 3. To establish basic knowledge about optimization techniques and hybrid models in soft computing.

Course Outcomes

- 1. Have a general understanding of soft computing methodologies, to deal with imprecise and uncertain data
- 2. Identify and describe soft computing techniques and build supervised learning and unsupervised learning networks.
- 3. Apply fuzzy logic, rough sets and reasoning methods to handle uncertainty and solve various engineering problems.
- 4. Apply optimization methods to solve real world problems.
- 5. Evaluate and compare solutions by various soft computing approaches for a given problem.

Module:1 | Introduction to Neural Network 6 hours Evolution of Neural Network, Mathematical model of neuron, Terminologies of ANN, Characteristics of neural networks, Learning Methods, Early neural network architectures, Application domains, Introduction to Pattern Recognition Module:2 | Memory Models 7 hours Pattern Association, Auto Associative Memory Networks, Hetero Associative Memory Networks, Bidirectional Associative Memory, Hopfield networks Module:3 | Unsupervised Learning Algorithms 7 hours Self-Organizing Maps, Kohonen Network, Adaptive Resonance Theory (ART), algorithms and Illustration of ART1 and ART2 model, Related Applications Module:4 | Fuzzy Sets and Fuzzy Relations 7 hours Crisp Sets, Fuzzy sets, Membership functions, fuzzy set operations, properties of Fuzzy sets, Crisp Relations, Fuzzy relations, Operations of Fuzzy Relations- Fuzzy Logic, Fuzzy Inference systems, Fuzzy knowledge based systems, Fuzzy Decision making Module:5 | Fuzzy and Neuro Fuzzy Modeling 6 hours

Fuzzy clustering, Fuzzy C-Means Clustering, Fuzzy Classification Algorithms - Fuzzy Decision Trees – Fuzzy SVM - Neuro Fuzzy Modeling – Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling - Fuzzy Rule based Structure Identification – Neuro-Fuzzy Control.

Module:6 Rough sets

5 hours

Fundamentals of Rough sets, Rough Approximations and their properties, Measures of Accuracy, Rough Membership function and properties, Attribute reduction using Rough sets, Knowledge representation systems using Rough sets, Decision tables, Rule induction, Discernibility matrix, Class - Classification using neuro Fuzzy rough sets.

Module:7 | Optimization Techniques

5 hours

An	Introduction, Genetic Algorithms, Memetic Algorithms, Particle Swarm Optimization, Ant Colony Optimization, Grey wolf optimization - Hybrid Models, Neuro genetic						
alg	algorithms - Applications						
Mc	dule:8	Recent Trends			2 hours		
Gu	est lecti	ures from Industry and Re	search and Develop	ment Orga	nizations		
			Total Lectu	re hours:	45 hours		
	Text B	ook(s)					
1.	Princip	es of Soft Computing, 3 rd	Edition by Sivanand	am & Dee	pa, Wiley India,		
	2018		·		•		
	Refere	nce Books					
1.		sekaran and G.A.V. Pai, ims: Synthesis and Applic			ic and Genetic		
2.		pathy, J.Anuradha," Soft ge Learning, 2015.	Computing – Adv	ances and	Applications",		
3.	3. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, —Neuro-Fuzzy and Soft Computingll, Prentice-Hall of India, 2009.						
	Mode of Evaluation: CAT / Written Assignment / Quiz / FAT						
Re	commer	ded by Board of Studies	12-05-2023				
Ap	proved b	y Academic Council	No. 70 Date	24-06-202	23		

Course Code	Course Title	L	Т	Р	С
BCSE414L	High Performance Computing	3	0	0	3
Pre-requisite	NIL	Sylla	bus v	/ersi	on
			1.0)	

- 1. Understand the modern architecture, data structures and algorithms for high-performance computing.
- 2. Create fast, powerful, energy-efficient programs that scale to tackle big data.
- 3. Engineering and computing to utilize high-performing heterogeneous resources.

Course Outcomes

- 1. Appraise modern high performance architectures.
- 2. Investigate the inherent potential and limitations of programs/applications.
- 3. Design high performance applications for multi-core processors.
- 4. Develop high performance applications for distributed systems.
- 5. Examine tools and resources for Exa-scale performance

Module:1	Introduction	5 hours
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High-Performance Computing Disciplines, Impact of Supercomputing on Science, Society, and Security, Anatomy of a Supercomputer, Computer Performance, A Brief History of Supercomputing

Module:2 | HPC Architecture: Systems and Technologies | 6 hours

Key Properties of HPC Architecture, Parallel Architecture Families—Flynn's Taxonomy, Accelerating Technologies: Symmetric Multi-Processor (SMP), Massively Parallel Processor (MPP), Graphical Processor Units (GPU) and Tensor Processing Unit (TPU)

Module:3	Commodity Clusters and Essential Resource	7 hours
	Management	

Introduction to Commodity Cluster, Beowulf Cluster Project, Hardware Architecture, Programming Interfaces, Software Environment, Basic Methods of Use, Managing Resources, The Essential SLURM, Summary of Commands, The Essential Portable Batch System, Overview of Grid and Cloud Technologies

Module:4 | HPC Peripherals and Algorithms | 6 hours | Amdahl's Law, Memory Hierarchy, PCI Bus, External I/O Interfaces, Fork–Join, Divide and Conquer, Manager–Worker, Embarrassingly Parallel, Halo Exchange, Permutation: Cannon's Algorithm, Task Dataflow

Module:5 Operating Systems and Performance Monitoring 6 hours

Operating System Structures and Services, Process Management, Threads, Memory Management, Time Measurement, Performance Profiling, Monitoring Hardware Events, Integrated Performance Monitoring Toolkits, Profiling in Distributed Environments

Module:6 Debugging HPC Applications

6 hours

Tools, Debugging OpenMP Example: Accessing an Unprotected Shared Variable, Debugging MPI Example: Deadlock, Compiler Flags for Debugging, System Monitors to Aid Debugging

Module:7 | Mass Storage and MapReduce

7 hours

Storage Device Technology, Aggregated Storage, Storage Area Networks, Network Attached Storage, Tertiary Storage, Role and Function of File Systems, Network File System, General Parallel File System, Lustre File System, Map and Reduce Distributed Computation, Overview of Hadoop.

Module:8 | Recent Trends

2 hours

Guest lectures from Industry and, Research and Development Organizations

Total Lecture hours:

45 hours

Text Book(s)

 Thomas Sterling, Matthew Anderson, MaciejBrodowicz,High Performance Computing: Modern Systems and Practices, 2018, 1st Edition, Morgan Kaufmann publication.

Reference Books

- 1. Vadim Levchenko, High Performance Computing, 2020, 1st Edition, Excelic Press, USA
- 2. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, 2019, 1st Edition, CRC Press, USA

Mode of Evaluation: CAT / written assignment / Quiz / FAT

Recommended by Board of Studies	12-05-2023			
Approved by Academic Council	No. 70	Date	24-06-2023	

Course Code Course Title			L	Т	Р	С
BCSE431L	Fundamentals of Quantum Computing		3	0	0	3
Pre-requisite NIL			llak	ous v	/ersi	on
·				1.0		

- 1. To provide a mathematical foundation for Quantum Computing and provide the basics of working
- 2. To interpret the various aspects and applications of quantum computing.
- 3. To examine the factors that affect Quantum computation.

Course Outcomes

On completion of the course, the student will be able to

- 1. Ability to understand the concept behind quantum physics and the mathematical computations lies in it.
- 2. Explain the postulates and representation of a Qubit.
- 3. Explain the different basis in Quantum phenomena and its measurements.
- 4. Explain the working model of Quantum computing as teleportation and function finding
- 5. Explain the various factors that affect a qubit and handling methods

Module:1 Physical Properties of Quantum Particles and basic 5 hours Mathematics of Quantum Computing 5

Physical properties: Double Slit Experiment; Light: Particle Vs Wave; Heisenberg Uncertainty Principle.

Linear Algebra: Vector spaces – basis; Inner product; Outer product; Tensor product; Linear operators.

Module:2 Quantum Mechanics for Quantum Computing

6 nours

Review of postulates, Bloch sphere, Single qubit states and gates, superposition; Two Qubit States and Gates - Bell States, Entanglement, CNOT gate, Phase oracles, Phase kickback, Entanglement generation

Module:3 Notation and Basis in QC Quantum gates and circuits

6 hours

Detailed exposure of one and two qubit gates and states, Examples of Dirac's notation for quantum computing, Computational Basis, Orthonormality, Pauli Gates, Hadamard and Phase Gates- building quantum circuits

Module:4 | Fundamental Algorithms in QC-1

8 hours

Teleportation Algorithm, Deutsch–Josza Algorithm, Grover search algorithm: Problem definition, Amplitude amplification, Grover oracle, diffuser, multiple solutions in the search space

Module:5 | Fundamental Algorithms in QC-2

8 hours

Quantum Fourier Transform (QFT), and efficient representation of QFT as a quantum circuit. Application of the QFT to enable Quantum Phase Estimation (QPE). Order-finding problem – eigenvalue estimation approach to order finding – Shor's algorithm for order finding/factoring

Module: 6 Measurements and Errors

6 hours

Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant

quantum computation									
Мо	dule:7	Programming a quantu	m compute	r		4 hours			
		coding a quantum comput	ter using a S	imulator [·]	to carry out ba	isic quantum			
	measurement and state analysis.								
Мо	dule:8	Contemporary Issues				2 hours			
			Total Lectur	re hours	:	45 hours			
Tex	<u>kt Book</u>	(s)							
1.	Chuck	Easttom, "Quantum Con	nputing Fund	damental	s", 1st editior	n, Published			
	by Add	lison-Wesley Professional	(June 1st 20	21)					
2	Qiskit 7	TextBook - https://qiskit.org	g/textbook/pr	eface.htr	nl (2022)				
Ref	ference								
1.		pasic Quantum Computation							
2	Kasira	an, Venkateswaran. <i>Fur</i>	ndamentals	of quan	tum computir	ng. Springer			
		itional Publishing, 2021.							
3		Bernhardt, Quantum Comp	outing for Eve	eryone, T	he MIT Press,	Cambridge,			
	2020								
4		n, Michael A., and Isaac L.				nd Quantum			
	Information" Cambridge University Press (5 April 2013)								
Mode of Evaluation: CAT / written assignment / Quiz / FAT									
Re	Recommended by Board of Studies 24-11-2022								
App	proved k	y Academic Council	No. 68	Date	19-12-2022				